Programmer Guide

Programmer Guide

Release 5.5.0

Publication date Aug 30, 2022
Copyright © 2022 DF/Net Research, Inc.

All rights reserved. No part of this publication may be re-transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of DF/Net Research, Inc. Permission is granted for internal re-distribution of this publication by the license holder and their employees for internal use only, provided that the copyright notices and this permission notice appear in all copies.

The information in this document is furnished for informational use only and is subject to change without notice. DF/Net Research, Inc. assumes no responsibility or liability for any errors or inaccuracies in this document or for any omissions from it.

All products or services mentioned in this document are covered by the trademarks, service marks, or product names as designated by the companies who market those products.

Google Play and the Google Play logo are trademarks of Google LLC. Android is a trademark of Google LLC.

App Store is a trademark of Apple Inc.

Table of Contents

Preface xx
1. Getting Help xx
2. Conventions xx
1. Introduction 1
1.1. About This Guide 1
1.2. DFdiscover Programming Limits 1
2. DFdiscover Study Files 4
2.1. Introduction 4
2.2. DFdiscover study directories 4
2.3. Study File Permissions 9
2.4. Format used to describe files 9
2.5. DFdiscover Retrieval Files (DRF) 9
2.6. The study `data` directory 11
2.6.1. Temporary data files 11
2.6.2. Plate data files 11
2.6.3. Query data files 14
2.6.4. Reason for change data files 16
2.6.5. Newly arrived data file 17
2.6.6. Journal files 19
2.6.7. Index files 21
2.7. The study `ecsrc` directory 23
2.8. The study `lib` directory 23
2.9. The study `lut` directory 57
2.10. The study `work` directory 59
3. Shell Level Programs 69
3.1. Introduction 69
3.2. User Credentials 69
3.2.1. Good Password Management 69
3.2.2. Order of Evaluation 70
3.3. Organization of Reference Pages 70
3.4. Alphabetical Listing 71
4. Utility Programs 177
4.1. Introduction 177
4.2. Alphabetical Listing 177
5. Edit checks 204
5.1. Introduction 204
5.1.1. `DFopen_study` and `DFopen_patient_binder` 204
5.2. Language Features 205
5.3. Database Permissions 205
5.4. Language Structure 205
5.4.1. `return` and `exit` statements 206
5.5. Variables 207
5.5.1. Variables and Types 207
5.5.2. Database Variables 208
5.5.3. Positional Variables 209
5.5.4. Local Variables 210
5.5.5. Global Variables 210
5.5.6. Variable Groups 210
5.5.7. Date Variables 211
5.6. Missing/Blank Data 212
5.6.1. `dfblank` 213

5.6.2. dfmissing 213
5.6.3. dfmissval 214
5.6.4. dfmisscode 214
5.6.5. dfmissingrecord 214
5.6.6. dflostcode 215
5.6.7. dflosttext 215
5.6.8. Missing Records 215
5.6.9. Examples 216
5.7. Arithmetic Operators 217
5.7.1. Addition 217
5.7.2. Subtraction 218
5.7.3. Multiplication/Division/Modulus 218
5.7.4. Exponentiation 219
5.7.5. Assignment 220
5.8. Conditional Execution 221
5.8.1. Comparison Operators 221
5.8.2. Logical Operators 222
5.8.3. if/else 222
5.9. Built-in Functions and Statements 223
5.9.1. Edit check Function Compatibility Notes 223
5.9.2. dfaccess 226
5.9.3. dfaccessinfo 227
5.9.4. dfalias2id 228
5.9.5. dfask 228
5.9.6. dfbatch 229
5.9.7. dfcapture 229
5.9.8. dfcenter 231
5.9.9. dfclosestudy 231
5.9.10. dfdate2str 231
5.9.11. dfday 232
5.9.12. dfdirection 232
5.9.13. dfentrypoint 233
5.9.14. dfexecute 233
5.9.15. dfgetfield 234
5.9.16. dfgetlevel/dflevel 235
5.9.17. dfgetseq 235
5.9.18. dfhelp 235
5.9.19. dfid2alias 236
5.9.20. dfillegal 236
5.9.21. dfimageinfo 237
5.9.22. dflegal 238
5.9.23. dflength 238
5.9.24. dflogout 239
5.9.25. dfmail 239
5.9.26. dfmatch 240
5.9.27. dfmessage/dfdisplay/dferror/dfwarning 241
5.9.28. dfmetastatus 242
5.9.29. dfmode 243
5.9.30. dfmoduleinfo 244
5.9.31. dfmonth 245
5.9.32. dfmoveto 245
5.9.33. dfneed 246
5.9.34. dfpageinfo 247
5.9.35. dfpassword 247

5.9.36. dfpasswdx 248
5.9.37. dfplateinfo 249
5.9.38. dfpref 250
5.9.39. dfprefinfo 254
5.9.40. dfprotocol 255
5.9.41. dfrole 256
5.9.42. dfsiteinfo 257
5.9.43. sqrt 258
5.9.44. dfstay 258
5.9.45. dfstr2date 259
5.9.46. dfstudyinfo 260
5.9.47. dfsubstr 260
5.9.48. dftask 261
5.9.49. dftime 262
5.9.50. dftoday 262
5.9.51. dftool 263
5.9.52. dftrigger 263
5.9.53. dfuserinfo 265
5.9.54. dfvarinfo 266
5.9.55. dfvarname 268
5.9.56. dfview 268
5.9.57. dfvisitinfo 269
5.9.58. dfwhoami 269
5.9.59. dfyear 269
5.9.60. int 270
5.10. Query operations 270
5.10.1. dfaddqc 271
5.10.2. dfaddmpqc 272
5.10.3. dfanyqc 273
5.10.4. dfanyqc2 274
5.10.5. dfanympqc 275
5.10.6. dfdelmpqc 275
5.10.7. dfeditqc 276
5.10.8. dfreplyqc 277
5.10.9. dfresqc/dfunresqc 278
5.10.10. dfqcinfo 278
5.10.11. dfqcinfo2 279
5.11. Reason operations 280
5.11.1. dfaddreason 280
5.11.2. dfanyreason 281
5.11.3. dfautoreason 281
5.11.4. dfreasoninfo 282
5.12. Lookup Tables 283
5.12.1. Pre-requisites 283
5.12.2. dflookup 283
5.13. Looping 284
5.13.1. while 284
5.13.2. break 285
5.13.3. continue 286
5.14. User-Defined Functions 286
5.14.1. Sharing edit check files with the **#include** directive 287
5.15. Examples and Advice 288
5.16. Optimizing Edit checks 289
5.16.1. Saving Time for the User 290

5.16.2. Limitations in the Language 290
5.16.3. Maximize Cache 290
5.16.4. Simplify Conditional Testing 290
5.16.5. Reduce the Number of Function Calls 291
5.16.6. Shortcut, and Order of, Evaluation 291
5.16.7. Delay Message Construction 291
5.17. Creating generic edit checks 292
5.17.1. More Examples 293
5.18. Debugging and Testing 298
5.18.1. Debugging 298
5.18.2. Testing 299
5.18.3. Compiling and Reloading Edit checks 299
5.19. Language Reference 299
5.19.1. Identifiers (edit check and variable names) 299
5.19.2. String Constants 299
5.19.3. Maximum number of instructions per edit check execution 300
5.19.4. Reserved Words 300
6. Batch Edit checks 302
6.1. Introduction 302
6.1.1. Overview 302
6.1.2. About this chapter 302
6.2. **DFbatch** Basics 303
6.2.1. The **DFbatch** Layer 303
6.2.2. Do you need **DFbatch**? 303
6.2.3. How does **DFbatch** work? 304
6.2.4. Getting Started 304
6.2.5. Summary 308
6.3. Using **DFbatch** 308
6.3.1. General Control File Layout 308
6.3.2. Invoking **DFbatch** 315
6.3.3. Strategies for using **DFbatch** 318
6.4. Limitations 320
6.4.1. Default actions for interactive functions 320
6.4.2. Not possible with **DFbatch** 321
6.4.3. Not recommended with **DFbatch** 322
6.5. Example Control Files 322
6.6. Common Pitfalls and System Messages 324
6.6.1. Common Pitfalls 324
6.6.2. System Messages 324
6.7. BATCHLIST Element Reference 325
6.7.1. BATCHLIST Document Type Definition 325
6.7.2. Organization of Reference Pages 326
6.7.3. Reference Pages 326
6.8. BATCHLOG Element Reference 354
6.8.1. BATCHLOG Document Type Definition 354
6.8.2. Element Reference 355
6.9. XML Language Basics 404
6.9.1. The Rules of XML 405
6.9.2. Companions to XML 405
6.9.3. Recommended Reading 406
7. Writing Your Own Reports 407
7.1. General Guidelines 407
7.2. Installing Your Reports 407
7.3. Input Data Files 408

7.4. Programming Tools 408
7.5. An Example 408
7.6. Writing Documentation for Study Specific Reports 409
8. **DFsas**: DFdiscover to SAS® 411
8.1. An Example 411
8.1.1. Global Specifications 412
8.1.2. Data Retrieval Specifications 413
8.1.3. SAS® Procedures 414
8.1.4. Running **DFsas** 414
8.2. Creating a **DFsas** job file 414
8.2.1. Impact of SAS® limits 414
8.2.2. Creating an initial **DFsas** job file 415
8.2.3. String splitting 415
8.2.4. String truncation 416
8.2.5. Date exporting 416
8.2.6. A sampling of other options 416
8.3. Creating SAS® job and data files 417
8.3.1. Force Option 417
8.3.2. Export Script Option 417
8.3.3. Use Field Alias Option 417
8.3.4. Syntax Checks 418
8.4. Date Fields 418
8.4.1. Global Statements 418
8.4.2. Qualified Dates 419
8.4.3. Time Qualifiers 420
8.4.4. Default Actions Performed When Creating a **DFsas** Job File 420
8.5. String Fields 420
8.5.1. String Splitting 420
8.5.2. Extracting Sub-Strings 421
8.5.3. Retaining Quotes in String Fields 421
8.6. **DFsas** Job File Syntax 422
8.6.1. Global Specifications 422
8.6.2. Data Retrieval Specifications 434
8.6.3. SAS® Procedures 437
8.7. Creating a Normalized Data Set 437
8.7.1. Merge 439
8.7.2. Specifying Data Fields 439
8.7.3. String Fields in Normalized Data Sets 439
8.7.4. Case Selection 440
8.7.5. Value codes or labels 441
8.7.6. Variable Description 441
8.7.7. Specifying Normalized Records 441
8.7.8. Sorting a Normalized Data Set 442
8.7.9. Example Data File 442
9. **DFsqlload**: DFdiscover to Relational Database Tables 443
9.1. Introduction 443
9.1.1. Overview 443
9.1.2. About **DFsqlload** 443
9.2. **DFsqlload** and Relational Database Concepts 443
9.2.1. Why Relational Databases? 443
9.2.2. Why is **DFsqlload** a one-way street? 444
9.2.3. Relational Database Concepts 444
9.3. Using **DFsqlload** 444

9.3.1. **DFsqlload** defaults - a quick tutorial 444
9.3.2. **DFsqlload** in Detail 445
A. Copyrights - Acknowledgments 448
A.1. External Software Copyrights 448
A.1.1. DCMTK software package 448
A.1.2. Jansson License 448
A.1.3. Mimencode 449
A.1.4. RSA Data Security, Inc., MD5 message-digest algorithm 449
A.1.5. mpack/munpack 449
A.1.6. TIFF 449
A.1.7. PostgreSQL 450
A.1.8. OpenSSL License 450
A.1.9. Original SSLeay License 451
A.1.10. gawk 451
A.1.11. Ghostscript 455
A.1.12. MariaDB and FreeTDS 455
A.1.13. QtAV 461
A.1.14. FFmpeg 461
A.1.15. c3.js 461
A.1.16. d3.js 462
Index 463

List of Figures

2.1. Encoding for bits within the status byte 22
5.1. Group declaration syntax 211
6.1. **DFbatch** interacts with the study database and the edit checks language in the same manner as **DFexplore** 303
6.2. The descendants of `ACTION` and their attributes 312
6.3. The BATCHLOG DTD 355
8.1. Sample Case Report Form 438

List of Tables

2.1. File attributes 9
2.2. Data Retrieval Files (DRF) 10
2.3. DFdiscover Retrieval File field descriptions 10
2.4. plt###.dat - per plate data files 11
2.5. plt###.dat field descriptions 12
2.6. plt###.dat - missed records 13
2.7. Missed record field descriptions 13
2.8. DFqc.dat - the Query database 14
2.9. DFqc.dat field descriptions 15
2.10. DFreason.dat - reason for change records 16
2.11. Reason for data change record field descriptions 17
2.12. DFin.dat - the new records database 17
2.13. DFin.dat field descriptions 18
2.14. YYMM.jnl - monthly database journal files 19
2.15. YYMM.jnl field descriptions 19
2.16. DFaudit.db sqlite audit trail 20
2.17. plt###.ndx - per plate index files 21
2.18. plt###.ndx header bits 22
2.19. plt###.ndx record bits 22
2.20. DFedits - edit checks 23
2.21. DFcenters - sites database 23
2.22. Field definitions for DFcenters 25
2.23. DFccycle_map - conditional cycle map 25
2.24. DFcvisit_map - conditional visit map 27
2.25. DFcplate_map - conditional plate map 28
2.26. DFcterm_map - conditional termination map 29
2.27. DFCRFType_map - CRF type map 30
2.28. DFcrfbkgd_map - CRF background map 30
2.29. DFedits.bin - published edit checks 31
2.30. DFfile_map - file map 31
2.31. DFlogo.png - study logo, for reports 32
2.32. DFlut_map - lookup table map 32
2.33. DFmissing_map - missing value map 33
2.34. DFpage_map - page map 34
2.35. DFqcsort - Query and CRF sort order 35
2.36. DFqcproblem_map - Query category code map 36
2.37. .DFreports.dat - reports history 37
2.38. DFschema - database schema 38
2.39. DFschema.stl - database schema styles 40
2.40. Schema codes and their meaning 40
2.41. DFsetup - study definition 42
2.42. DFserver.cf - server configuration 43
2.43. DFserver.cf configuration keywords 43
2.44. DFsubjectalias_map - subject alias map 44
2.45. DFsubjectalias_map.log - subject alias change log 45
2.46. Field definitions for DFsubjectalias_map.log 45
2.47. DFtips - ICR tips 45
2.48. DFtips plate specific keywords 47
2.49. DFtips variable specific keywords 47
2.50. DFvisit_map - visit map 48
2.51. DFvisit_map field descriptions 49

2.52. Visit codes and their meaning 50
2.53. DFwatermark - watermark 50
2.54. DFwatermark field descriptions 51
2.55. QCcovers - Query cover pages 51
2.56. QCmessages - Query Report messages 53
2.57. QCtitles - Query Report titles 54
2.58. QCtitles font specifications 56
2.59. Variables available for use in QCcovers, QCmessages, and QCtitles 56
2.60. DFreportstyle - DFdiscover Report styling 56
2.61. Lookup tables 58
2.62. DFX_ccycle - cycle conditions met 59
2.63. DFX_ccycle conditional cycle map conditions that were met 60
2.64. DFX_cvisit - visit conditions met 60
2.65. DFX_cvisit conditional visit map conditions that were met 61
2.66. DFX_cplate - plate conditions met 61
2.67. DFX_cplate conditional plate map conditions that were met 62
2.68. DFX_cterm - termination conditions met 62
2.69. DFX_cterm conditional termination map conditions that were met 62
2.70. DFX_keys - key fields for all required plates 63
2.71. DFX_keys key fields from all required plates 63
2.72. DFX_schedule - subject scheduling and visit status 63
2.73. field definitions for cycle records in DFX_schedule 64
2.74. field definitions for visit records in DFX_schedule 65
2.75. DFX_time1 - date and time from receipt to last modification 65
2.76. DFX_time1 timing data for each CRF page 66
2.77. DFX_visit.dates - value in the database of all visit dates 67
2.78. DFX_visit.dates the value of all dates using the VisitDate attribute 67
3.1. Notation for program options 70
3.2. Software Components Affected by Read-Only Mode 72
3.3. **DFaudittrace** Output: Fields 1 to 7 78
3.4. New Records 78
3.5. Changed Field 79
3.6. Deleted Record 79
3.7. Numeric value, record status keyword, query status and reason status equivalence 95
3.8. Record and query status equivalence 107
3.9. Deriving operations from import mode 128
3.10. Add operation 128
3.11. Replace operation 128
3.12. Database Parameters 159
3.13. Data typing 167
3.14. Fields for typed SQL tables 167
3.15. Fields for untyped SQL tables 168
5.1. Return values for dfblank, dfmissing, dfmissval, dfmisscode, and dfmissingrecord 212
5.2. dfblank usage 213
5.3. dfmissing usage 213
5.4. dfmissval usage 214
5.5. dfmisscode usage 214
5.6. dfmissingrecord usage 214
5.7. dflostcode usage 215
5.8. dflosttext usage 215
5.9. Result table for Addition operator 217
5.10. Result table for Subtraction operator 218
5.11. Result table for Multiplication/Division/Modulus operators 218
5.12. Result table for Exponentiation 219

5.13. Casting rules for logical operators 222
5.14. Edit check Function Implementation 223
5.15. dfaccess usage 226
5.16. dfaccessinfo usage 227
5.17. dfalias2id usage 228
5.18. dfask usage 229
5.19. dfbatch usage 229
5.20. dfcapture usage 229
5.21. dfcenter usage 231
5.22. dfclosestudy usage 231
5.23. dfdate2str usage 231
5.24. dfday usage 232
5.25. dfdirection usage 232
5.26. dfentrypoint usage 233
5.27. dfexecute usage 233
5.28. dfgetfield usage 234
5.29. dfgetlevel/dflevel usage 235
5.30. dfgetseq usage 235
5.31. dfhelp usage 235
5.32. dfid2alias usage 236
5.33. dfillegal usage 236
5.34. dfimageinfo usage 237
5.35. dflegal usage 238
5.36. dflength usage 239
5.37. dflogout usage 239
5.38. dfmail usage 240
5.39. dfmatch usage 241
5.40. dfmessage/dferror/dfwarning usage 242
5.41. dfmetastatus usage 242
5.42. Query Status codes 242
5.43. Reason Status codes 242
5.44. Query Category Codes 243
5.45. Query Usage codes 243
5.46. dfmode usage 243
5.47. dfmoduleinfo usage 244
5.48. dfmonth usage 245
5.49. dfmoveto usage 245
5.50. dfneed usage 246
5.51. dfpageinfo usage 247
5.52. dfpassword usage 248
5.53. dfpasswdx usage 248
5.54. dfplateinfo usage 249
5.55. dfpref usage 250
5.56. dfprefinfo usage 254
5.57. dfprotocol usage 255
5.58. dfrole usage 256
5.59. dfsiteinfo usage 257
5.60. sqrt usage 258
5.61. dfstay usage 258
5.62. dfstr2date usage 259
5.63. dfstudyinfo usage 260
5.64. dfsubstr usage 260
5.65. dftask usage 261
5.66. dftime usage 262

5.67. dftoday usage 262
5.68. dftool usage 263
5.69. dftrigger usage 263
5.70. dfuserinfo usage 265
5.71. dfvarinfo usage 266
5.72. dfvarname usage 268
5.73. dfview usage 268
5.74. dfvisitinfo usage 269
5.75. dfwhoami usage 269
5.76. dfyear usage 270
5.77. int usage 270
5.78. dfaddqc usage 271
5.79. Category codes 271
5.80. Query Usage codes 271
5.81. Refax codes 272
5.82. dfaddmpqc usage 272
5.83. Query Usage codes 272
5.84. Refax codes 272
5.85. dfanyqc usage 273
5.86. Query status codes 274
5.87. dfanyqc2 usage 274
5.88. Query status codes 274
5.89. dfanympqc usage 275
5.90. dfdelmpqc usage 275
5.91. dfeditqc usage 276
5.92. dfreplyqc usage 277
5.93. dfresqc usage 278
5.94. dfqcinfo usage 279
5.95. dfqcinfo2 usage 279
5.96. dfaddreason usage 280
5.97. dfanyreason usage 281
5.98. Reason status codes 281
5.99. dfautoreason usage 281
5.100. dfreasoninfo usage 282
5.101. dflookup usage 284
6.1. Special characters 309

List of Examples

3.1. Enable read-only access to study #123, do lengthy operation, and then reinstate read-write access 74
3.2. Restrict study #123 in read-only access to DFdiscover and study administrators only, while they analyze and run reports on a static database, and then reinstate normal access to all users 74
3.3. Query the current status of 74
3.4. Attach `1234_1_12.pdf` to subject 1234, visit 1, plate 12 in the database for study 100 76
3.5. Attach `radiograph.pdf` to subject 30001, visit 10, plate 200 in the database for study 22 77
3.6. Attach all of the documents in directory `/tmp/newdocs` to the matching keys in study 200 and record the successes in `/tmp/results.drf` 77
3.7. Execute **DFaudittrace** to output journal information for study 254 between the dates of January 1, 2001 and January 15, 2001. 81
3.8. Execute **DFaudittrace** to output journal information for study 254 between the dates of January 1, 1998 and today, for field numbers 10-13. 81
3.9. Execute **DFaudittrace** to output all journal information for study 254, for records that have existed at or above a validation level of 2 at some point during the study. 81
3.10. Execute **DFaudittrace** to generate an Excel file containing all changes for data related to subject 44002. 81
3.11. Compile and check the syntax for edit checks defined in `DFedits` for study 254 84
3.12. Disable study #123 so that database maintenance can be performed 86
3.13. Enable study #123 87
3.14. Encrypt a set of CRFs stored in `crfs.pdf` and protect with the password "DoNotUse". 88
3.15. List all module names used in plates 100 through 200 92
3.16. List schema information for data fields of all plates 92
3.17. List schema information for data fields of all modules 92
3.18. Export all missed records in plates 1 through 10 95
3.19. Export all ESIG modules in plates 100 through 110 and 200 95
3.20. Export eSignature records for eligible, african-american males 96
3.21. Re-construct the demographics module for output 97
3.22. Calendar and Julian Date Modifiers 100
3.23. Output coded and decoded values 100
3.24. Split a string field into 5 fields 100
3.25. Digit extraction from subject ID 101
3.26. Insert `AD` into the data export 101
3.27. Specify a field name for the header record 101
3.28. Select and filter using data from two different plates 103
3.29. Module-based export 103
3.30. Export eSignature records with a specific name 104
3.31. Output the coded and decoded values for the sex variable 110
3.32. Split a string field into 5 fields 110
3.33. Export all records from plate 1 of study 255 to standard output 112
3.34. Export, with header, all primary records at validation levels 1-2 from plate 1 of study 255 to standard output 112
3.35. Export the first 3 and the 7th fields from plate 1 to standard output 112
3.36. Export the `VDATE` date field in 4-digit year format and export the subject initials in 3 single-character fields. Include the header record and define names for the newly created fields 112
3.37. Export the primary records for subject IDs 99001 and 99002 selecting the fields from `DFSTUDY` to `VDATE` inclusive 112
3.38. Show all forms of manipulation for a partial date value in the variable `DateCompleted1` for study 251 112
3.39. Create a DFdiscover Retrieval File (ID99001_plate10.drf) for study 254, all primary records for plate 10, for subject ID 99001 113
3.40. Export all primary records for plates 1-3, 7 and 8 to standard output 113
3.41. Export all primary records for all plates in a study and create separate text files for each set of plate data. 113
3.42. Export, in CSV format, a subset of fields for plate 3 of study 254 and write the results to standard output 114

3.43. Export only missed records for plate 1, inserting the missing value code "NA" into the fields of each missed record exported. Export the results to standard output. 114
3.44. Scheduled but not yet sent fax 115
3.45. In-progress fax to multiple recipients 116
3.46. Removing a fax by its faxid 117
3.47. Removing a fax by its faxid 117
3.48. Retrieving specified fields from input records 120
3.49. Determine the working directory for study 123 122
3.50. Echo the value of the default printer for the master daemon 122
3.51. Determine the access permissions for study 253 for the current user 122
3.52. Determine the DFdiscover host identifier 124
3.53. Get and write a requested CRF image to a file 126
3.54. Get and re-direct a requested CRF image to a file 126
3.55. Get and write a **DFsetup** background image to a file 126
3.56. List the plates defined for study 123 to the standard output 132
3.57. List all plate numbers, one per line, for study 254 - Bourne shell method 132
3.58. Capture any error output from to the system error log 134
3.59. Add credentials 136
3.60. Remove credentials 136
3.61. Use **DFpdf** without the use of the **DFexplore Save As PDF** option 140
3.62. Use **DFpdfpkg** without the use of the **DFexplore Create Subject Packages...** option 144
3.63. Print the UNIX password file to the printer "hplj" 145
3.64. Print all primary adverse event report records (plate 50) for study 222 147
3.65. Simple use of **DFpsprint** for printing the file `/tmp/rasterfile` 148
3.66. Concatenating 3 image files where the second is read from standard input 148
3.67. Create a default **DFsas** job file for study 11 153
3.68. Create a **DFsas** job file for study 11, include only a subset of plates and request labels for check fields 153
3.69. Send the file `/etc/printcap` to one recipient at 5551212 156
3.70. Schedule a fax for transmission at 11:00pm tonight and send it to two recipients, one via email (with a specific from email address) 156
3.71. Schedule a fax for transmission 30 minutes from now and be informed via email that the fax was either successfully transmitted or failed 157
3.72. Import study 254 into mySQL 169
3.73. Display record status and current user connections for study 253 171
3.74. Display current seat usage on the server 172
3.75. Print output from **DF_SSvisitmap** report 173
3.76. Show the version information for DFedcservice 176
4.1. Creating a **DFedcservice** SSL certificate and signing request 181
4.2. Clean out the incoming fax directory 183
4.3. Report on all inconsistencies for study 240 185
4.4. Perform exhaustive checking for inconsistencies on plate 2 for study 254 185
4.5. Report on the current status of the sequence files 187
4.6. Report on the current status of the DFdiscover master, first in quiet mode and then in non-quiet mode 189
4.7. Migrate study 100 to the current version 192
4.8. Migrate a non-active study to current version 193
4.9. Migrate all studies found in /opt/dfdiscover/lib/DFstudies.db to current version 193
4.10. Convert all Sun raster files in the pages directory found in the study directory `/opt/studies/demo253` into PNG files 194
4.11. What is the status of study 7's database server? 196
4.12. **DFstudyDiag** detects a problem with study 8 196
4.13. Check, in verbose mode, the permissions for study 251 198
4.14. Convert the file `fax12345.tif` into PNG files `rast001`, etc 200
4.15. Importing USER and PASS records 202
4.16. Importing ROLE, RLPM, and USRL records 203

5.1. Difference between `exit` and `return` 207
5.2. Local variable declaration 210
5.3. Global variable declaration 210
5.4. Compute the total dose from the individual dosages 211
5.5. Set the default date output format to `MM/DD/YY` 211
5.6. Incrementing a date value 211
5.7. Testing for a missing record with `dfmissing` 215
5.8. Testing for a missing record with `dfmissingrecord` 216
5.9. Calculate the subject's age provided both birth date (`bdate`) and the study entry date (`edate`) are available. 216
5.10. Complain if the subject was hospitalized (hospital has the value 2) but the hospitalization date has been left blank 216
5.11. Check for a specific missing value label 216
5.12. Check for a specific missing value code 216
5.13. Calculation of Body Surface Area 219
5.14. Probable erroneous use of the = operator 221
5.15. Date format conversion issues 261
5.16. A simple edit check that prints all the numbers from 1 to 10 284
5.17. Compare visit date fields of adjacent visits 285
5.18. Example use of `break` 285
5.19. User-defined function to add two numbers and report when the sum is greater than 10 286
5.20. User function that calculates a dose level based on the subject's weight and sex 287
5.21. Calling a user defined function from an edit check 287
5.22. Including `DFedits.gen` in the `DFedits` file 287
5.23. Convert pounds to kilograms 288
5.24. Convert pounds to kilograms with error checking 288
5.25. If "Other" Race check box has been checked, does the "Other, specify" field also contain a value? 293
5.26. Does the reported date of surgery occur before the study enrollment date? 293
5.27. Does the subject meet all eligibility criteria? 293
5.28. Compute age from birth date and compare with Age field. 294
5.29. If an adverse event has been checked on a follow-up form has the adverse event report been received? 294
5.30. Is the subject's weight within the normal range for their gender? 295
5.31. Compute body mass index 295
5.32. Send an e-mail notification of elevated blood pressure 295
5.33. Use batch edit checks to verify consistency of subject initials 296
5.34. Check visit date order 296
5.35. Define a look-up table of study investigators 297
5.36. Define a generic function that will fill fields in the specified range of field numbers with the specified value 298
6.1. Example batch control file 305
6.2. Properly balanced, nested elements 306
6.3. Improperly balanced, nested elements 306
6.4. Testing **DFbatch** exit status in C-shell 308
6.5. The general format of an input file 308
6.6. Use of entity for special character 309
6.7. Selection criteria for all final records of visits 1 through 5, 10, and 20 through 29 inclusive 310
6.8. Use of the `sort` attribute to sort selected records on ascending id, then descending visit, and then descending plate 310
6.9. Select records specified by `IDRF` 310
6.10. Select records specified by `IDRF` in a sub-folder using relative pathname 311
6.11. Select records specified by `IDRF` in a sub-folder using absolute pathname 311
6.12. Execute only the aeCoding edit check on plate 5 records 311
6.13. Equivalent specifications for multiple edit checks 311
6.14. Executing **DFbatch** on study 254 with the control file `/opt/studies/val254/batch/test_in.xml` 315
6.15. Using **cron** to run **DFbatch** at scheduled times 316
6.16. Process batches named b3 and b1 317

6.17. Complimentary uses of **DFbatch** and **DFstyle** 318
6.18. Creating multiple presentations 318
6.19. Improper usage 320
6.20. Implementation strategy for `dflookup` 321
6.21. Comparing calculated and reported values 322
6.22. Execute all edit checks on all records, logging their actions without actually applying them 322
6.23. Execute all edit checks on all incomplete, level 1 records for plates 1 through 5, applying no changes, and logging only the messages generated 323
6.24. Perform AE coding on all level 4 records, assigning the records to level 5 when coding is complete 323
6.25. Execute the `echoWho` edit check on all level 1 and 2 records, processing records in the specified order 323
6.26. Execute the `missingAEreport()` edit check on all plate 15 records, adding and logging only queries 324
6.27. Processing action that applies all records with new queries to the database and logs all activity 327
6.28. Apply no changes to the database - this is the recommended usage for this element 329
6.29. Apply all records to the database that have had data fields modified, qc notes added or deleted, or messages generated and assign those records a validation level of 2 329
6.30. A simple BATCH that logs all messages generated by the msgIllegalBP edit check when applied to level 1, plate 2 records 330
6.31. A BATCHLIST containing two BATCHes, named first and example 331
6.32. Specify that the looping limit is 30 consecutive `dfmoveto()` invocations and a non-default reason for data changes 333
6.33. Select records that were created on or after January 1, 2000 334
6.34. Use of the sort attribute 335
6.35. Select records from plate 5, modified on or after January 1, 2000, at validation level 3, for subjects 1000 to 4999 inclusive, and for visits 1 through 10, inclusive, and 14 336
6.36. Description of a batch 337
6.37. Select records that reference the edit checks medHx or codeAE 338
6.38. Select records for subject IDs 1000 through 4999 inclusive, 10000 through 14999 inclusive, and 99999 339
6.39. Select records from the DRF named `/opt/studies/val254/drf/needcoding.drf` 340
6.40. Select records that are at validation level 2 or 3 341
6.41. Log all records that have had data values changed, messages generated, or queries added or deleted 343
6.42. Log records which have had data values changed or messages generated to an output file in a subfolder 344
6.43. Select all records that were modified today 345
6.44. Increase the looping limit to 25 consecutive `dfmoveto()` invocations 346
6.45. Write all records that have had messages generated to the DRF named `/opt/studies/254/batch/outputs/sample1.drf` and enable file sharing 348
6.46. Write records which have had data value changed or messages generated to the DRF in a sub-folder 348
6.47. Select all records for plates 21 through 29 inclusive 350
6.48. Indicate the the reason for all of these changes is the installation of a new lookup table 351
6.49. Select all final and incomplete records 352
6.50. Batch title 353
6.51. Select all records with a visit identifier of 10 354
6.52. Meta information for the context record indicating a record status of `final`, validation level of 5, and CRF image name of `0022/0001001` 356
6.53. A BATCHLOG 357
6.54. The current working directory `/opt/studies/val254/lib` and the source file `test_in.xml` 358
6.55. A data changed element 359
6.56. The 25th day of the month 360
6.57. A date entry for October 19, 2000 361
6.58. An edit check element and its children 362
6.59. A query on the `age` variable was edited 364
6.60. A user defined query added to the `visitDate` variable 364
6.61. Two history elements 365
6.62. A history entry 366
6.63. The 14th hour, commonly called 2pm 367

6.64. A key element that identifies subject ID 1, visit 10, and plate 9 368
6.65. A message generated by dfwarning 369
6.66. The 45th minute of the hour 370
6.67. The month June 371
6.68. A missing page query added for subject 1001, visit 1, plate 5, with no additional query or note 373
6.69. A missing page query deleted for subject 99001, visit 2, and plate 4 374
6.70. A new value of 1 375
6.71. Summary information of 1 successful data change, no failed changes, and no successful but truncated changes, applied to the database 376
6.72. dfeditqc called 4 times successfully, 1 time with a failure, APPLY set for queries 377
6.73. Summary information of 210 messages generated, APPLYset for messages 378
6.74. Summary information of 1 failed missing page query addition, APPLY element set. 379
6.75. Summary information of 4 successfully deleted missing page queries and 2 that failed, APPLY set. 380
6.76. 210 DRF records successfully written 381
6.77. 4 queries successfully added and 1 failure, APPLY set for queries 382
6.78. 2365 records selected 383
6.79. An additional note added to a query 384
6.80. A batch that executed in 12 seconds 385
6.81. Good news, no system messages 386
6.82. An original value of 56.6 387
6.83. The DRF /opt/studies/val254/drf/example.drf 388
6.84. The log file /opt/studies/val254/lib/example_out.xml 389
6.85. A query added to the age variable 391
6.86. A user defined query added to the visitDate variable 391
6.87. The query added to a query 392
6.88. The reply to a query 393
6.89. A record element and its children 394
6.90. A reason for data change added to the RACE variable 395
6.91. The 30th second of the minute 396
6.92. The batch input file example_in.xml, from the same directory as the current working directory 397
6.93. Study 254 398
6.94. The summary element and its children 399
6.95. Reason for change text 400
6.96. A time entry for 10 minutes, 3 seconds after midnight 401
6.97. Identification of the batch executed by user eric 402
6.98. A variable element for id9 and its children 403
6.99. The year 2000 404
6.100. Improperly nested tags 405
6.101. Comments 405
8.1. Typical **DFsas** job file 411
8.2. Build a **DFsas** job file named job1 for all variables on all plates for study number 7. 415
8.3. Create SAS® job file and data files for **DFsas** job file job1 417
8.4. Using OPTIONS YEARCUTOFF 419
8.5. String splitting 420
8.6. SAS® data sets mylib1 and mylib2 are created by specifying the previously saved SAS® data sets of baselib and aelib, respectively, in a LIBNAME statement in the global section of a **DFsas** job file. 423
8.7. The data set name mylib1.vitals is specified using a DATA statement following the RECORD statement for plate 5. 423
8.8. The data set name mylib2.meds is specified using a DATA statement following the NORMALIZE statement for normalized data set specifications. 423
8.9. The name mylib1.baseline replaces the default name of final using the MERGE statement in the global specifications section of a **DFsas** job file. 424
8.10. Select a subset of subjects 424

8.11. STRING coding and string splitting 426
8.12. Generate a SAS® job file called `testjob` for plate 5 of study #254, view the global `MISSING` statements, and recode all illegal SAS® missing value codes. 430
8.13. Common uses of fixed fields 431
8.14. Sample data retrieval 434
8.15. Normalization code for Sample Case Report Form 438

Preface

1. Getting Help

For software support, please contact the DFdiscover team:

- via email, <help@dfnetresearch.com>;
- visit our website, www.dfnetresearch.com.

2. Conventions

A number of conventions have been used throughout this document.

Any freestanding sections of code are generally shown like this:

```
# this is example code
code = code + overhead;
```

If a line starts with # or %, this character denotes the system prompt and is not typed by the user.

Text may also have several styles:

- Emphasized words are shown as follows: *emphasized words*.
- Filenames appear in the text like so: `dummy.c`.
- Code, constants, and literals in the text appear like so: `main`.
- Variable names appear in the text like so: `nBytes`.
- Text on user interface labels or menus is shown as: **Printer name**, while buttons in user interfaces are shown as Cancel.
- Menus and menu items are shown as: **File** > **Exit**.

Chapter 1. Introduction

1.1. About This Guide

This guide is for programmers, and for those who aspire to be. It covers DFdiscover file formats and those tools that are executed at the shell level. As a result, some familiarity with the UNIX operating system and UNIX shell level programming is assumed.

If this is your first encounter with UNIX we strongly recommend that you look for a good UNIX programming book in your local bookstore. We would not hesitate to recommend *The UNIX Programming Environment* by Kernighan and Pike, and *The Awk Programming Language* by Aho, Kernighan and Weinberger. The former is an excellent introduction to writing UNIX shell scripts, while the latter describes awk, a simple C-like language which is ideal for manipulating data files. All of the tools described in these 2 books come as standard components of the UNIX operating system.

In the remaining chapters of this guide we will describe:

- **DFdiscover Study Files.** A description of the location and format of all study files (including the configuration and data files) used in all DFdiscover studies
- **Shell Level Programs.** Over a dozen shell level commands for doing such things as:
  - exporting data records from a study database
  - selecting individual data fields
  - reformatting exported data records
  - importing data records from other sources into a DFdiscover study database
  - sending and managing faxes
  - getting study configuration parameters

  These programs can be used in shell scripts to create your own programs. When combined with standard UNIX commands (like awk, sed, grep, etc.) they provide an extremely powerful and flexible way of creating study report programs.
- **Utility Programs.** Descriptions of several infrequently used, yet useful, utility programs that can simplify some DFdiscover management tasks.
- **Edit checks.** A programming language for writing and executing edit checks that occur in real-time during data validation.
- **Batch Edit checks.** An extension of the edit checks language that permits execution of edit checks in batch, non-interactive mode.
- **DFsas: DFdiscover to SAS®.** An environment for generating SAS® job and data files from a DFdiscover study database and study schema.
- **DFsqlload: DFdiscover to Relational Database Tables.** A program that creates relational database tables from a DFdiscover study database and study schema.

1.2. DFdiscover Programming Limits

The following cribsheet is for DFdiscover programmers and summarizes all relevant DFdiscover database limits and formats. This cribsheet is to be used in conjunction with the information that follows in this chapter.

Description	Limit	Comments
DFdiscover Study Number	1-999	The suggested range for study numbers is 1-249 as study numbers of 250-255 are reserved for DFdiscover test and validation studies (e.g. ATK = 254). With the appropriate software license, study numbers 256-999 are available for defining EDC studies.
Plate Number	0-501, 510, 511	Plates 501 and 511 are reserved by DFdiscover for Query Reports and can not be re-defined at the user level. Plate 0 references the new record queue. Plate 510 is reserved by DFdiscover for Reason records.
Visit/Sequence Number (barcoded)	0-511	
Visit/Sequence Number (first data field)	0-65535	Any data field representing the visit/ sequence number must be defined in the database as field #6 using DFdiscover schema numbering.
Site Number	0-21460	This limit applies to the site number only. A subject identifier is concatenated to the site number to obtain the subject ID.
Subject ID Number	0-281474976710655	For subject IDs that are composed of site # + ID #, this limit applies to the concatenated value of the two. This field could contain 15 digits at maximum.
Any numeric value	-2147483647-2147483647	Any numeric field, except the subject ID field, can contain 10 digits at maximum, which include any leading sign and decimal point. This limit applies to the following DFdiscover field types, which have a base numeric value: numeric, visual analog scale (VAS), choice codes, check codes.
Query Use	0 = none 1 = external 2 = internal	
Query Type	0 = none 1 = Q&A (clarification) 2 = refax (correction)	
Query Category Code	1=missing, 2=illegal, 3=inconsistent, 4=illegible, 5=fax noise, 6=other, 21=missing page, 22=overdue visit, 23=edit check missing page, 30-99=user-defined problem type	
Query Status	0=pending review, 1=new, 2=in unsent report, 3=resolved, NA, 4=resolved, irrelevant, 5=resolved, corrected, 6=in sent report	
Query Detail Field	max 500 characters	
Query Note Field	max 500 characters	

Description	Limit	Comments
Missed Data Log Explanation Field	max 500 characters	
Default Date Format	YY/MM/DD	
Validation Level (system)	0-7	Level 0 represents new, not yet entered, records
Validation Level (user)	1-7	A user cannot assign a validation level of 0 to a data record.
Maximum Data Record Length	16384 ASCII (4096 UNICODE) characters	This is the maximum length that the system can accept and includes 55 characters of overheard maintained by the system. Therefore, the length of data record available for user-defined fields is 55 characters less.
Maximum **DFsas** Record Length	2048 characters	**DFsas** is unable to process input files for SAS® greater than this size.

Chapter 2. DFdiscover Study Files

2.1. Introduction

This chapter describes the files maintained under each DFdiscover study directory. It starts with a brief overview of the top-level directories and then describes the files kept under each directory in detail. A similar chapter, *System Administrator Guide, DFdiscover System Files*, describes the files located under a DFdiscover installation directory.

2.2. DFdiscover study directories

The following directories are part of a standard DFdiscover study definition.

- **`bkgd`.** This directory holds CRF background images created by **DFsetup**. Three files are created for each study plate. These include the plate background used by **DFsetup** (plt###), the data entry screen used by **DFexplore** (DFbkgd###), and a background used when printing CRFs containing database values from **DFprintdb** or **DFexplore** (DFbkgd###.png).

  > **Note**
  >
  > This directory must not be used to store any other files. Extraneous files will be deleted when CRF images are published from a development study to its production study, or when reverting a development study to the current state of its production study.

- **`data`.** This directory holds the study data files, queries data file, and journal files. The following files are described in detail later in this chapter in The study data directory:
  - **plt###.dat - per plate data files.** the study data files are created from the data recorded on the study CRFs
  - **DFqc.dat - the Query database.** the quality control data file contains all field level queries added to flag CRF problems and request data clarifications from investigators
  - **DFreason.dat - reason for change records.** the reason for change data file contains all field level reasons for data changes clarifying, if required, why a field's data value was changed
  - **DFin.dat - the new records database.** the new record queue contains all records that have been received and ICRed by the DFdiscover software but not yet validated
  - **plt###.dat - missed records.** missed records serve as placeholders in data files indicating that requested data records will never be available
  - **plt###.ndx - per plate index files.** per plate index files that speed database searching and hold record lock information
  - **YYMM.jnl - monthly database journal files.** the journal files record all database transactions and provide an audit trail of additions and modifications
  - **DFaudit.db sqlite audit trail.** sqlite version of the journal files
- **`dfsas`.** This directory contains any stored SAS® jobs that were created from **DFexplore**.
- **`dfschema`.** This directory contains any stored DFschema files which are used to track changes to the study setup. These are used by **DFaudittrace** to generate records for **DF_ATmods**.
- **`drf`.** This directory contains any .drf files (DFdiscover Retrieval Files) created by server-side tools, including reports and the program **DFmkdrf.jnl**. The common .drf files created by DFdiscover reports include:

- **`DupKeys.drf`.** Lists any duplicate primary keys found in the database by the last execution of **DF_XXkeys**.
- **`VDillegal.drf`.** Lists any illegal visit dates found in the database by the last execution of **DF_XXkeys**.
- **`VDincon.drf`.** Lists any inconsistent visit dates found in the database by the last execution of **DF_XXkeys**.
- **`DFunexpected.drf`.** Lists any unexpected data records found in the database by the last execution of **DF_QCupdate**.

- **`ecbin`.** Any study specific scripts or programs that are run by edit check function `dfexecute()` and any Plate Arrival Trigger scripts defined in the **DFsetup** Plates View, must be stored in the study level `ecbin` directory. Executables can also be stored in the DFdiscover level `ecbin` directory for use in all studies. The study level `ecbin` directory has priority if the same program or script is stored in both locations.
- **`ecsrc`.** This directory contains the edit check files: `DFedits` and any other edit check source files referenced in 'include' statements. Include files can also be stored in the DFdiscover level `ecsrc` directory. The study level `ecsrc` directory has priority if the same include file is stored in both locations.
- **`lib`.** All study configuration files, created through both the **DFadmin** and **DFsetup** tools, are located in this directory. The following files are described in detail later in this chapter in The study lib directory:
  - **DFccycle_map - conditional cycle map .** Defines cycles that may be required, unexpected or optional, depending on specified database conditions (optional).
  - **DFcenters - sites database .** Study sites database includes information on all clinical sites participating in the study.
  - **DFcplate_map - conditional plate map .** Defines plates that may be required, unexpected or optional, depending on specified database conditions (optional).
  - **DFcterm_map - conditional termination map .** Defines database conditions that signal termination of subject follow-up (optional).
  - **DFcvisit_map - conditional visit map .** Defines visits that may be required, unexpected or optional, depending on specified database conditions (optional).
  - **DFCRFType_map - CRF type map .** Defines categories for different CRF background types (e.g. translations) (optional).
  - **DFcrfbkgd_map - CRF background map .** Defines visits with CRF backgrounds used across multiple visits (optional).
  - **DFedits.bin - published edit checks .** The "published" equivalent of the edit checks - for use by **DFexplore** clients only (optional).
  - **DFfile_map - file map .** Specifies each unique CRF plate used in the study.
  - **DFlut_map - lookup table map .** Defines and associates lookup table names with directory names of lookup tables. Also includes definition for query lookup table, if it exists (optional).
  - **DFmissing_map - missing value map .** Missing value codes (and labels) used in the study (optional).
  - **DFpage_map - page map .** Used to specify descriptive labels to replace the visit/sequence and plate numbers that are used by default to identify problems on the Query Reports (optional).
  - **DFqcsort - Query and CRF sort order .** Specifies a sort order for queries as written on Query Reports. The default is to sort by field number within plate number within visit/sequence number within subject ID (optional).

- **.DFreports.dat - reports history .** Personal file of DFdiscover report commands (and options) corresponding to reports which the user runs in the reports tool (optional).
- **DFschema - database schema .** Study database schema (or dictionary) describes all variables on all plates, as specified in the setup tool.
- **DFschema.stl - database schema styles .** Study database schema (or dictionary) describes all variable styles defined for the study in the setup tool.
- **DFserver.cf - server configuration .** Configuration file for the study database server.
- **DFsetup - study definition .** This is a JSON format file maintained and used by **DFsetup** to record all study setup information, including all plate, style and variable definitions.
- **DFsubjectalias_map - subject alias map .** Used to specify descriptive labels to optionally replace the numeric subject ID used as an identifier throughout DataFax.
- **DFsubjectalias_map.log - subject alias change log .** Log all changes to the mapping of subject ID to subject alias over the course of a study.
- **DFtips - ICR tips .** This file contains the coordinates, field type and legal values for all variables defined on all plates. It is used by the ICR software to create the initial data record from new CRF pages that arrive by fax.
- **DFvisit_map - visit map .** This file describes the scheduling of subject assessments during the trial and the CRF pages expected at each assessment.
- **DFwatermark - watermark .** This file describes watermarks used for printed output assigned by role.
- **QCcovers - Query cover pages .** This file contains formatting information to be included in a Query Report cover sheet. To include a cover sheet for a Query Report, QCcovers must first be defined.
- **QCmessages - Query Report messages .** This file contains messages to be included in Query Report cover sheets. More than one message may be included in a single Query Report, however, **DF_QCreports** expects the cover sheet information and all messages to fit on a single page.
- **QCtitles - Query Report titles .** This file describes how the report title and each title of the 3 sections of a DFdiscover Query Report are to be customized. **DF_QCreports** checks for the existence of this file and will use it if it exists, otherwise standard titles will be produced.
- **DFqcproblem_map - Query category code map .** This file contains all the system-defined and user-defined query category codes.
- **DFreportstyle - DFdiscover Report styling .** This file contains styling "instructions" for reports, excluding Legacy reports. Styling includes font choices and colors used in graphs and charts.

- **`lut`.** This directory contains all study specific lookup tables. Lookup tables can also be stored in directory lut at the DFdiscover level. Study level files have priority if a lookup table with the same file name is stored in both locations. Lookup table file names must be associated with an edit check name in `DFlut_map` (found in the study `/lib` directory) before they can be used in edit checks.
- **`pages`.** This directory holds all standard (SD) resolution (100 dpi) CRF image and supporting document files for all CRF pages received or uploaded during the study. Each CRF page received as a fax or PDF is stored as a PNG file (Sun Rasterfile in pre-2014 DFdiscover releases), and requires about 25K bytes of disk space (i.e. 40 CRF pages per MB). Supporting documents can be audio, video, DICOM or PDF files and will be in their native format.

DFdiscover creates subdirectories, below the study pages directory, in which to store the CRF image files. These subdirectories are named by the year and week (in *yyww* format) in which the CRFs arrived. For example, a study which started on January 1, 1995 would have subdirectories named: 9501, 9502, 9503, etc. through to the end of the trial.

Within each of the *yyww* subdirectories, the individual CRF page files are named by the concatenation of the sequence number of the fax (starting at 0001 each week) in which they arrived during that week, and their page number within the fax. The file-naming format is *ffffppp*. For example, if the first fax to arrive in the week of 9501 contained 3 pages, it would be represented by the following files beneath the study pages directory: `9501/0001001`, `9501/0001002`, and `9501/0001003`. The *ffff* part of the file name is a sequential value constructed from 4 characters, each character taken from the alphabet:

```
0 1 2 3 4 5 6 7 8 9 B C D F G H J K L M N P Q R S T V W Y Z
```

This is essentially the digits 0 through 9 followed by the uppercase letters A through Z, with the exception of the letters A, E, I, O, U, and X. This part of the file name thus lies between 0001 and ZZZZ, which allows for a total of 30x30x30x30-1 = 809,999 faxes per week. Example file names within a week include:

- `0001005` 5th page of 1st fax
- `000B001` 1st page of 10th fax
- `000Z011` 11th page of 29th fax
- `0010002` 2nd page of 30th fax
- `01C0004` 4th page of 1230th fax

- **`pages_hd`.** This directory holds all higher (HD) resolution (300 dpi) CRF images and supporting document files received or uploaded during the study. DFdiscover creates subdirectories and stores the files in the same manner as the `pages` directory.

- **`reports`.** It is recommended that all study specific reports, i.e. those programs which have been created specifically for a particular clinical trial, are stored in the study reports directory. This helps to standardize maintenance across studies.

  Documentation for study specific reports must also be stored in this directory in a file named `.info`, which uses the same format used to document the standard DFdiscover reports. The specific requirements of this file and its format are described in Writing Documentation for Study Specific Reports.

- **`reports/QC`.** This directory is used to store the standard DFdiscover Query Reports, created by **DF_QCreports**. The files and directories maintained under this directory are briefly described below.

  ccc-yymmdd The naming convention for Query Reports is a zero padded 3 digit site ID (if the site ID is greater than 999, it will be a 4 digit number), followed by a dash, and then the date on which the report was created. For example: 055-150815 would identify a Query Report created for site 55 on Aug 15, 2015. Thus you can tell from a Query Report name, both whom it was created for and when.

  Although this is helpful it does have one disadvantage, namely, it means that you cannot create more than one Query Report per day for an individual clinical site. If you do, the earlier one will be over-written. However, since Query Reports are sent to the clinical sites, and this isn't something you should do more than about once a week, and certainly not more than once a day, this approach to naming Query Reports works.

  Query Reports remain under `QC` until they are sent to the clinical sites. Thus any reports that you see at this level have not been transmitted to the study clinics.

`QC/sent` Query Reports are moved to this directory after they have been successfully sent to their respective clinical sites.

`QC/internal` **DF_QCreports** is also able to create named, internal Query Reports, which can include subjects from more than one site. These reports are written directly to this directory.

QC_LOG This is a plain ASCII file that lists any error messages reported during the last execution of **DF_QCreports**.

`QC_NEW` This is a plain ASCII file that lists the Query Reports created by the most recent execution of **DF_QCreports**.

SENDFAX.log This is a plain ASCII file in which **DF_QCfax** records the success or failure of its attempts to fax Query Reports to the clinical sites.

SENDFAX.qup This is a plain ASCII file that lists all Query Reports which have been queued up for transmission to the clinical sites.

other files Occasionally, **DF_QCreports** might be halted in mid-execution, by a power failure, or some other problem. In such cases it may not have time to remove the temporary files that it creates in the process of generating the Query Reports. These files generally contain a process ID#; for example you might see files that look like this `18273_N.refax`, `18273_N.qalist`. These temporary files can, and should, be removed.

- **`work.`** The work directory contains temporary files, DFdiscover retrieval files and summary data files. It is important to be aware of the files that DFdiscover creates and maintains in this directory so that programmers do not inadvertently overwrite them.

  - **Temporary Files.** The work directory is used for temporary files created by various reports and is the recommended location for temporary files created by study specific reports and for data files exported using **DFexport.rpc**. If **DFexport.rpc** is used to export study data files to this directory, or create temporary files here in the process of generating study specific reports, you need to be very careful in your selection of temporary file names, so that simultaneous execution of different programs does not result in temporary file name conflicts. A useful strategy is to include the process ID plus some part of the program name in all temporary file names, and also to check for and create a lock directory for any programs that should not be executed simultaneously by more than one user.

    Because the work directory is used for temporary file creation by various DFdiscover programs, you might find temporary files that were not removed because a program failed to complete due to a power failure or some other problem. Any file that is several days old, and has what looks like a process id number as part of it's name, is probably a temporary file left over when a program failed to complete successfully. Such files can be removed. This should be done periodically to clean up the study work directory.

  - **Summary Files.** The work directory contains a number of summary data files created by **DF_XXkeys** and **DF_QCupdate** and used by other programs including **DF_QCreports** and **DF_PTvisits**. The following files are described in detail later in this chapter in The study work directory:

    - DFX_ccycle - cycle conditions met
    - DFX_cplate - plate conditions met
    - DFX_cterm - termination conditions met
    - DFX_cvisit - visit conditions met
    - DFX_keys - key fields for all required plates

- DFX_schedule - subject scheduling and visit status
- DFX_time1 - date and time from receipt to last modification
- DFX_visit.dates - value in the database of all visit dates

2.3. Study File Permissions

The `data`, `pages`, and `pages_hd` directories must be owned by user `datafax`, with read, write and execute permissions for owner, and read and execute permissions for group.

The `bkgd`, `dde`, `frame`, `lib`, `reports`, and `work` directories must have read, write and execute permissions set for all users of the study group (typically this will be UNIX group `studies`).

These permissions are set by **DFadmin** on those directories which it creates when the study is first registered. The utility program DFstudyPerms is available for diagnosing and correcting study permission problems. A detailed list of study files and directories checked by this program can be found at *System Administrator Guide, Maintaining study filesystem permissions*

2.4. Format used to describe files

Each file documented in this section is described with the following attributes:

Table 2.1. File attributes

Heading	Description
Usual Name	the file name that is usually given to files having this format. Some files are kept at the DFdiscover directory level while others are kept separately with each study directory.
Type	one of: "clear text" or "binary". Clear text files can be reviewed with any text editor.
Created By	the name of the DFdiscover program(s) that create and modify this file. If you need to edit the contents of the file, use the program listed here.
Used By	the name of the DFdiscover program(s) that reference or read this file.
Field Delimiter	how fields within a record are delimited. Typically, the delimiter is a single character.
Record Delimiter	how records within the file are delimited. Typically, the delimiter is a single character.
Comment Delimiter	how comments within the file are delimited. If comments are not permitted within the file, "NA" is indicated.
Fields/Record	the expected number of fields per record. If the number of fields varies across records, the minimum number is given, followed by a +.
Description	a detailed description of the meaning of each field.
Example	one or more example records from the file.

2.5. DFdiscover Retrieval Files (DRF)

A DFdiscover Retrieval File (DRF) is an ASCII file in which each record identifies the subject ID, visit or sequence number and CRF plate number (in that order, | delimited) and optionally the image ID corresponding to a record in the study database.

DFdiscover retrieval files are created by **DFexplore**, DFdiscover reports, and the DFdiscover programs DFmkdrf.jnl and **DFexport.rpc**.

DFdiscover retrieval files created by **DFexplore** and DFdiscover reports and programs reside in the study `drf` directory. It is also recommended that DRFs created using **DFexport.rpc** also be saved to the study `drf` directory. All DRFs must end with the `.drf` extension. Exercise caution when selecting DRF names to avoid conflicts with those DRF file names generated by DFdiscover applications. Below is a description of the DRF file format.

Table 2.2. Data Retrieval Files (DRF)

Usual Name	`filename.drf`
Type	clear text
Created By	**DFexport.rpc**, **DFmkdrf.jnl**, **DFexplore**
Used By	**DFexplore**
Field Delimiter	`|`
Record Delimiter	`\n`
Comment Delimiter	#
Fields/Record	3+
Description	Data records have the common fields and characteristics defined in Table 2.3, “DFdiscover Retrieval File field descriptions”.

Example	This is an example of a DRF listing all primary records having one or more queries attached to them. The DRF filename `ext_qcs.150813.drf` was created on August 13, 2015 and has the description `external qc notes.150813`.
	
	`99001|1|2`
	`99001|1011|9`
	`99002|1|2`
	`99002|22|5`
	`99002|1011|9`
	`99004|1|2`

Table 2.3. DFdiscover Retrieval File field descriptions

Field #	Contains	Description
1	subject/case ID	this is a number in the range of `0-281474976710655` used to uniquely identify each subject/case in the study database
2	visit/sequence number	a number in the range of `0-21460`, that uniquely identifies each occurrence of a visit number for a subject ID
3	plate number	a number in the range of 1-501 that uniquely identifies the plate to be included in the DRF.
4	image identifier	the value in this optional field is the unique identifier of the CRF image identified by the keys in the first 3 fields. This field is used to identify a specific instance of a CRF when there are one or more secondaries having the same key fields.
5	optional text	this field can be used to provide a short descriptive message to **DFexplore** users. The text is displayed in the message window at the bottom of **DFexplore** when the data record is selected in the **DFexplore** record list.

2.6. The study `data` directory

The study data directory holds all study data files, including the plate files that correspond to CRF plates, the query data file and the database transaction journals. These files are managed by the study database server and should not be accessed directly. Instead the records required should be exported from the study database to another file, as described in DFexport.rpc, and then read from the exported file.

Data records should never be added to these database files without doing so through the study database server. The program DFimport.rpc is available and is the recommended method of sending new or revised data records to the study database server.

Occasionally you may need to make extensive changes to an entire database file. The typical scenario is a change to one or more of the study CRFs to add or remove fields. In this case the plate definitions originally entered in the setup tool also need to be changed to match the new structure of the corresponding data files. This is a major operation. It requires that the study server be disabled while the database and setup definitions are being changed, and that the effected data files be re-indexed before the study database server is re-enabled.

2.6.1. Temporary data files

The following sections describe data and index files ending with `.dat` and `.idx` suffixes. Very rarely, you may notice files having the same name but with `.tad` or `.xdi` suffixes. These files are temporary files created and managed by the database server. They are present while the server performs sorting and garbage collection on a particular data file. As such they should be treated in the same manner as the other data and index files - basically, do not touch them. Typically, this is not a problem because the files are present for only a second or two.

2.6.2. Plate data files

Table 2.4. `plt###.dat` - per plate data files

Usual Name	`plt###.dat`
Type	clear text
Created By	**DFserver.rpc**
Used By	**DFserver.rpc**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	9+
Description	After first validation, new records are moved from to the study database files, *`plt###.dat`*. There is a separate data file for each unique CRF plate number defined for the study. For plate *`N`*, the data file is named *`pltN.dat`*, where *`N`* is leading zero-padded to 3 digits in length. Each record in one of these data files corresponds to the data entered from one CRF page with that plate number. Thus, each data file holds the data recorded for all instances of that CRF page (i.e., across all subjects and all visits). All database records are stored in free-field format with a | delimiter and \n delimiter. All database records have 3 CRF information fields followed by 4 key fields. Within all database files for each study, the study number key should always be the same; and within each *`plt###.dat`* data file, the plate number key should always be the same.

	Do not edit data files Data files must not be edited by conventional means. Doing so will surely corrupt the database. Each data file has a corresponding binary index file that encodes the information of the data file. Editing any data file will change the contents so that they are inconsistent with the index file. Another reason not to read or edit the data files explicitly is that each record may appear in the database more than once. This arises because each time a record is modified, the new version is appended to the end of the database file. Only the index file knows which version of the record is the most recent. There is no indication in the data record. **DFexport.rpc** should always be used to read data files because it consults the index files to identify the correct version of each record to be exported. Old versions of modified records are removed by the study database server the next time the database is resorted. Data records have the common fields and characteristics described in Table 2.5, "`plt###.dat` field descriptions".

Example	Here is an example of a plate 4 data record after level 1 validation to database file `plt004.dat`
	
	`1|1|9145/0045001|099|4|1|0123|egb|92/01/01|high blood pressure|`
	`Dr. Smith|92/01/10 10:23:23|92/01/10 10:23:23|`
	
	The text fields have been entered and record status has been set to `final`.

Table 2.5. `plt###.dat` field descriptions

Field #	Contains	Description
1 (DFSTATUS)	record status	Enumerated value from the list `1=final`, `2=incomplete`, `3=pending`, `4=FINAL`, `5=INCOMPLETE`, `6=PENDING`, `0=missed`
2 (DFVALID)	validation level	Enumerated value from the list 1, 2, 3, 4, 5, 6, 7
3 (DFRASTER)	raster name	the fax image id from which this data record was derived, if there was a fax image. The image id is always in the format `YYWW/FFFFPPP` or `YYWWRFFFFPPP`, where `YY` is the year (minus the century) in which the image id was created, `WW` is the week of the year, `FFFF` is a sequential base 30 value, in the range 0001-ZZZZ, representing the fax arrival order within the week, and `PPP` is the page number within the fax (also see `pages`). If the image id contains a slash (`/`) in the 5th character position, then the image id is for a fax. Pre-pending this image id with the value of the `PAGE_DIR` variable for the study creates a unique pathname to the file containing the fax image. If the image id contains `R` in the 5th character position, then the image id is for a raw data entered record, and in fact there is no image.
4 (DFSTUDY)	study number	the DFdiscover study number (must be constant across all records for the same study). Legal limit is `1-999`.
5 (DFPLATE)	plate number	the plate number as identified in the barcode of the CRF. Within each data file, this field has a constant value. Legal limit is 1-501.
6 (DFSEQ[a])	visit/seq number	the visit or sequence number of this occurrence of a plate for a subjects id. Legal limit is 0-511 if defined in the barcode, and `0-65535` if defined as the first data field on the page.
7	subject ID	the subject identifier. Legal limit is `0-281474976710655`. subject identifiers are composed of site # + subject ID. This limit applies to the concatenated value of the two, where the site # legal limit is `0-21460`.
8 to N-3	data	data fields from the corresponding CRF page

Field #	Contains	Description
N-2 (DFSCREEN)	record status	Enumerated value from the list 1=final, 2=incomplete, 3=pending. This record status mimics the status recorded in the first field except that there is no distinction between primary and secondary.
N-1 (DFCREATE)	creation date	the creation date and time stamp in the format yy/mm/dd hh:mm:ss. The creation date and time stamp are added to the record the first time it is validated to a level higher than 0. It is never modified after initial addition to the record.
N (DFMODIFY)	last modification date	the last modification date and time stamp in the format yy/mm/dd hh:mm:ss The initial value for this field is the same as the creation date. Each time any data within the record is modified, the modification stamp is updated. It is not updated if only the record's validation level has changed.

[a]Field 6 has this name only if the field is defined to be in the barcode; otherwise, the name is user-defined.

Table 2.6. plt###.dat - missed records

Usual Name	plt###.dat
Type	clear text
Created By	**DFserver.rpc**
Used By	**DFserver.rpc**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	11
Description	If a CRF is reported missing, and is not expected to ever arrive (e.g. because the subject missed a visit, or refused a test), it can be registered in the study database using **DFexplore**. These records have a status of lost and are added to the study database file with the same plate number, *plt###.dat*, similar to actual data records. The contents of the record fields are described in Table 2.7, "Missed record field descriptions".
Example	Here is an example of a missed data record `0|7|000/0000000|099|4|1|0123|1|subject was on vacation|92/01/10 10:23:23|92/01/10 10:23:23|`

Table 2.7. Missed record field descriptions

Field #	Contains	Description
1 (DFSTATUS)	record status	Enumerated value - always contains a 0 for missed records, which is equivalent to the record status lost
2 (DFVALID)	validation level	Enumerated value from the list 1, 2, 3, 4, 5, 6, 7
3 (DFRASTER)	image name	always contains 0000/0000000 for missed records. This is simply a placeholder value as there is no CRF image.
4 (DFSTUDY)	study number	the DFdiscover study number (must be constant across all records for the same study)
5 (DFPLATE)	plate number	the plate number

Field #	Contains	Description
6	visit/seq number	the visit or sequence number
7	subject ID	the subject identifier
8	reason code	Enumerated value - the reason that the CRF was missed, selected from the following list: 1=Subject missed visit, 2=Exam or test not performed, 3=Data not available, 4=Subject refused to continue, 5=Subject moved away, 6=Subject lost to follow-up, 7=Subject died, 8=Terminated - study illness, 9=Terminated - other illness, 10=Other reason
9	reason text	an additional, optional explanation as to why the CRF was missed
10 (DFCREATE)	creation date	the creation date and time stamp in the format yy/mm/dd hh:mm:ss
11 (DFMODIFY)	last modification date	the last modification date and time stamp will always be the same as the creation date and time stamp as missed records are never modified once created (changes, if necessary, are made by deleting the existing missed record and creating another one)

2.6.3. Query data files

Table 2.8. DFqc.dat - the Query database

Usual Name	DFqc.dat
Type	clear text
Created By	
Used By	**DFserver.rpc**, **DFexplore**, **DFbatch**, **DF_CTqcs**, **DF_ICqcs**, **DF_ICrecords**, **DF_PTcrfs**, **DF_PTqcs**, **DF_QCreports**, **DF_QCsent**, **DF_QCstatus**, **DF_QCupdate**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	22
Description	The query data file, DFqc.dat, is maintained by the study server in the same manner as the CRF data files, DFin.dat and plt*.dat. All query records have exactly the same format, across all DFdiscover studies. Each query record has 22 fields, of which 5 (fields 4-8) are the keys needed to uniquely identify each record. Multiple queries are permitted per field provided their category codes are unique. As for study data files, you should always use **DFexport.rpc** to export the query database before using it. For this purpose, DFqc.dat has been assigned a DFdiscover reserved plate number of 511. Table 2.9, "DFqc.dat field descriptions" describes each field in a query record.
Example	An example of a newly added query that is to be included in the next Query Report sent to the originating site (the line break is for presentation purposes only): `1|1|0000/0000000|20|10|999|2100101|6|21|000000|0||1. Sample collection date |11/10/05|1|2|||user1 06/05/27 11:35:57|user1 06/05/27 11:35:57||1|` An example of a query that was sent out in a Query Report and has now been resolved:

```
5|4|0000/0000000|20|397|2030|1415412|11|14|060424|31|1|A2. Whole Blood 1ml
 ID #
||1|2|||brian 06/03/23 12:57:20|brian 06/03/23 12:57:20|barry 06/05/11
 14:10:04|1|
```

Table 2.9. `DFqc.dat` field descriptions

Field #	Contains	Description
1 (DFSTATUS)	record status	current status of the query. Legal values are: 0=pending (review), 1=new, 2=in unsent report, 3=resolved NA, 4=resolved irrelevant, 5=resolved corrected, 6=in sent report, 7=pending delete
2 (DFVALID)	validation level	validation level at which the query was created or last modified. The query validation level matches the level of the data record upon export only when the **DFexport.rpc** -m option is used.
3 (DFRASTER)	raster name	must contain "0000/0000000". Any references to actual raster names will result in the deletion of those rasters if the referencing query is deleted.
4 (DFSTUDY)	study number	the DFdiscover study number. Again, this number is constant across all records for one study.
5 (DFPLATE)	plate number	the plate number of the record that this query is attached to
6 (DFSEQ)	visit/seq number	the visit or sequence number of the record that this query is attached to
7 (DFPID)	subject ID	the subject identification number
8 (DFQCFLD)	query field number	the data entry field to which this query is attached **Query Field Number = Database Field Number - 3** For historical reasons this number is 3 less than the database field number. For example, a query on the ID field, which is always database field 7, will have a query field number of 4.
9 (DFQCCTR)	site ID	the site ID that the query was sent to or will be sent to. This is determined when the query is created. Also, it is checked, and updated if necessary to account for a subject move, each time **DF_QCupdate** is executed.
10 (DFQCRPT)	report number	the Query Report that the query was written to. The Query Report number is always in the format yymmdd, for the year, month, and day the report was created. If the query has not yet been written to a report, the value is 0.
11 (DFQCPAGE)	page number	the page number of the Query Report, on which the query appears, or 0 if it has not yet been written to a report.
12 (DFQCREPLY)	reply to query	the reply entered by an **DFexplore** user in the format *name yy/mm/dd hh:mm:ss reply* The maximum length of this field is 500 characters. It is blank when a new query is created, or when an old query is reset to new. This field cannot be created or edited in **DFexplore** by users who do not have adequate permissions. When a new reply is entered, the query status is changed to pending.
13 (DFQCNAME)	name	a description of the data field that is referenced by this query. Although this field can be edited when the quality control report is being added, its default value is taken from the "Description" part of the variable definition entered in the Setup tool. The maximum length of this field is 150 characters, but only the first 30 appear on quality control reports.

Field #	Contains	Description
14 (DFQCVAL)	value	the value held in the data field when the query was added. If the query is subsequently edited and the value of the data field has changed, this field is updated with the new value. The maximum length of this field is 150 characters. For overdue visit queries, this field contains a julian representation of the date on which the visit was due (expressed as the number of days since Jan 1,1900).
15 (DFQCPROB)	category code	the numeric category code. Legal values are: 1=missing value, 2=illegal value, 3=inconsistent value, 4=illegible value, 5=fax noise, 6=other problem, 21=missing plate, 22=overdue visit, 23=EC missing plate, 30-99=user-defined category code.
16 (DFQCRFAX)	refax code	refax request code. Should the CRF page, which this query references, be re-sent? Legal values are: 1=no (clarification query type), 2=yes (correction query type).
17 (DFQCQRY)	query	any additional text needed to clarify the query to the investigator who will receive the Query Reports. The maximum length of this field is 500 characters. Note: the category code label from field 15 is included automatically and is often all that is needed.
18 (DFQCNOTE)	note	any additional text needed to describe the problem when it is resolved. The maximum length is 500 characters.
19 (DFQCCRT)	creation date	the creator, creation date and time stamp of the query in the format *name yy/mm/dd hh:mm:ss* The creation date and time stamp are added when the query is first created.
20 (DFQCMDFY)	last modification date	the modifier, last modification date and time stamp in the format *name yy/mm/dd hh:mm:ss* The initial value for this field is the same as the creation date. Each time the query is modified, the modification stamp is updated.
21 (DFQCRSLV)	resolution date	the resolver, resolution date and time stamp in the format *name yy/mm/dd hh:mm:ss* Until the query is resolved, this field is blank
22 (DFQCUSE)	usage code	Legal values are: 1=send to site (these queries are formatted into a Query Report and sent to the appropriate study site), 2=internal use only (these queries do not appear in site Query Reports).

2.6.4. Reason for change data files

Table 2.10. `DFreason.dat` - reason for change records

Usual Name	`DFreason.dat`
Type	clear text
Created By	**DFserver.rpc**
Used By	**DFserver.rpc**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	12

Description	Data fields may require that a change to the value in the field be supported by a reason for the change. This reason information is recorded in . The contents of the record fields are described in Table 2.11, "Reason for data change record field descriptions".
Example	Here is an example of a reason data record `1|3|000/0000000|254|4|1|0123|9|phone|information provided by physician over the phone|nathan 03/01/10 10:23:23|nathan 03/01/10 10:23:23` It indicates that field 9 was changed because of the reason "information provided by physician over the phone".

Table 2.11. Reason for data change record field descriptions

Field #	Contains	Description
1 (DFSTATUS)	record status	valid status codes include: 1=approved, 2=rejected, 3=pending
2 (DFVALID)	validation level	Enumerated value from the list 1, 2, 3, 4, 5, 6, 7. This is the record's last validation level when the reason was created or modified.
3 (DFRASTER)	image name	always contains `0000/0000000` for reason for data change records. This is simply a placeholder value as there is no CRF image.
4 (DFSTUDY)	study number	the DFdiscover study number (must be constant across all records for the same study)
5 (DFPLATE)	plate number	the plate number
6 (DFSEQ)	visit/seq number	the visit or sequence number
7 (DFPID)	subject ID	the subject identifier
8 (DFRSNFLD)	reason field number	the data entry field number this reason note refers to. This numbering does not correspond directly to the DFdiscover schema numbering, but instead is offset by 3, so for example, the ID field which is always database field number 7 will always report the reason field number as 4. This is identical to the behavior of the field number reported in queries.
9 (DFRSNCDE)	reason code	an optional coding of the reason for data change. Although this code field contains textual data, it should be possible to use it as a categorical variable. The code will typically come from the first field of the REASON lookup table, if it is defined.
10 (DFRSNTXT)	reason text	required text that provides the reason for the data change. The maximum length of this field is 500 characters.
11 (DFRSNCRT)	creation date	the creator, creation date and time stamp in the format `name yy/mm/dd hh:mm:ss`. This field is completed when the reason for data change is first created.
12 (DFRSNMDF)	last modification date	the modifier, last modification date and time stamp in the format `name yy/mm/dd hh:mm:ss`. The initial value for this field is the same as the creation date. Each time the reason note is modified, the modification stamp is updated.

2.6.5. Newly arrived data file

Table 2.12. `DFin.dat` - the new records database

Usual Name	`DFin.dat`

Type	clear text
Created By	**DFserver.rpc**
Used By	**DFserver.rpc**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	5+
Description	Each initial data record, created by the ICR software when it scans a CRF page, is passed to the study database server which appends it to this file. These are called "new records". All new records have the common fields and attributes identified in Table 2.13, "DFin.dat field descriptions". The first 5 fields are added by the process that ICRed the page. The 4th and 5th fields were read from the barcode at the top of each CRF page. Dependant upon the success of the ICR algorithm, subsequent fields in each new record may or may not be filled in. If a fax image is particularly difficult to read, it is possible that only the first five fields will appear in the new record. The first three fields, in addition to being delimited, are also in fixed column positions. The record status begins in the first column and is one column wide. The validation level begins in the third column and is one column wide. The raster name begins in the fifth column and is 12 columns wide. Columns two and four contain the field delimiter.
Example	Here is an example of a new data record from `0|0|9145/0045001|099|4|1|0123||92/01/01|||` This record has new record status, has not yet been validated, contains the data from fax image $(PAGE_DIR)/9145/0045001, and belongs to study 99, plate 4, visit 1, and subject ID 123.

Table 2.13. `DFin.dat` field descriptions

Field	Contains	Description
1 (DFSTATUS)	record status	Enumerated value - always contains a `0` for new records, which is equivalent to the record status `new`
2 (DFVALID)	validation level	Enumerated value - always contains a `0` for new records, which indicates that the record has only been validated by the ICR software
3 (DFRASTER)	image name	the fax image from which this data record was derived. The value for this field will always be in the format `yyww/ffffppp`. Prepending this name with the value of the `PAGE_DIR` variable for the study creates a unique pathname to the file containing the fax image
4 (DFSTUDY)	study number	the DFdiscover study number (must be constant across all records for the same study)
5 (DFPLATE)	plate number	the plate number as identified in the barcode of the CRF

2.6.6. Journal files

Table 2.14. `YYMM.jnl` - monthly database journal files

Usual Name	`YYMM.jnl`
Type	clear text
Created By	**DFserver.rpc**
Used By	**DF_ATfaxes**, **DF_ATmods**, **DF_WFcrfs**, **DF_WFqcs**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	11+
Description	The study database server adds a record to the current study database journal file, each time that a data record is written to the study database, including when: • a new record arrives in the study database from the incoming daemon • an existing record is modified in **DFexplore** • the validation level of an existing record is modified in **DFexplore** • the status of an existing record is modified in **DFexplore** • an existing record is deleted in **DFexplore** • a query is added, modified, resolved, or deleted in **DFexplore** • a record is imported into the study database using **DFimport.rpc** • the database is structured by **DFsetup** Separate journal files are kept for each study, and within a study, a new journal file is created for each month. The naming scheme for journal files is *YYMM.jnl* where *YY* is the last two digits of the year (e.g. 92) and *MM* is the two digit month of the year, January being 01 and December being 12. The fields within each journal record are defined as described in Table 2.15, "`YYMM.jnl` field descriptions".

Example	Following is an example of a complete journal record. The line breaks are for presentation purposes only.
	`980312|132426|valid1|d|1|1|9807/0047008|254|5|24|99001|ABC|06/07/97|`
	`171|097|172|096|2|055.1|121.5|2||1143|00|*|*|*|1|1|*|1|1|`
	`98/03/12 13:24:26|98/03/12 13:24:26|`

Table 2.15. `YYMM.jnl` field descriptions

Field #	Contains	Description
1	date stamp	A date stamp, in *YYMMDD* format, identifying when the data record was written to the database

Field #	Contains	Description
2	time stamp	a time stamp, in *HHMMSS* format, identifying when the data record was written to the database. Hours are reported in 24-hour notation.
3	username	the username of the person who wrote the record to the database. This is the login name of the user who modified the record.
4	record type	Enumerated value - indicates the type of the journal record. Possible values are: `d` for data record, `q` for query record, `r` for reason record, `s` for the beginning of a setup restructuring, and `S` for the end of a setup restructuring.
5-11	record keys	fields 5 through 11 contain the first 7 fields from the data record.
12+	record data fields	the remaining data fields (8 to the end of the record) follow.

Table 2.16. `DFaudit.db` sqlite audit trail

Usual Name	`DFaudit.db`
Type	binary
Created By	**DFserver.rpc**, **DFauditdb**
Used By	**DFserver.rpc**, **DFedcservice**, **DF_SBhistory**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	NA
Fields/Record	NA

Description	All journal records are stored additionally in a sqlite database. The database contains table DFaudit and indexes. Columns in the DFaudit table match the output from DFaudittrace:
	
	`CREATE TABLE IF NOT EXISTS dfaudit (`
	`  dftype  TEXT  NOT NULL,  -- 1  type: N=new, C=changed field, D=deleted`
	`  dfdate  INTEGER NOT NULL,  -- 2  date: yyyymmdd`
	`  dftime  TEXT  NOT NULL,  -- 3  time: hhmiss`
	`  dfuser  TEXT  NOT NULL,  -- 4  user`
	`  dfsubject  INTEGER,  -- 5  subject`
	`  dfvisit  INTEGER,  -- 6  visit`
	`  dfplate  INTEGER NOT NULL,  -- 7  plate`
	`  dffieldid  INTEGER,  -- 8  unique field id: data(=0), query(>0), reason(<0)`
	`  dffieldchange INTEGER,  -- 9  changed field: data(0, unique id), query(field#), reason(field#)`
	`  dfstatus  INTEGER,  -- 10 data, query and reason status`
	`  dflevel  INTEGER,  -- 11 validation level`
	`  dfmaxlevel  INTEGER,  -- 12 maximum validation level reached`
	`  dfcategory  TEXT,  -- 13 missed record code, query category, reason code`
	`  dfuse  TEXT,  -- 14 missed record text, query usage, reason text`
	`  dfoldval  TEXT,  -- 15 old value`
	`  dfnewval  TEXT,  -- 16 new value`

```
  dffieldnum    INTEGER,           -- 17 field number
  dffielddesc   TEXT,              -- 18 field description
  dfoldlbl      TEXT,              -- 19 old coded field label
  dfnewlbl      TEXT,              -- 20 new coded field label
  dfuid         INTEGER)           -- 21 internal use for database
 restructure

CREATE INDEX IF NOT EXISTS dfidx_date ON dfaudit (dfdate, dfsubject)
CREATE INDEX IF NOT EXISTS dfidx_user ON dfaudit (dfuser)
CREATE INDEX IF NOT EXISTS dfidx_fuid ON dfaudit (dfuid)
CREATE INDEX IF NOT EXISTS dfidx_fid  ON dfaudit (dffieldid)
CREATE INDEX IF NOT EXISTS dfidx_fnum ON dfaudit (dffieldnum)
CREATE INDEX IF NOT EXISTS dfidx_keys ON dfaudit (dfsubject, dfvisit,
 dfplate)
CREATE INDEX IF NOT EXISTS dfidx_vst  ON dfaudit (dfvisit)
CREATE INDEX IF NOT EXISTS dfidx_plt  ON dfaudit (dfplate)
CREATE INDEX IF NOT EXISTS dfidx_sta  ON dfaudit (dfstatus, dflevel)
CREATE INDEX IF NOT EXISTS dfidx_lvl  ON dfaudit (dflevel)
```

DFserver.rpc opens `DFaudit.db` in read-write mode. Whenever a record entry is added to journal file, it will be appended to DFaudit table. **DFedcservice** opens `DFaudit.db` in read-only mode when requesting history. **DFauditdb** converts existing journal files to `DFaudit.db`.

2.6.7. Index files

Table 2.17. `plt###.ndx` - per plate index files

Usual Name	`plt###.ndx`
Type	binary
Created By	**DFserver.rpc**
Used By	, **DFshowIdx**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	NA
Fields/Record	NA
Description	Every study data file has a corresponding index file that the study server uses to track the current status and location of each record in the data file. The index entry for a particular data record includes the value of the key fields id, plate, and visit/sequence number, the record status, the validation level, the offset of the beginning of the record into the data file, and the length of the data record. When searching for a data record by keys, it is much more efficient for the database server to search the index file for matching keys and then use the offset and length to extract the data record from the data file. Each time an existing data record is modified or a new record is added, a new entry is made at the end of the index file for the new, modified copy of that record, and the status of the old index entry (if there was one) is changed to indicate that it has been superseded by a new entry. Index and data files are sorted (on id and visit/sequence number) by the study database server, each time the server exits. Before sorting, an index file has *M* sorted entries at the top of the file, and *N* unsorted

entries at the bottom of the file. When searching, the unsorted index entries are searched first in a linear fashion and then, if necessary, a binary search is performed on the sorted entries.

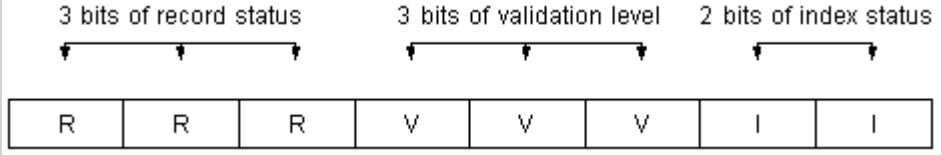
The first 32 bytes of an index file are header information, consisting of four 4-byte numbers that identify attributes of the file as a whole, as described in Table 2.18, "`plt###.ndx` header bits", followed by 16 bytes of padding. Before the study database server exits, it checks this header information of each index file. If the number of unsorted entries and the number of pending deletes are both 0, then the file is already sorted and does not need further attention.

The 32 bytes of header information are followed by the actual index entries. Each index entry is 32 bytes in size and is described in Table 2.19, "`plt###.ndx` record bits".

Each index entry contains 8 bytes for the subject ID, 2 bytes for the visit number, 2 bytes for the plate number, 4 bytes for the offset into the data file, 2 bytes for the record length, a status byte and 13 bytes of padding.

The status byte encodes three pieces of information: the record status (equivalent to the numeric value of the first byte of the data record), the record validation level (equivalent to the numeric value of the third byte of the data record), and the status of the index entry. This is encoded as illustrated in Figure 2.1, "Encoding for bits within the status byte".

Figure 2.1. Encoding for bits within the status byte



The record status contains the same values as those allowed in the record status field of the data record, namely 0 through 7 (binary 111). Similarly, the validation level will take on the same values as those allowed in the validation level of the data record, again 0 through 7. The index status contains the value 2 if this is a new index entry, 1 if the index entry has been superseded by a newer one, and 0 otherwise.

The size of all index files should always be a multiple of 32 bytes.

Table 2.18. `plt###.ndx` header bits

First Byte	Last Byte	Contains
1	4	magic number indicating that this is an index file. Should always have the fixed value 0xdf6464df.
5	8	the number of sorted index entries
9	12	the number of unsorted index entries
13	16	the number of pending deletions
17	32	reserved for future use

Table 2.19. `plt###.ndx` record bits

Size	Contains
8 bytes	subject ID
2 bytes	visit/sequence number
2 bytes	plate number

Size	Contains
4 bytes	offset in bytes from beginning of data file to first byte of record (0 based)
2 bytes	length of record in bytes
1 byte	status bits
13 bytes	reserved for future use

2.7. The study `ecsrc` directory

This directory contains the edit check source files.

Table 2.20. `DFedits` - edit checks

Usual Name	`DFedits`
Type	clear text
Created By	**DFsetup**
Used By	**DFexplore**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	#
Fields/Record	NA
Description	This file contains the edit checks that are defined for this study. The edit check language is fully described in Edit checks.

Example	<pre>edit SetInit()
	{
	    if (dfblank(init) && !dfblank(init[,0,1]))
	        init = init[,0,1];
	}
	edit AgeOk()
	{
	    number age;
	    if (!dfblank(p001v03) && !dfblank(p001v04))
	    {
	        age = (p001v03 - p001v04) / 365.25;</pre>
	...

2.8. The study `lib` directory

This directory contains the study configuration files, those files that make this study unique from every other DFdiscover study.

Table 2.21. `DFcenters` - sites database

Usual Name	`DFcenters`
Type	clear text

Created By	**DFsetup**
Used By	all study tools and the standard reports including: **DF_CTqcs**, **DF_CTvisits**, **DF_PTcrfs**, **DF_QCfax**, **DF_QCfaxlog**, **DF_QCreports**, **DF_QCupdate**, **DF_SScenters**, **DF_XXtime**, and **DF_qcsbyfield**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	11+

Description	Each DFdiscover study has a sites database that records where each participating site is located, who the contact person is, and what subject ID number ranges are covered by each site ID.
	
	Each site typically corresponds to a different clinical site, but this is not required. If necessary, a single clinical site may be defined as 2 or more sites, each corresponding to a different participating clinical investigator at that site. The sites database consists of one record per site ID. The field definitions are described in Table 2.22, "Field definitions for `DFcenters`".
	
	Each site ID must be a number in the range `0` to `21460` and uniquely identifies the site within the database. All site numbers printed on DFdiscover reports are leading zero-padded to 3 digits but they may be up to 5 digits in length if the site number is greater than 999. The contact person is required as it is the person that outgoing faxes for the site are addressed to. A primary fax is not required and may be left blank for sites that are not meant to receive Query Reports. The primary fax number, if specified, should exactly match the number, including long distance, country, and area codes, that would be dialed from a numeric keypad. Most punctuation characters are ignored so they can be used for improving readability. Valid punctuation characters include: +#*-,()0-9 For example, `1-(416)521-9800` is equivalent to `14165219800`.
	
	Whitespace characters
	Whitespace characters (space and tab) may not be used as punctuation as they are interpreted as delimiters between multiple entries.
	Each comma inserts a one-second pause in the dialing sequence. This can be helpful when leaving a local PBX or waiting to dial an extension.
	
	A valid email address may also be supplied in place of or together with a primary fax number. The email address must be specified using the notation **`mailto:`*`email_address`***. The prefix **`mailto:`** is fixed and required while ***`email_address`*** must be a valid email address (there is no validity checking performed on email addresses, so be careful to enter them correctly).
	
	If more than one email and/or fax number is specified, each must be separated by a single space. Comma separators are not permitted.
	
	Subject ID ranges are specified in fields 11 through the end of the record. There is no limit to the number of range fields that can be given. Each range field contains a minimum subject ID and maximum subject ID separated by exactly one space character. For example,
	
	`|101 199|`
	
	indicates that subject IDs 101 through 199 inclusive are to be included for the site. Individual subject IDs that are disjoint from any range are indicated by setting both the minimum and maximum ids to the actual subject ID. For example,
	
	`|244 244|301 399|401 420|`

	includes subject IDs 244, 301 through 399 inclusive, and 401 through 420 inclusive. In the event that subject IDs are incorrectly entered in data records, there should always be a 'catch-all' site listed that receives all subject IDs that do not fall into any of the other subject ID ranges. This site is indicated by the phrase `ERROR MONITOR` in the 11th field and no other subject ID range fields. **Note** **DFcenters** may be modified at any time, via **DFsetup** only, for an active study. However, if quality control reports are being created for the study, the DFdiscover report **DF_QCupdate** must always be run after **DFcenters** modification and prior to Query Report creation. **DF_QCupdate** ensures that the most up-to-date **DFcenters** file will be used when generating subject status and scheduling information for the Query Reports.
Example	A single sites database record for a site that is responsible for subject IDs 1101 through 1149, and 1151 through 1199 inclusive. `011|Lisa Ondrejcek|DFnet|140 Lakeside Avenue, Suite 310, Seattle, Washington, 98122|1-206-322-5932|country:USA;enroll:100|1-206-322-5931|Lisa Ondrejcek|1-206-322-5931||1101 1149|1151 1199`

Table 2.22. Field definitions for `DFcenters`

Field #	Description	Required	Maximum Size
1	site ID	yes	5 digits
2	Contact	yes	30 characters
3	Name	yes	40 characters
4	Address	no	80 characters
5	Fax	no	4096 characters
6	Attributes including Start Date, End Date, Enroll Target, Protocol Effective Date (x5), Protocol Version (x5) This field contains zero of more semi-colon (:) delimited pairs, where each pair is a keyword and value where the keyword is from the list `country`, `beginDate`, `endDate`, `enroll`, `protocol1`, `protocol1Date`, `protocol2`, `protocol2Date`, `protocol3`, `protocol3Date`, `protocol4`, `protocol4Date`, `protocol5`, `protocol5Date`, `testSite`.	no	4096 characters
7	Telephone (site)	no	30 characters
8	Investigator	no	30 characters
9	Telephone (investigator)	no	30 characters
10	Reply to email address	no	80 characters
11+	Subject ID ranges	yes	30 digits,1 space

Table 2.23. `DFccycle_map` - conditional cycle map

Usual Name	`DFccycle_map`

Type	clear text
Created By	**DFsetup**
Used By	**DF_QCupdate**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	#
Fields/Record	2+

Description	This table describes the conditional cycle map file structure and provides an example. It does not describe all of the syntax and rules related to this feature. Usage instructions for all 4 conditional maps is fully described in *Study Setup User Guide, Conditional Maps*.
	
	The file contains one or more specifications, each consisting of a condition definition followed by one or more actions to be applied if the condition is met. Entries in the file have the general appearance of:
	
	`IF|Visit List|Plate|Field|Value`
	`AND|Visit List|Plate|Field|Value`
	`[+-~]|List of conditional cycles`
	
	Each condition may be followed by one or more action statements. Each of these statements begins with: '+' to indicate that the cycles are required, '-' to indicate that the cycles are unexpected, or '~' to indicate that the cycles are optional, when the condition is met.
	
	There is no limit to the number of condition/action entries that may be included but the order in which the conditions appear may be important, because in the event of a conflict, the action specified by the last entry, applicable to each cycle, is the action that will be applied. This point is illustrated in the following example.

Example	`IF|0|1|22|6`
	`+|2,5,8`
	`-|3,6,9`
	`~|4,7,10`
	
	`IF|0|1|22|5`
	`AND|0|9|13|>0`
	`AND|0|9|36|!1`
	`+|11`
	
	`IF|1|3|9|~^A`
	`-|11`
	
	This example, consists of 3 conditional specifications. They are applied in the order in which they are defined. The first specification indicates that, if field 22 on plate 1 at visit 0 equals 6, then cycles 2, 5 and 8 are required; cycles 3, 6 and 9 are not expected; and cycles 4, 7 and 10 are optional. The second specification indicates that, if field 22 on plate 1 at visit 0 equals 5, and field 13 on plate 9 at visit 0 is greater than zero, and field 36 on plate 9 at visit 0 is not equal to 1, then cycle 11 is required. The third specification indicates that, if field 9 on plate 3 at visit 1 begins with the capital letter "A", then cycle 11 is not expected.
	
	If both conditions 2 and 3 are met cycle 11 will be considered unexpected because, when a conflict occurs, the last condition wins.

Table 2.24. `DFcvisit_map` - conditional visit map

Usual Name	`DFcvisit_map`
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCupdate**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	#
Fields/Record	2+

Description	This table describes the conditional visit map file structure and provides an example. It does not describe all of the syntax and rules related to this feature. Usage instructions for all 4 conditional maps is fully described in *Study Setup User Guide, Conditional Maps*.
	
	The file contains one or more specifications, each consisting of a condition definition followed by one or more actions to be applied if the condition is met. Entries in the file have the general appearance of:
	
	`IF|Visit List|Plate|Field|Value`
	`AND|Visit List|Plate|Field|Value`
	`[+-~]|List of conditional visits`
	
	Each condition may be followed by one or more action statements. Each of these statements begins with: '+' to indicate that the visits are required, '-' to indicate that the visits are unexpected, or '~' to indicate that the visits are optional, when the condition is met.
	
	There is no limit to the number of condition/action entries that may be included but the order in which the conditions appear may be important, because in the event of a conflict, the action specified by the last entry, is the action that will be applied. This point is illustrated in the following example.

Example	`IF|0|1|22|6`
	`+|10-19`
	`-|20-29`
	`~|30`
	
	`IF|0|1|22|5`
	`AND|0|9|13|>0`
	`AND|0|9|36|!1`
	`+|40`
	
	`IF|1|3|9|~HIV`
	`-|40`
	
	This example, consists of 3 conditional specifications. They are applied in the order in which they are defined. The first specification indicates that, if field 22 on plate 1 at visit 0 equals 6, then visits 10 to 19 are required, visits 20 to 29 are unexpected, and visit 30 is optional. The second specification indicates that, if field 22 on plate 1 at visit 0 equals 5, and field 13 on plate 9 at visit 0 is greater than zero, and field 36 on plate 9 at visit 0 is not equal to 1, then visit 40 is required. The third specification indicates that, if field 9 on plate 3 at visit 1 contains the literal string "HIV", then visit 40 is not expected.

	If both conditions 2 and 3 are met, visit 40 will be considered unexpected because, when a conflict occurs, the last condition wins.

Table 2.25. `DFcplate_map` - conditional plate map

Usual Name	`DFcplate_map`
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCupdate**
Field Delimiter	`|`
Record Delimiter	`\n`
Comment Delimiter	#
Fields/Record	2+

Description	This table describes the conditional plate map file structure and provides an example. It does not describe all of the syntax and rules related to this feature. Usage instructions for all 4 conditional maps is fully described in *Study Setup User Guide, Conditional Maps*.
	
	The file contains one or more specifications, each consisting of a condition definition followed by one or more actions to be applied if the condition is met. Entries in the file have the general appearance of:
	
	`IF|Visit List|Plate|Field|Value`
	`AND|Visit List|Plate|Field|Value`
	`[+-~]Visit List|List of conditional plates`
	
	Each condition may be followed by one or more action statements. Each of these statements begins with: '+' to indicate that the plates are required, '-' to indicate that the plates are unexpected, or '~' to indicate that the plates are optional, at the specified visits, when the condition is met.
	
	There is no limit to the number of condition/action entries that may be included but the order in which the conditions appear may be important, because in the event of a conflict, the action specified by the last entry, applicable to each plate, is the action that will be applied. This point is illustrated in the following example.

Example	`IF|0|1|22|6`
	`+10,20|50,51`
	`-10,20|40,41`
	`~10,20|15`
	
	`IF|0|1|22|5`
	`AND|0|9|13|>0`
	`AND|0|9|36|!1`
	`+91-95|16`
	
	`IF|1|3|9|yes`
	`-91|16`
	
	This example, consists of 3 conditional specifications. They are applied in the order in which they are defined. The first specification indicates that, if field 22 on plate 1 at visit 0 equals 6, then at visits 10 and 20: plates 50 and 51 are required, plates 40 and 41 are not expected, and plate 15 is optional. The second specification indicates that, if field 22 on plate 1 at visit 0 equals 5, and field 13 on plate 9 at visit

	0 is greater than zero, and field 36 on plate 9 at visit 0 is not equal to 1, then at visits 91-95 plate 16 is required. The third specification indicates that, if field 9 on plate 3 at visit 1 contains exactly the string "yes", and nothing more, then plate 16 is not expected at visit 91. If both conditions 2 and 3 are met plate 16 will be considered unexpected at visit 91, but required at visits 92-95, because, when a conflict occurs, the last condition wins.

Table 2.26. `DFcterm_map` - conditional termination map

Usual Name	`DFcterm_map`
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCupdate**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	#
Fields/Record	1+

Description	This table describes the conditional termination map file structure and provides an example. It does not describe all of the syntax and rules related to this feature. Usage instructions for all 4 conditional maps are fully specified in *Study Setup User Guide, Conditional Maps*.
	
	The file contains one or more specifications, each consisting of a condition definition followed by one action to be applied if the condition is met. Entries in the file have the general appearance of:
	
	`IF|Visit List|Plate|Field|Value`
	`AND|Visit List|Plate|Field|Value`
	`A or E`
	
	Each condition is followed by either the letter 'A' (abort all follow-up), or 'E' (early termination of the current cycle). The termination date is defined as the visit date of the visit that triggered the condition, specifically the visit specified in the `IF` statement.

Example	`IF|0|1|22|6`
	`A`
	
	`IF|6|1|22|5`
	`AND|6|9|13|>0`
	`AND|6|9|36|!1`
	`E`
	
	This example, consists of 2 conditional specifications. The first specification indicates that, if field 22 on plate 1 at visit 0 equals 6, then all follow-up terminates as of the visit date for visit 0. Visits scheduled to occur before this date are still expected, but visits scheduled following this date are not.
	
	The second specification indicates that, if field 22 on plate 1 at visit 6 equals 5, and field 13 on plate 9 at visit 6 is greater than zero, and field 36 on plate 9 at visit 6 is not equal to 1, then the current cycle terminates, i.e. the cycle in which visit 6 is defined; with the termination date being the visit date of visit 6. Any visits in this cycle (or in previous cycles) that were scheduled to occur before the termination date are still expected, but visit within this cycle scheduled following this date are not. On termination of a cycle, subject scheduling proceeds to the next cycle in the visit map, if there is one.

Table 2.27. `DFCRFType_map` - CRF type map

Usual Name	`DFCRFType_map`
Type	clear text
Created By	**DFsetup**
Used By	**DFbatch**, **DFprintdb**, **DFimport.rpc**, **DFexport.rpc**, **DFcmpSchema DFcmpSchema**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	2
Description	Each record in the CRF type map has two fields, an acronym or short form (1st field), and a descriptive label (2nd field). The CRF type acronym and label appear in the Import CRFs dialog. The CRF type label appears in the **DFexplore** Preferences dialog. This file is optional. If it does not exist, CRF Types are not used for this study.

Example	`PAPER|Print Version`
	`CHINESE|Chinese`
	`ENGLISH|English`
	`SWEDISH|Swedish`
	`FRENCH|French`
	`SPANISH|Spanish`

Table 2.28. `DFcrfbkgd_map` - CRF background map

Usual Name	`DFcrfbkgd_map`
Type	clear text
Created By	**DFsetup**
Used By	**DFprintdb**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	3
Description	Each record in the CRF background map has three fields: the visit number with the background to be repeated (1st field), the list or range of visit numbers where the background will be repeated (2nd field), and an optional comment field (3rd field). This file is optional. If it does not exist, the default CRF will be displayed for visits not tagged during the Import CRFs step. If no default CRF has been imported, the CRF background will be blank for untagged visits.

Example	`10|11,13-14,16-17,19-20|Quarterly visits`
	`12|15,18|Annual visits`
	`22|25,28|Annual lab work`

Table 2.29. `DFedits.bin` - published edit checks

Usual Name	`DFedits.bin`
Type	binary
Created By	**DFsetup**, **DFcompiler**
Used By	**DFexplore**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	NA
Fields/Record	NA
Description	This file contains an internal, binary equivalent of the edit checks stored in the plain text `DFedits` file. This binary format contains no external references to other included files and is a more compact representation that can be more efficiently transmitted to and interpreted by **DFexplore** clients. The `DFedits.bin` file is created when Publish is selected in **DFsetup**'s edit checks dialog. This file is the only edit checks file used by **DFexplore**.

Table 2.30. `DFfile_map` - file map

Usual Name	`DFfile_map`
Type	clear text
Created By	**DFsetup**
Used By	**DFserver.rpc**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	4
Description	The file map lists all of the unique plate numbers used in a particular study database. The study server uses this file at start-up to determine which database files it may need to initialize and allocate file descriptors for. In addition to the listed plate numbers, the study server also allocates file descriptors for the new records file () and the query data file (). The format of this file is one record for each plate defined in the study setup. Each record has 4 fields. The first field of the record is the plate number, leading zero-padded to three digits. The second field is a textual description of the plate from the user-supplied definition in **DFsetup**. The textual part is displayed in the plate selection dialogs that can be found in various study tools. The third field identifies how the visit/sequence number key field is coded for that plate. A code of 1 means that the visit/sequence number is in the barcode; a code of 2 means that it is the first data field on the data entry screen for that plate. Any other code is an error. The fourth field indicates whether the arrival of this plate signals early termination of study follow-up for the subject, as would for example the arrival of a death report. A code of 1 appears if the plate signals early termination, otherwise the code is 2.

	The records in the file map do not have to be sorted in increasing plate number order as the file is internally sorted by the study database server at start-up time.

Example	`001|Dosage of Study Drug (DOST-2)|2|2`
	`002|Concomitant Medication (COM)|1|2`
	`003|Written Consent (CONS-w)|1|2`
	`005|Diagnosis (DSM-III-R)|1|2`
	`006|Psychiatric History (PSH)|1|2`
	`200|Death Report|1|1`

Table 2.31. `DFlogo.png` - study logo, for reports

Usual Name	`DFlogo.png`
Type	PNG
Created By	NA
Used By	**DFexplore**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	NA
Fields/Record	NA
Description	A study logo is a small PNG file, maximum dimension is 64 pixels tall and 128 pixels wide. The study logo is displayed in the top-left corner of report output in **DFexplore**, in the data entry screen header of DFweb, in the studies list displayed during login, and in several **DFadmin** dialogs. If no study logo is available, the study name is written to the header of each report output. The study logo must be created outside of DFdiscover - there is no interface for creating it. Once the file is created, it must be copied to the study folder and saved as `lib/DFlogo.png`.

Table 2.32. `DFlut_map` - lookup table map

Usual Name	`DFlut_map`
Type	clear text
Created By	**DFsetup**
Used By	**DFexplore**, **DFbatch**
Field Delimiter	|
Record Delimiter	`\n`
Comment Delimiter	NA
Fields/Record	2
Description	Lookup tables are used to select results from a list of pre-defined values and insert them into DFdiscover data fields. Lookup tables can also be defined for the query, query note, and reason fields to allow users to select pre-specified text for these fields. Lookup tables are described in Lookup tables. A study setup may use multiple lookup tables and so the lookup table map is used to associate simple table names with more complex and lengthy full pathnames of the actual lookup tables.

	Each record in the lookup table map has a lookup table name, followed by a `|`, and a filename containing the lookup table. DFdiscover will search for the lookup table filename first in the `$(STUDY_DIR)/lut` directory and if that fails in the `/opt/dfdiscover/lut` directory. The table name is a symbolic name that can be referenced in edit checks. The special table names `QC`, `QCNOTE` and `QCREPLY` are used to associate a lookup table with the detail, note and reply fields, respectively, in the **DFexplore Field** > **Add/Edit/Reply Query** dialogs. The special table name `REASON` is used to associate a lookup table with the reason code and text for data changes.

Example	`QC|DF_QClut`
	`QCNOTE|DF_QCnotelut`
	`QCREPLY|DF_QCreplylut`
	`REASON|DF_Reasonlut`
	`MEDS|meds.dict`
	`COSTART|costart.dict`
	`WHO|who.dict`

Table 2.33. `DFmissing_map` - missing value map

Usual Name	`DFmissing_map`
Type	clear text
Created By	**DFsetup**
Used By	**DFbatch**, **DFprintdb**, **DFimport.rpc**, **DFexport.rpc**, **DFcmpSchema**, **DF_QCupdate**, **DF_XXkeys**, **DF_stats**, **DFsas**
Field Delimiter	`|`
Record Delimiter	`\n`
Comment Delimiter	NA
Fields/Record	2
Description	Each record in the missing value map has two fields, the missing value code (1st field), and a descriptive label for the code (2nd field). The missing value code appears verbatim in any data field which has been identified as missing with that code. The missing value map lists all missing value codes used in the study. These codes can be entered into any data field by selecting the desired code from the list available under **Field** > **Mark Field Missing** in **DFexplore**. Note that the field delimiter, `|`, which is used in all DFdiscover databases, can not be used as a missing value code (for obvious reasons). Any other single (or multiple) character is acceptable. This file is optional. If it does not exist, a single missing value of * (asterisk) - `Not Available` is available by default. If it does exist but is empty, then no missing values are permitted. **Changes to the missing value map for an in-progress study** DFdiscover determines if each data value is a missing value code by comparing the value with each of the missing value codes in the map. If there is a match, DFdiscover handles that data value as a missing value. If there is no match, the data value is handled as a normal data value. This is important to remember because changes to the missing value map after a study has started and data has been entered can result in DFdiscover handling data values in a manner which is different from the handling when the value was originally entered. For

	example, defining `.A` as a missing value code at study start and then subsequently deleting that code from the missing value map will result in DFdiscover treating each occurrence of `.A` in the current database as a normal data value.

Example	`*|Not Available`
	`.|Not Applicable`
	`-|Temporarily Unavailable`
	`.U|Unknown`

Table 2.34. `DFpage_map` - page map

Usual Name	`DFpage_map`
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCreports**, **DFexplore**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	3
Description	This file is optional for a study. If defined, it must be located in `$(STUDY_DIR)/lib/DFpage_map`. The page map allows one to specify non-default labels, to identify visits and CRF pages, on Query Reports and in **DFexplore**'s subject binder view. If a page map file is not defined, queries and pages in the binder are identified by the visit number and plate number keys of the CRF. The first record in a page map contains only a single field which specifies a text label to be used as a title over the queries. The default label is: `PLATE SEQNO` This label appears at the top of the Fax/Refax List and Question & Answer List sections of the Query Reports. The remaining records describe the text labels to be used in place of the default plate and visit number identifiers. The first field is the plate number, the second field is the visit/sequence number, and the third field is the substitution to be used for that plate and visit/sequence combination. The third field can contain %P and %S which are replaced with the plate number and the visit/sequence number fields from the query, respectively. It may also contain parts of the plate number and/or sequence number fields by using the notation `%{n.P}`, `%{P.n}`, `%{n.S}`, or `%{S.n}`. `%{n.P}` which returns the leading n digits of the plate number while `%{P.n}` returns the trailing n digits of the plate number. Similarly, `%{n.S}` and `%{S.n}` produce n leading and trailing digits of the sequence number. The third field may also contain the notation %# which is replaced with the value stored in field n of the data record matching the specified plate and sequence number. Additionally, when using the %# notation, and for data fields that have a data type of choice or check, it is possible to request that the reported value be decoded by using the `%n:d` notation. This substitutes the label associated with the value, instead of the value itself. [a] When a Query Report is created, those queries whose plate and visit numbers match the first and second fields, will be identified on the Query Report by the label which appears in the third field.

	If either the first field or second field contains a *, all values for that field that have not yet matched a previous rule will use the format in the third field. For more information, see *Study Setup User Guide, Page Map*.

Example	`PAGE (PLATE-SEQ)`
	`018|001|MED VISIT1`
	`*|001|VISIT1 (%P-%S)`
	`025|*|TERM (%P-%S)`
	`*|*|(%P-%S)`
	
	Note how the last rule catches all plate and visit/sequence pairs that were not previously matched.

[a]To implement %# or %n:d, the data record must be available. This is always true for Query Reports. However, in **DFexplore** only the currently visible data record is available at any moment. The result is that in the subject binder, for any record other than the current record, use of %# or %n:d is substituted with ???. This limits the usefulness of this notation in **DFexplore**.

Table 2.35. DFqcsort - Query and CRF sort order

Usual Name	DFqcsort
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCreports**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	3

Description	A query sort order map can be specified to control the order in which queries appear on the reports created by **DF_QCreports**.
	
	If DFqcsort is not defined, queries will appear on Query Reports sorted by ascending subject ID, then visit number, then plate, and finally data field number. A different sort order can be specified to reorder queries from particular visits and/or plates. For example, one might want all queries from adverse event reports to appear at the top of each subject's list. This can be done with DFqcsort.
	
	The file contains one or more records in the following format:
	
	`plate#|visit#|sort_order#`
	
	where the *sort_order#* is an integer-valued sort priority such that a lower value indicates an earlier sort order. There is no minimum or maximum value for *sort_order#*, hence negative numbers can be used to give higher priority to *sort_order#*s of zero or greater. If two or more entries assign the same *sort_order#*, those entries are sorted in the default manner of ascending plate number within ascending visit number.
	
	Within each record the plate number, or the visit number, can be replaced by * to signify all plates for a specified visit, or all visits for a specified plate. In such cases queries are sorted numerically on the unspecified field within the specified field. For example:
	
	`12|*|1`

	specifies that, for each subject, all queries on plate 12 are to be given a sort priority of 1 as compared to other queries. Since no visit number is specified, if queries appear on plate 12 at more than one visit for a given subject, they will appear on the Query Report sorted by visit/sequence number. * may also be specified for both plate and visit numbers (to catch all plate and visit combinations that were not otherwise specified), but this is not necessary as this is given the lowest sort priority by default. Note that while sort order control is provided over plates and visits, no control is provided at the individual field level. Queries on a given plate are always sorted in field number order. Also queries and records are always sorted by ascending subject ID. Thus the control provided here does not allow for all possible sort orders. It merely provides a mechanism for controlling query ordering by plate and visit numbers.
Example	`12|*|1` ❶ `*|1|2` ❷ `25|2|3` ❸ `13|2|4` ❹ `5|2|5` ❺ `*|2|6` ❻ `*|*|7` ❼ ❶ Queries on plate 12 of any visit appear first ❷ Queries for visit 1 appear next (in plate number order) ❸ Queries on plate 25 of visit 2 appear next ❹ Queries on plate 13 of visit 2 appear next ❺ Queries on plate 5 of visit 2 appear next ❻ Queries on all remaining plates of visit 2 appear next ❼ All the rest appear in the default order (i.e. plate# within visit#)

Table 2.36. `DFqcproblem_map` - Query category code map

Usual Name	`DFqcproblem_map`
Type	clear text
Created By	**DFsetup**
Used By	**DFbatch**, **DFprintdb**, **DFimport.rpc**, **DFexport.rpc**, **DFcmpSchema**, **DF_QCupdate**, **DF_XXkeys**, **DF_stats**, **DFsas**, **DFexport**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	4
Description	Each record in the Query category code map has four fields, the category code (1st field), the descriptive label (2nd field), the auto-resolve value (3rd field), and the sort value (4th field). The query category code appears verbatim in any data field which has been assigned a query with that code. The pre-defined categories are assigned integer codes from 1-6 and 21-23 (inclusive). User-defined categories must be assigned integer codes ranging from 30-99 (inclusive). Category codes must be unique. The problem labels must have a length ranging from 1-20 characters (inclusive), must be unique, and are case insensitive.

	The auto-resolve field may be set to No (0) or Yes (1). With auto-resolve set to Yes, an outstanding query with this category code will be automatically resolved if a new reason is added to the corresponding data value.
	
	The sort value may be set to any integer value between -2147483648 and 2147483647. Category types are sorted in ascending order by sort value, then by code.
	
	The query category code map lists all query category codes in the study. A query with one of these types can be entered into any data field by selecting the desired type from the category code list available under **Field** > **Add Query...** in **DFexplore**.
	
	When a new study is started, the file is created. By default, the file is populated with the following:
	
	`1|Missing|1|0`
	`2|Illegal|1|0`
	`3|Inconsistent|1|0`
	`4|Illegible|1|0`
	`5|Fax Noise|1|0`
	`6|Other|1|0`
	`21|Missing Page|0|0`
	`22|Overdue Visit|0|0`
	`23|EC Missing Page|0|0`

Example	`1|Missing|1|0`
	`2|Illegal|1|0`
	`3|Inconsistent|1|0`
	`4|Illegible|1|0`
	`5|Fax Noise|1|0`
	`6|Other|1|0`
	`21|Missing Page|0|0`
	`22|Overdue Visit|0|0`
	`23|EC Missing Page|0|0`
	`30|Clinical QC|1|1`
	`50|Needs Review|0|1`
	`37|Refuted|1|2`

Table 2.37. `.DFreports.dat` - reports history

Usual Name	`.DFreports.dat`
Type	clear text
Created By	**DFexplore**
Used By	**DFexplore**
Field Delimiter	`|`
Record Delimiter	`\n`
Comment Delimiter	#
Fields/Record	9+
Description	Users create and save report history lists (including options) in much the same way that they create and save task lists.

	The reports history list for ail study users is stored in this file in the study `lib` directory. Each history list is represented by a single record in this file. Each user may have more than one history list. History lists are created in **DFreport** by executing the desired reports and then saving the history list. There is no text-based interface to this file or its contents.

Table 2.38. `DFschema` - database schema

Usual Name	`DFschema`[a]
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCupdate**, **DF_ICschema**, **DF_ICrecords**, **DF_SSvars**, **DF_SSschema**, **DFcmpSchema**, **DFimport.rpc**, **DFsas**, **DFsqlload**
Field Delimiter	`\n`
Record Delimiter	`\n\n`
Comment Delimiter	NA
Fields/Record	5+
Description	The schema, or data dictionary, is generated/updated automatically by **DFsetup** whenever a save is required for the study definition. Each field is composed of a key letter (with a leading % character) to indicate the field type, a space character, and the value of the field. This is essentially UNIX 'refer' format. The defined key letters and corresponding field types are listed in the Table 2.40, “Schema codes and their meaning”. The `T` code requires additional explanation. Its value is the variable type (one of `choice`, `check`, `int`, `date`, `string`) followed by the setup style name. If the variable type is `date`, the style name is followed by the variable pivot year and the date imputation method and whether the date is used for scheduling purposes or not. The pivot year represents the first possible year in those dates where the year is only 2 digits. The imputation method is one of: 0 never - no imputation is allowed 1 start - impute dates to the beginning of the month or year 2 middle - impute dates to the middle of the month or year 3 end - impute dates to the end of the month or year The scheduling attribute is unused by most programs except for **DF_QCupdate** which searches the schema file for date fields which use the `Visit Date` attribute. These date fields are used to determine subject visit scheduling. **DFsas** also uses this information to determine the correct year value to include in the `YEARCUTOFF` option statement. Each study schema begins, in order, with records defining values for the `S`, `B`, `N`, `Y` and then `Z` codes. If study is linked with another study then a and b fields are included identifying production and development study numbers. If tag definitions for custom properties are given, then one or more `z` records follow. These definitions document the relationship between the standard name of the custom property and a tag that is defined to replace the standard name in future use. For example, `%z DFSTUDY_USER1 TITLE` defines `TITLE` as the tag for the custom property with the standard name of `DFSTUDY_USER1`. Where values are defined for custom properties, `y` records follow. Such definitions connect a custom property

	to a value. The custom property is referenced by it's tag, is one is defined, otherwise by the standard name. For example, `%y TITLE Acme Pharma Next Gen Skin Rejuvenator` defines `Acme Pharma Next Gen Skin Rejuvenator` as the value for the `TITLE` custom property. Thereafter, each new plate definition begins with a record defining values for the `P`, `t`, `n`, `E`, and `R` codes. Plate definitions may also include `y` and `z` records for plate level custom properties. This is followed by records for each variable in that plate. Each variable has a record that begins with an `I` field, followed by at least `i`, `V`, `D`, `W`, `w`, `T`, and `A` fields. The `v`, `F`, `L`, `H`, `J`, `j`, `K`, `k`, `g`, `h`, `s`, `c`, and `C` fields are included only if applicable. Variable definitions may also include `y` and `z` records for variable level custom properties.

Example	`%S 254`
	`%N 12`
	`%B 1990`
	`%Y 0 0`
	`%Z 40`
	
	`%P 1`
	`%p Blood Pressure Screening Visits`
	`%n 35`
	`%t simple`
	`%E 1`
	`%R PrintCRF.shx`
	
	`%I 1`
	`%i 10`
	`%V DFstatus1`
	`%v DFSTATUS`
	`%D DFdiscover Record Status`
	`%T choice SimpleChoice`
	`%A required`
	`%W 1`
	`%L 0~6`
	`%C 0 lost`
	`%C 1 final`
	`%C 2 incomplete`
	`%C 3 pending`
	`%C 4 FINAL`
	`%C 5 INCOMPLETE`
	`%C 6 PENDING`
	
	`%I 2`
	`%i 11`
	`%V DFvalid1`
	`%v DFVALID`
	`%D DFdiscover Validation Level`

[a]This file is present for users and programs that require backwards compatibility and are not able to read the JSON study definition. This file may be removed in a future release.

Table 2.39. `DFschema.stl` - database schema styles

Usual Name	[a]
Type	clear text
Created By	**DFsetup**
Used By	**DFsetup**
Field Delimiter	`\n`
Record Delimiter	`\n\n`
Comment Delimiter	NA
Fields/Record	2+
Description	This file is very much like the study schema, DFschema - database schema, but instead of variable definitions it simply catalogs all of the variable styles used in **DFsetup** to define new variables. Like `DFschema` the file is generated/updated automatically by **DFsetup** whenever a save is required for the study definition. Note that the style schema lists only field types that are defined by the style itself. It omits those definitions that are specified at the variable level.

Example	`%S 254`
	`%N 51`
	
	`%I 1`
	`%T int SimpleNumber`
	`%A optional`
	
	`%I 2`
	`%T date SimpleDate 1940 0`
	`%A optional`
	`%W 8`
	`%F dd/mm/yy`
	
	`%I 3`
	`%T string SimpleString`
	`%A optional`
	
	`%I 4`
	`%T choice SimpleChoice`
	`%A optional`
	`%L $(choices)`
	`%l 0`
	`%c 0`

[a] This file is present for users and programs that require backwards compatibility and are not able to read the JSON study definition. This file may be removed in a future release.

Table 2.40. Schema codes and their meaning

Code	Relevance	Meaning
S	Study	DFdiscover study number
a	Study	production study number

Code	Relevance	Meaning
b	Study	development study number
B	Study	year in which study database was defined
e	Study	Run edit checks in View mode
N	Study	the total number of user-defined plates in the setup (this excludes plate 0 (new records), plate 510 (reasons for data change), and plate 511 (queries). In `DFschema.stl` file this represents total number of styles defined in the study
U	Study	DFdiscover version used to create setup
u	Study	DFdiscover version used on last setup change
Y	Study	reason is required for data change for specified fields (0=per field), for all fields (2=always), or for no field (1=never). These values are followed by the value for the 'Only if changing a non-blank value' setting; 0=no, 1=yes.
Z	Study	field description maximum length (25 or 40)
M	Study	number of new patients to be listed in patient binder
m	Study	enable Start New Subject dialog
P	Plate	plate number
n	Plate	total number of fields per plate; this includes the 6 DFdiscover default fields present on all records (i.e., DFstatus, DFcreate, DFmodify, etc.)
p	Plate	plate label
E	Plate	is the sequence number predefined (code 1) or is it the first data field (code 2)?
R	Plate	plate arrival trigger. This tag identifies an executable shell script or program, located in the study ecbin or DFdiscover ecbin directories, which is executed on plate arrival.
t	Plate	does plate trigger early termination; "simple" = plate does not trigger early termination, "term" = plate triggers early termination
I	Field/Style	the field order number or the style index in the `DFschema.stl` file
i	Field	the number that uniquely identify fields within a study
V	Field/Style	alias
v	Field/Style	name
D	Field/Style	description
g	Field/Style	the minimum validation level after which any changes to the data value will require a reason. This code is optional, or may be present and have the value 0, in which case a reason for a data change is never required. If a minimum validation code between 1-7 is present, it will be followed by the value for the 'Only if changing a non-blank value' setting; 0=no, 1=yes.
h	Field/Style	field visibility
L	Field/Style	legal values; where `$(ids)` has been used as a legal range definition for patient id variables, the literal `$(ids)` will be reported.
A	Field/Style	field optionality
F	Field/Style	format
H	Field/Style	help message
W	Field/Style	maximum number of stored characters
w	Field/Style	maximum number of displayed characters
J	Field/Style	edit check(s) on field entry

Code	Relevance	Meaning
K	Field/Style	edit check(s) on field exit
j	Field/Style	edit check(s) on plate entry
k	Field/Style	edit check(s) on plate exit
c	Field/Style	code value and label definition for no choice
C	Field/Style	code value and label definition
s	Field/Style	number of fields to skip and condition
T	Field/Style	a compound value containing, in order: • data type, one of string, int, date, choice, check, time • style name (which may contain spaces) • for dates only, the cutoff year • for dates only, the imputation method • for dates only, one of NonSched or VisitDate
r	Field/Style	field's module name, instance number and description.
X	Field/Style	is field constant (0=no, 1=yes) and constant value (if constant)
y	Study/Plate/ Field/Style	value for a custom property (tag)
z	Study/Plate/ Field/Style	tag for a custom property, useful to replace a standard name

Table 2.41. `DFsetup` - study definition

Usual Name	`DFsetup`
Type	JSON
Created By	**DFsetup**
Used By	**DFsetup**, **DFexplore**, **DFprintdb**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	NA
Fields/Record	NA
Description	The setup file contains the study definition in JSON format that can be read and written efficiently by **DFsetup**. It keeps the internal state of the program together with all of the information about study, page, and variable definitions. Many other study configuration files, such as the ICR tips file and study database schema, are constructed from this internal representation. **Internal use only** This file format is intended to be written only by **DFsetup** only. It may be read and processed by other programs that need to determine setup information but its internal structure is subject to change without notice.

Table 2.42. `DFserver.cf` - server configuration

Usual Name	`DFserver.cf`
Type	clear text
Created By	**DFadmin**
Used By	**DFserver.rpc**
Field Delimiter	=
Record Delimiter	\n
Comment Delimiter	#
Fields/Record	2
Description	Each study database server is configured by this file. The study server configuration keywords and their meanings are given in the Table 2.43, "`DFserver.cf` configuration keywords".

Example	`STUDY_NUMBER=254`
	`STUDY_NAME=DFdiscover Acceptance Test Study`
	`STUDY_DIR=/opt/studies/val254`
	`PAGE_DIR=$(STUDY_DIR)/pages`
	`WORKING_DIR=$(STUDY_DIR)/work`
	`PRINTER=hp4000`
	`THRESHOLD=500000`
	`STUDY_URL=http://www.ourstudy.com/index.html`
	`LOCAL_CACHE=1`
	`VERSION_STRICT=0`
	`AUTO_LOGOUT=5|30`
	`ADD_IDS=1||`
	`VERIFY_IDS=0|`

Table 2.43. `DFserver.cf` configuration keywords

Keyword	Meaning
`STUDY_NUMBER`	the unique study number identifier. Legal values are in the range 1 to 999 inclusive.
`STUDY_NAME`	a descriptive name or acronym for the study. This name appears, among other places, in the toolbox frame label. Its recommended length should be no more than 20 characters.
`STUDY_DIR`	the study root (highest-level) directory. All other study related directories should be sub-directories of this directory and should accomplish this by referencing `$(STUDY_DIR)` in their value. This directory, by default, is writable by both user and group and is owned by `datafax`.
`PAGE_DIR`	the root directory for all CRF image files. This directory has sub-directories named by year and week within year. Within each of these sub-directories each CRF page image is numbered sequentially by page number within fax number. By default, this directory is defined as `$(STUDY_DIR)/pages` and is writable only by user `datafax`.
`WORKING_DIR`	the root directory for all study specific temporary or work files. Any temporary files created by report programs should be written in this directory. By default, this directory is defined as `$(STUDY_DIR)/work` and is writable only by user `datafax` and group.
`PRINTER` or `PRINT_CMD`	default printer for the study.
`THRESHOLD`	the minimum number of Kilobytes of free disk space in the partition containing the study data directory. During normal operation, the study server will exit when the free disk space in this partition drops below

Keyword	Meaning
	the threshold value. Further connections to the study server will fail until additional disk space is made available or the threshold is reduced.
AUTO_LOGOUT	a compound value expressed as two numbers delimited with a |. Both numbers represent a time interval expressed in minutes. The first number is the minimum number of minutes that any study user can choose for their auto logout interval; the second is the maximum number of minutes.
VERSION_STRICT	a true (1) or false (0) value specifying whether the study server accepts client connections from the current minor release version only, or client connections with any minor release version. The major release version must always match.
LOCAL_CACHE	a true (1) or false (0) value specifying whether the study server allows a client application to cache, in local storage, setup information (but never data) about the study.
STUDY_URL	for future use only, and is currently not used.
ADD_IDS	for future use only, and is currently not used.
VERIFY_IDS	for future use only, and is currently not used.

Table 2.44. DFsubjectalias_map - subject alias map

Usual Name	DFsubjectalias_map
Type	clear text
Created By	**DFsetup**
Used By	All DFdiscover applications, except for legacy reports
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	2
Description	This file is optional for a study. If defined, it must be located in $(STUDY_DIR)/lib/DFsubjectalias_map. The subjectalias map allows the specification of "aliases" (descriptive labels), each up to 30 UNICODE characters in length, that may be used in place of the standard numeric subject identifier. If a subjectalias map is defined, and has been enabled as a preference for the current user, the subject alias appears everywhere in DataFax that the numeric subject ID would normally appear. Otherwise, the numeric subject ID is displayed. [a] The file contains zero or more rows, each row containing 2 fields and the fields are delimited by |. The value in the first field is the numeric subject ID and the value in the second field is the matching alias for that subject ID. Each subject ID must be unique and each subject alias must also be unique. For more information, see *Study Setup User Guide, Subject Alias Map*.
Example	150040|T1-B-40 150041|T1-B-41 150042|T1-B-42 150043|T1-B-43 150044|T1-B-44 150045|T1-B-45 200006|T2-A-6 200007|T2-A-7 200008|T2-A-8

	200009|T2-A-9 200010|T2-A-10

[a]There are a few exceptions, for example subject aliases are not implemented in any legacy reports.

Table 2.45. `DFsubjectalias_map.log` - subject alias change log

Usual Name	`DFsubjectalias_map.log`
Type	clear text
Created By	**DFserver.rpc**;
Used By	**DFserver.rpc**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	7
Description	This file is optional for a study. If defined, it must be located in `$(STUDY_DIR)/lib/DFsubjectalias_map.log`. The contents of the file are managed entirely by **DFserver.rpc** - it is not meant for external editing. The file contains zero or more rows, each row containing 7 fields where the fields are delimited by |. Each row logs the addition, editing or deletion of a single, specific subject alias.
Example	200703|174748|userB|n|500003|T5-B-3| 200703|180202|userB|n|250009|T2-A-259| 200703|180219|userB|c|250009|T25-A-9|T2-A-259 200722|112345|userA|d|200004||T2-A-4 200722|112345|userA|d|200005||T2-A-5

Table 2.46. Field definitions for `DFsubjectalias_map.log`

Field #	Description	Required	Maximum Size
1	Date	yes	6 digits
2	Time	yes	6 digits
3	Name	yes	up to 16 characters
4	Log Type (n = new alias, c = change alias, d = delete alias); for new, field 6 is required; for change, fields 6 and 7 are required; for delete, field 7 is required	yes	1 character
5	Subject ID	yes	15 digits
6	Subject Alias (new)	no	30 UNICODE characters
7	Subject Alias (old)	no	30 UNICODE characters

Table 2.47. `DFtips` - ICR tips

Usual Name	`DFtips`
Type	clear text
Created By	**DFsetup**

Used By	**DFinbound.rpc**
Field Delimiter	\n
Record Delimiter	.\n
Comment Delimiter	#
Fields/Record	3+
Description	The purpose of this file is to document the location, size, and type of each data field on each study plate. This information is parsed and used by during its ICR processing of each CRF image file. The tips file begins with 4 comment lines which identify the study number, name, number of CRF plates that have been defined and the date on which the tips file was created. This is followed by the keyword DELIMITER which identifies the single character delimiter used to separate fields in data records. The current implementation of DFdiscover accepts only the | delimiter. The above header information is followed by N plate definitions, where N is the number of unique plates defined for the study. Each plate definition begins with plate specific information followed by M variable definitions, where M is the number of variables defined on that plate. Each variable definition includes: the data field number and unique name, the data type, legal values (if any were specified), the size of the boxes, or VAS line, used to record the data field, and its location on the CRF image that was used to define the plate in **DFsetup**. Each field in the tips file has a leading keyword separated from the value by a \t (TAB) character. The plate specific keywords are listed in Table 2.48, "DFtips plate specific keywords". The keywords recognized for variable definitions are listed in Table 2.49, "DFtips variable specific keywords".
Example	

```
# Study Number: 253
# Study Name: Demo Study 253
# Total Pages: 14
# Created: Wed Dec  1 12:33:29 2004
DELIMITER       |
PAGE    1
PLATE   1       # Blood Pressure Screening Visits
SEQ_CODE        1
PREOP   echo "$image $data" >> /tmp/test
DO_ICR  2
# FAX: plt001
FIELD   1 # ID001
TYPE    int
LEGAL   $(ids)
PART    106 84 2 50 25
PART    167 84 3 74 25
.
FIELD   2 # PINIT001
TYPE    string  skip
PART    380 84 3 74 25
.
FIELD   3 # AGE
TYPE    int
LEGAL   21-90
PART    79 182 2 50 25
```

```
.
FIELD   4 # SEX
TYPE    choice
LEGAL   0,1,2, blank
PART    0 0 0 0 0 # blank
PART    277 189 1 1 15 # male
PART    277 212 1 2 15 # female
.
FIELD   5 # RACE
TYPE    choice
LEGAL   0-65535
PART    0 0 0 0 0 # no choice
PART    464 188 1 1 15 # Caucasian
PART    464 213 1 2 15 # African American
PART    464 238 1 3 15 # Asian
PART    464 263 1 4 15 # Other
.
FIELD   6 # RACEOTH
TYPE    string  skip
PART    588 257 1 107 26
.
FIELD   7 # S1DATE
TYPE    date
FORMAT  dd/mm/yy
DATES   1940 0
LEGAL   01/01/01-today
PART    172 330 2 49 25
PART    232 330 2 50 25
PART    295 330 2 49 25
```

Table 2.48. `DFtips` plate specific keywords

Keyword	Description
PAGE	an internal page number that simply sequences the plate definitions
PLATE	the unique plate number that is being defined
SEQ_CODE	a code to indicate whether the visit/sequence number is in the barcode or the first data field. Legal values are: 1=barcoded, 2=first data field.
PREOP	a shell command that is to be executed before the ICR processing for any occurrences of this plate begins. This keyword is optional.
POSTOP	a shell command that is to be executed after the ICR processing for any occurrences of this plate ends. This keyword is optional.
DO_ICR	a code that indicates whether or not ICR processing should be performed on occurrences of this plate. Legal values are: 1=yes perform ICR, 2=no do not perform ICR.

Table 2.49. `DFtips` variable specific keywords

Keyword	Description
FIELD	the data field number as it is sequenced on the form. This will not be the same number as the field number that the data value is eventually stored in. The first data field is the visit/sequence number if SEQ_CODE=2; otherwise, the first data field is the subject ID. Hence to determine the actual field number in the database record, add 5 if SEQ_CODE=2; and add 6 if SEQ_CODE=1.

Keyword	Description
TYPE	data field type. Legal values are: int=integer, string=text fields, date=date, choice=choice, check=check, vas=visual analog scale, and numeric=a rectangular box containing 2 or more digits. The numeric data type is internal to the tips file and is not used anywhere else in DFdiscover. They are defined in **DFsetup** as strings with pre-printed numerals, although they can also be used for hand-written numbers. The type record ends in the keyword 'skip' if the field is not to be ICRed. Strings and hidden fields (i.e. fields which do not appear on the paper CRF) will be automatically marked as ICR skips by **DFsetup**.
FORMAT	the format, if any, that is to be applied to the ICRed value before it is added to the database record. Typical values include: mm/dd/yy (which inserts the '/' delimiters into dates), nn.n (which inserts a decimal point).
DATES	the pivot year and imputation method to be used for interpreting 2-digit years (applicable only if the current field is of type date). The imputation method is one of: `0` never - no imputation is allowed `1` start - impute dates to the beginning of the month or year `2` middle - impute dates to the middle of the month or year `3` end - impute dates to the end of the month or year
LEGAL	the legal value definition for the field. This is the same definition defined in the study schema. If an ICRed value is illegal, the value for that field is left blank in the data record generated by the ICR software.
PART	defines the location, size and coding for each part of the data field. String, check, numeric and VAS fields consist of just one part but choice fields have a part definition for each choice box and dates and ints may be comprised of more than one separate parts. Each part record consists of 5 or 6 space delimited components. For all field types the first 2 components are the x and y location of the field on the CRF plate, with x increasing from left to right and y increasing from top to bottom. The location is given in units corresponding to standard fax resolution (i.e. 102 units per inch horizontally and 98 units per inch vertically). For each part the x value is 8 units left of the first box or VAS line, and the y value gives the location of the middle of the box or VAS line. The meaning of the remaining components depends on the field type. For int, date, and string fields they are: the number of boxes in the part, the total length of the part (enclosing all boxes) and the height of the part. For numeric fields they are: the maximum number of digits in the data field, the total length of the rectangular box and height of the box. For VAS scales they are: the length of the scale, the minimum and maximum values at the ends of the scale, and the precision (i.e. number of decimal places) in the stored value. For check fields they are: the number of boxes (always 1), the code value to be stored in the database if the box is not check, the code if checked, and the edge dimension of the box. And for choice fields they are: the number of boxes (always 1), the code value to be stored in the database if the box is checked, and the edge dimension of the box. For check and choice fields each box is assumed to be square. Choice fields also have a special PART record in which all components are zero expect for the 4th one which specifies the code value stored in the database if none of the choice boxes are checked.

Table 2.50. `DFvisit_map` - visit map

Usual Name	`DFvisit_map`
Type	clear text
Created By	**DFsetup**
Used By	**DF_QCupdate**, **DF_ICvisitmap**, **DF_SSvisitmap**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA

Fields/Record	12
Description	The visit map file describes the subject assessments to be completed during the study, the timing of these assessments, and the pages of the study CRFs which must be completed at each assessment. Each assessment is identified by a visit type. There must always be a baseline visit which is typically the date on which the subject qualified for entry to the trial and was randomized. There must also be a termination visit which ends study follow-up. Between baseline and termination there are often several scheduled visits, subject diaries, laboratory tests, and perhaps a few unscheduled visits. At each of these visits there will be a set of required (and possibly optional) forms to be completed. Each visit is defined in a single record of the visit map. The fields in each record are described in Table 2.51, "DFvisit_map field descriptions". For additional information regarding visit maps, refer to *Standard Reports Guide, DF_QCupdate* and *Study Setup User Guide, Visit Map*.

Example	A simple 4-visit visitmap:
	
	`0|B|Baseline|1|9 (mm/dd/yy)|0|0| 1 2 3 4 5 6 7 8||99|3 4 1 2 5 6 8 7`
	`10|S|One Week Followup|9|9 (mm/dd/yy)|7|0| 9 10 14||||`
	`20|S|Two Week Followup|9|9 (mm/dd/yy)|14|0| 9 10||||`
	`30|T|Termination Visit|9|9 (mm/dd/yy)|21|0| 11 12||||`

Table 2.51. DFvisit_map field descriptions

Field #	Contains	Description
1	visit number	the unique visit number, which can be any number between 0 and 65535 inclusive. For all scheduled visits, (types P, B, S, T), the numerical value of visit numbers must correspond to the sequential ordering of the visits in time.
2	visit type	a 1 character code for the type of visit. Legal values are enumerated in Table 2.52, "Visit codes and their meaning".
3	visit label	a short (maximum 40 character) textual description of the visit that will be used in quality control reports to identify the visit when it is overdue.
4	visit date plate	the plate on which the visit date can always be found. This must be one of the required plates listed in field 8. Obviously other plates will have visit dates, however, this is the one that will be used when visit dates (potentially conflicting) appear on several pages of the same visit.
5	visit date field & format	the data field number of the visit date on the plate identified in field 4 and its format. The allowable date formats include any combination of yy (year), mm (month), and dd (day) so long as each occurs exactly once. Delimiter characters are optional between the 3 parts. Note: this date field must be defined using the VisitDate attribute.
6	visit due day	the number of days before/after the baseline visit that the visit is scheduled. The baseline visit must have a value of 0, and pre-baseline visits must have negative values.
7	visit overdue allowance	the number of days that a scheduled visit is allowed to be late. Visits are considered overdue if they have not arrived within this number of days following the visit due day.
8	required plates	a space character delimited list of plate numbers for CRFs that are required to be completed on this visit (maximum 1200 characters).

Field #	Contains	Description
9	optional plates	a space character delimited list of plate numbers for CRFs that may be completed on this visit, but are not required (maximum 1200 characters).
10	missed visit notification plate	a plate number which if received, indicates that the visit number coded on that plate was missed, and hence that Query Reports should not complain that this visit is overdue, or that it has missing pages.
11	termination window	for visit type W, a termination window is required and may be one of the following forms: on yy/mm/dd before yy/mm/dd after yy/mm/dd between yy/mm/dd-yy/mm/dd fraction In each case, the date value must use the format that is defined as the VisitDate attribute's format (and is also recorded in field 5).
12	display order	a comma- or space-delimited range list of required and optional plate numbers. The order specified here determines the order in which pages within a given visit are to be displayed in the **DFexplore** subject binder.

Table 2.52. Visit codes and their meaning

Code	Meaning	Scheduled	When Required
C	cycle	no|yes	cycles are used to group visits. For additional information regarding cycle entries, refer to *Study Setup User Guide, Cycle Specifications*.
X	screening	no	if subject enters the trial (baseline arrives)
P	scheduled pre-baseline visit	yes	before arrival of baseline visit
B	baseline	yes	can be scheduled from a pre-baseline visit
S	scheduled follow-up	yes	scheduled from the baseline visit
O	optional follow-up	no	not required
r	required by time of next visit	no	before arrival of the next visit
T	cycle termination visit	yes	scheduled from the baseline visit
R	required by time of termination visit	yes	on termination if scheduled pre-termination
E	early termination of current cycle	no	if early termination event occurs
A	abort all cycles	no	if abort event occurs
F	final visit (terminates all cycles)	no	terminate multi-cycle visit maps
W	study termination window	yes	absolute date scheduling of final visit

Table 2.53. `DFwatermark` - watermark

Usual Name	`DFwatermark`
Type	clear text
Created By	**DFadmin**
Used By	**DFexplore**, **DFpdf**, **DFpdfpkg**
Field Delimiter	|

Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	9
Description	The DFwatermark file stores a description of the watermarks available for use in a study. The file contains zero or more records. The fields in each record are described in Table 2.54, "DFwatermark field descriptions". In determining which watermark to use, the records are searched in sequential order from the beginning of the file. The first record to match, based upon the current user's role and the role(s) in the record, is selected.
Example	`draft|Draft watermark|DRAFT|20|255,0,0|50|1|1|unrestricted,Sites`

Table 2.54. DFwatermark field descriptions

Field #	Contains	Description
1	name	The unique name for the watermark.
2	description	A description of how and why the watermark is used for this role.
3	watermark text	The text of the watermark.
4	size	The point size of the font.
5	color	The color of the watermark in RGB space in the format 0-255,0-255,0-255.
6	transparency	The transparency of the watermark as a percentage from 0 (opaque) to 100 (transparent).
7	position	The placement of the watermark on the page - 1=top, 2=center or 3=bottom.
8	frame	A flag to indicate if the watermark is framed (1) or not (0).
9	roles	A comma delimited list of roles that may use this watermark.

Table 2.55. QCcovers - Query cover pages

Usual Name	QCcovers
Type	clear text
Created By	text editor
Used By	**DF_QCreports**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	#
Fields/Record	NA
Description	External Quality Control report cover sheets can be included by defining them in the file QCcovers. They may then be requested by running **DF_QCreports** with no -i option or running **DF_QCreports** with -i c. If no options are specified with **DF_QCreports**, a full 3-part Query Report and cover sheet will be generated. If -i is used, you must also specify other report parts to be generated (e.g. s, r, q, c). The -i c option may be specified with the site selection option, -c #. This allows the user to generate cover

sheets only for those site IDs specified. The `-i c` option by itself will generate a cover sheet and nothing else for all sites.

A cover sheet begins with a

```
<FOR center="#list">
```

tag to identify the site(s) that are to receive the cover sheet. It is legal for some sites to receive cover sheets while others do not, and for different sites to receive different cover sheets.

Cover sheets are defined using a <TEXT> block. Within <TEXT> blocks, variable substitution may be performed as described in `QCtitles` for customized report titles. Aside from variable substitution, all other text will appear exactly as formatted within the text block. Blank lines used to double space text will also be preserved. The default font for cover sheet text is the constant width font, `fCW`.

If more than one cover sheet is defined and a site ID is included in the `<FOR center="#list">` for more than one cover sheet, all <TEXT> blocks from all covers sheets specified for the site ID will be added to that site's cover sheet. The <TEXT> blocks will appear in the order they appear in `QCcovers`, and the site will still only receive one cover sheet.

Sites not specified in either `QCcovers` or `QCmessages` do not get a cover sheet. If a site is not defined in `QCcovers`, but that site is named in `QCmessages`, a blank cover sheet is generated onto which the message(s) can be written.

> **Note**
>
> **DF_QCreports** does not perform line wrapping on cover sheets. Each text block is printed exactly as it appears in `QCcovers` and `QCmessages`. Care must be taken when choosing fonts and using variable substitutions to ensure that text lines do not exceed the width of the page.
>
> **DF_QCreports** also expects that the cover sheet and all messages will fit on a single cover page for each site. It will not create automatic page breaks.
>
> DFdiscover version 3.7-003 and earlier requires that font specifications in `QCcovers` include the control-P (^P) character; for example `<TEXT font="^P12 fB">`. DFdiscover version 3.7-004 and greater accept the ^P but it is no longer required. For example, `<TEXT font="12 fB">` is a valid font specification and may be defined using the Query Covers view in **DFsetup**.

Example

The following is an example of an English and French version of a cover sheet for an international trial, where sites 20 to 29 inclusive use French, and all other sites use English.

```
<FOR centers="1~19,30~300">
<TEXT font="^P12 fB">
-----------------------------------------------------------------
PLEASE DELIVER THIS FAX TO THE FITNESS STUDY COORDINATOR
TO: <WHO>
Site <CENTER>: <WHERE>
<DATE>
</TEXT>
</FOR>
<FOR centers="20~29">
<TEXT font="^P12 fB">
-----------------------------------------------------------------
DONNEZ CE RAPPORT AU COORDINATOR DE RECHERCHE POUR FITNESS, S'IL VOUS PLAIT
TO: <WHO>
Site <CENTER>: <WHERE>
```

```
<DATE>
</TEXT>
</FOR>
```

Table 2.56. QCmessages - Query Report messages

Usual Name	QCmessages
Type	clear text
Created By	text editor
Used By	**DF_QCreports**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	#
Fields/Record	NA
Description	Cover sheets may include messages for all or specified site IDs. Messages are stored in the file QCmessages and follow the same rules as described for QCcovers. While messages can be added to cover sheets by placing them in <TEXT> blocks in the QCcovers file, the use of a separate file for messages makes it easier to keep the fixed (probably unchanging) cover sheet header separate from the broadcast messages, which will change frequently throughout the trial. The file QCmessages may include more than one message, and each site may receive none, some or all of them, as indicated by <FOR centers="#list"> which must appear at the beginning of each message. If a site is to receive more than one message, the messages will be printed on the cover sheet in the order in which they are defined in QCmessages. It is unnecessary to define a cover sheet in order to use messages. If a message is specified for a site which has not been defined in QCcovers, a blank cover sheet will be created, onto which the message(s) will be printed. Cover sheets and messages must be requested by running **DF_QCreports** with the -i c option or by running **DF_QCreports** with no -i at all. **Note** **DF_QCreports** does not perform line wrapping on cover sheets or messages. Each text block is printed exactly as it appears in QCmessages. Care must be taken when choosing fonts and using variable substitution to ensure that text lines do not exceed the width of the page. **DF_QCreports** also expects that the cover sheet and all messages will fit on a single cover page for each site. It will not create automatic page breaks. Messages will continue to go on each report until the QCmessages file is removed. If you want to keep a message for use later on, but do not want to send it to anyone in the next batch of Query Reports, leave the site number string blank. e.g. use <FOR center="">. DFdiscover version 3.7-003 and earlier requires that font specifications in QCmessages include the control-P (^P) character; for example <TEXT font="^P12 fB">. DFdiscover version 3.7-004 and greater accept the ^P but it is no longer required. For example, <TEXT font="12 fB"> is a valid font specification and may be defined using the Query Messages view in **DFsetup**.

Example	In the following example all site IDs (1 to 300 inclusive) receive the announcement of an upcoming meeting. For site IDs 1, 4, 22 to 24, and 127, this is followed by an important message regarding their lack of response to data queries.
	
	`<FOR center="1~300">`
	`<TEXT font ="^P12 fB">`
	`----------`
	`PLEASE NOTE:`
	`</TEXT>`
	`<TEXT font="^P10 fCW">`
	`The next FITNESS Study investigator's meeting will be held on October 9-10, 1999 in Orlando, Florida.`
	`Location and times will follow at a later date.`
	`</TEXT>`
	`</FOR>`
	`<FOR center="1,4,22~24,127">`
	`<TEXT font="^P12 fB">`
	`----------`
	`IMPORTANT!`
	`</TEXT>`
	`<TEXT font="^P10 fCW">`
	`We have not received any corrections related to the Quality Control reports we have sent to your site over the last 2 months. Please make every attempt to resolve the outstanding data queries as soon as possible.`
	`By protocol and agreement with the FDA, all adverse events must be reviewed by us within 3 days of each subject assessment.`
	`If you are having problems of any kind, please let us know.`
	`</TEXT>`
	`</FOR>`

Table 2.57. `QCtitles` - Query Report titles

Usual Name	`QCtitles`
Type	clear text
Created By	text editor
Used By	**DF_QCreports**
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	#
Fields/Record	NA
Description	The external or internal report title and sub-titles for each of the 3 sections (Subject Status, Refax List, Q & A List) of a DFdiscover Quality Control report may be specified in this file. **DF_QCreports** checks for the existence of this file and will use it if it exists, otherwise standard titles will be produced. Title specifications must be formatted exactly as shown in the examples to follow. The opening and closing tags must appear on new lines by themselves, with no leading or trailing text outside of the tag. Anything entered outside of a tagged block is ignored. The # symbol may be used to indicate a comment line but

	the # is not strictly needed, and has no special meaning inside a tagged block. For example, it is legal to include a line of # as part of a title inside a tagged block. Tags are only recognized if they begin a new line. Nothing is to precede the tag symbol '<'. No space is allowed within the opening and closing tag except before the word "font". The "font" value must be enclosed in double quotes. Limited font specifications may be included within the opening tag as listed in Table 2.58, "QCtitles font specifications". The font specification is optional. By default, font `^P10 fCW` is used for external and internal report titles, and font `^P10 fB` is used for the 3 report section sub-titles. Note that in DFdiscover versions 3.7-003 and earlier, font specifications must include the control-P (^P) character; for example <EXTERNAL `font="^P12 fB"`>. DFdiscover versions 3.7-004 and greater no longer require the ^P specification, but it is accepted if present. For example <EXTERNAL `font="12 fB"`> is a valid font specification. The variables enumerated in Table 2.59, "Variables available for use in QCcovers, QCmessages, and QCtitles" may be included in the external and internal report titles which appear at the top of each page, but not in the sub-titles for the 3 parts of the report (status, refax and question & answer lists). **Note** **DF_QCreports** does not perform line wrapping on report titles. Each report title and section sub-title is printed exactly as it appears in `QCtitles`. Care must be taken when choosing fonts and using variable substitutions to ensure that text lines do not exceed the width of the page.

Example	Here is an example of a `QCtitles` file that contains formatting information for an external and internal report title and the 3 section sub-titles.
	
	`# TITLE AT THE TOP OF EACH PAGE OF AN EXTERNAL QUERY REPORT`
	`<EXTERNAL font="^P12 fB">`
	`FITNESS STUDY REPORT <NUM> for: <MON> <DAY>, <YEAR> at`
	`<TIME>`
	`TO: <WHO>, <WHERE>`
	`</EXTERNAL>`
	`# TITLE AT THE TOP OF EACH PAGE OF AN INTERNAL QUERY REPORT`
	`<INTERNAL font="^P12 fB">`
	`INTERNAL QC REPORT: <NAME> page <PAGE> created:`
	`<YEAR>-<MON>-<DAY>`
	`</INTERNAL>`
	`#SUB-TITLE ABOVE THE SUBJECT STATUS LIST (Part 1 of a standard external Query Report)`
	`<STATUSLIST font="^P10 fB">`
	`SUBJECT VISIT SCHEDULE: Note: *identifies subjects with data queries.`
	`</STATUSLIST>`
	`#SUB-TITLE ABOVE REFAX LIST (Part 2 of a standard external Query Report)`
	`<REFAXLIST font="^P10 fB">`
	`CRF CORRECTIONS: Initial and date each correction. Refax all corrected pages without delay.`
	`</REFAXLIST>`
	`# SUB-TITLE ABOVE THE QUESTION AND ANSWER LIST (Part 3 of a standard external Query Report)`
	`<QALIST font="^P10 fB">`
	`QUERIES: Print your response below each question and fax back this page.`
	`</QALIST>`

Table 2.58. `QCtitles` font specifications

Symbol	Description
^P	control P, not circumflex P, sets the point size (^P10 and ^P12 are recommended).
fB	bold
fH	Helvetica
fCW	constant width (monospace) font

Table 2.59. Variables available for use in QCcovers, QCmessages, and QCtitles

Variable	Use in External	Use in Internal	Meaning
<STUDYNAME>	yes	yes	study name
<SITE> [a]	yes	no	site ID
<WHO>	yes	no	primary site contact
<WHERE>	yes	no	site affiliation
<MAIL>	yes	no	site mailing address
<PRIMEFAX> <FAX1>	yes	no	primary fax number (to which Query Reports are sent)
<FAX2>	yes	no	secondary fax number
<PHONE1>	yes	no	primary contact's phone number
<PI>	yes	no	principal investigator
<PHONE2>	yes	no	principal investigator's phone number
<REPLYTO>	yes	no	email address to which replies made to emailed Query Reports will be sent
<NUM>	yes	no	external report name composed of site ID, date (yymmdd), and page, e.g. 025-080115-01.
<NAME>	yes	yes	external report name composed of site ID and date only, e.g. 025-080115
<PAGE>	yes	yes	page number of Query Report
<DAY>	yes	yes	two-digit day of month
<MON>	yes	yes	three-character month of year
<YEAR>	yes	yes	four-digit year
<WKDAY>	yes	yes	three-character day of week
<TIME>	yes	yes	time of day (hh:mm:ss AM/PM), e.g. 01:12:22 PM
<DATE>	yes	yes	date (ddd mmm dd hh:mm:ss yyyy), e.g. Tue Jan 15 14:34:07 2018

[a]The variable <CENTER> is also supported for backwards compatibility

Table 2.60. `DFreportstyle` - DFdiscover Report styling

Usual Name	`DFreportstyle`
Type	clear text
Created By	text editor

Used By	DFdiscover reports, excluding Legacy reports
Field Delimiter	NA
Record Delimiter	NA
Comment Delimiter	NA
Fields/Record	NA
Description	The file contains two optional sections, a `script` section and a `style` section. Both sections are optional. The `script` section contains an array, in JSON array notation, of colors for use in chart rendering. These values define the Palette picker. The `style` section contains CSS that is added to the head of the report output. This CSS can style the text and general appearance of reports.

Example	<pre><script type="application/json" id="dfreportjson">{
	"palettes": {
	"Corporate": ["#26456e", "#3a87b7", "#b4d4da", "#1c5998", "#67add4",
	"#1c73b1", "#7bc8e2"],
	"Diverging" : ["#000066", "#6699ff", "#ffff00", "#3333ff", "#99ccff",
	"#ffff99", "#cc9900",
	"# 3366ff", "#ccccff", "#ffff66", "#663300"],
	"Monochrome": ["#1a1a1a", "#666666", "#b3b3b3", "#333333", "#808080",
	"#cccccc", "#4d4d4d",
	"#999999", "#e6e6e6"],
	"Color blind": ["#006ba4", "#ff800e", "#595959", "#5f9ed1", "#c85200",
	"#898989", "#a2c8ec",
	"#ffbc79", "#cfcfcf"]
	}
	}</script>
	<style id="dfreportcss">
	/* Body font */
	body {
	font: 100% arial, sans-serif;
	}
	/* Title font */
	.contextText.reportNameText {
	font: italic bold 1.5em Helvetica, serif;
	}
	/* Heading font */
	.c3-title {
	font: 1.2em Helvetica, serif;
	}
	/* Axis label font */
	.c3-axis-y-label, .c3-axis-x-label {
	font: normal 1.2em Helvetica, sans-serif;
	}
	</style></pre>

2.9. The study `lut` directory

This directory contains all the lookup tables used in the study.

Table 2.61. Lookup tables

Usual Name	None
Type	clear text
Created By	text editor
Used By	**DFexplore**, **DFbatch**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	1+

Description	A lookup table is a simple ASCII file. If it is anything other than this, an error message will appear on the command-line upon starting **DFbatch**.
	
	Each lookup table file must be associated with a symbolic table name in the lookup table map in order to be used by the `dflookup` function or in **DFexplore**. The lookup table map is described in DFlut_map - lookup table map.
	
	Within a lookup table, each record has at least 1 field. The first field is a short acronym (the search field), and the subsequent fields are the lookup text. If the record has only one field, it is the search and the result field (this is useful for spell checking). If the record has 2 fields, the first field is the search key and the second is the return value.
	
	An example query lookup table with two fields is illustrated below.
	
	`miss|Please provide a response.`
	`dtformat|Date format is YYYY/MM/DD. Please review and correct this date.`
	`dtillegal|Date provided is illegal. Legal dates are 2016/01/01-today.`
	`dtbeforeic|Date provided is before date of informed consent.`
	`ongo|End date is provided, but Ongoing is checked.`
	`enddt|End date is prior to Start date.`
	
	Records may also have 3+ fields (e.g COSTART tables, MedDRA), where the first field is the search key and all other fields are returned as a single delimited string that can be parsed using the `dfgetfield` function.
	
	Within the lookup table structure, the search field is typically short but has no maximum length. The lookup text fields have no maximum length; however, they are truncated to the maximum length of the data field into which they are inserted.
	
	Multi-field lookup tables can also support a more flexible structure as illustrated below.
	
	`#N:LL Term|Pref Term|SOC Term|LL Code`
	`#L:Low Level Term|Preferred Term|System Organ Class|Low Level Code`
	`#F:1|1-4`
	`Abdomen enlarged|Abdominal distension|Gastrointestinal disorders|10000045`
	`Abdomen mimicking acute|Acute abdomen|Gastrointestinal disorders|10000047`

	`Abdominal cramp|Abdominal pain|Gastrointestinal disorders|10000056` These lookup tables contain 3 header rows which define the structure of the table. • The first row begins with '#N:' followed by a short column name for each field, which appears above the scrolling list of entries in the lookup dialog displayed by an edit check. • The second row begins with '#L:' followed by a longer descriptive label for each field. This appears in the top section of the lookup dialog where the field values for the current row are displayed, and where the user can indicate which fields to search. • The third row begins with "#F:" followed by 2 fields: the 1st lists the fields to be searched by dflookup() for a match and the 2nd lists the fields to be returned when a match is found or selected by the user. If multiple return fields are specified they are returned to the edit check as a '|' delimited string, which can be parsed using dfgetfield(). If a lookup table is defined for a study data field, the defined lookup text can be retrieved in 2 ways. If the user remembers the acronym (first field) the lookup value can be entered by typing the acronym in the current data field and pressing Enter. The acronym is then replaced with the value from the matching lookup table record. Matching on the acronym is performed case-insensitive. Alternatively the user can simply press Enter without giving an acronym, to pop-up a scrolling list of all acronyms and their lookup text, and then click on the desired choice.

Example	`a|before`
	`AA|auto accident (MVA)`
	`A&P|anterior & posterior`
	`abd|abdomen`
	`abg|arterial blood gases`
	`ac|before meals`
	`acid phos|acid phosphatase`
	`ACLF|adult congregate living facility`
	`ACTH|adrenocorticotrophic hormone`
	`acute MI|acute myocardial infarction`
	`ad|right ear`
	`Ad|up to`
	`Ad lib|as desired`
	`BaE|barium enema`
	`Ba|barium`
	`BB|blood bank`
	`BCP|biochemical profile`
	`BE|barium enema`
	`BEE|basal energy expenditure`

2.10. The study `work` directory

This directory contains summary files created by **DF_QCupdate**, DFdiscover retrieval files, and temporary files created during the execution of reports and other programs.

Table 2.62. `DFX_ccycle` - cycle conditions met

Usual Name	`DFX_ccycle`
Type	clear text
Created By	**DF_QCupdate**

Used By	**DF_PTvisits**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	4+
Description	This file records the conditions defined in the conditional cycle map that were met for each subject. It is updated each time **DF_QCupdate** is run. Table 2.63, "DFX_ccycle conditional cycle map conditions that were met" describes the data recorded for each of these conditions.

Example	The following example shows 3 conditions (1,4 and 6), that were met for subject 11020. These conditions were met at visits 10,5 and 60 respectively, with data values 2, 98 and 0 respectively. To determine the actions triggered by these conditions we would need to consult the conditional cycle map to determine which cycles are affected by each condition.
	
	`11020|10|1|2`
	`11020|5|4|98`
	`11020|60|6|0`

Table 2.63. DFX_ccycle conditional cycle map conditions that were met

Field #	Contains	Description
1	Subject ID	subject ID number
2	Visit Number	visit or sequence number at which the condition was met, taken from the IF statement if the condition includes both IF and AND statements
3	Condition Number	condition number, from the order in which conditions are defined in the conditional cycle map
4+	data value(s)	the database value(s) that resulted in the condition being met, for each IF and AND statements defined in the condition (in statement order)

Table 2.64. DFX_cvisit - visit conditions met

Usual Name	DFX_cvisit
Type	clear text
Created By	**DF_QCupdate**
Used By	**DF_PTvisits**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	4+
Description	This file records the conditions defined in the conditional visit map that were met for each subject. It is updated each time **DF_QCupdate** is run.

	Table 2.65, "DFX_cvisit conditional visit map conditions that were met" describes the data recorded for each of these conditions.
Example	The following example shows 3 conditions (1,4 and 6), that were met for subject 11020. These conditions were met at visits 10,5 and 60 respectively, with data values 2, 98 and 0 respectively. To determine the actions triggered by these conditions we would need to consult the conditional visit map to determine which visits are affected by each condition. 11020|10|1|2 11020|5|4|98 11020|60|6|0

Table 2.65. DFX_cvisit conditional visit map conditions that were met

Field #	Contains	Description
1	Subject ID	subject ID number
2	Visit Number	visit or sequence number at which the condition was met, taken from the IF statement if the condition includes both IF and AND statements
3	Condition Number	condition number, from the order in which conditions are defined in the conditional visit map
4+	data value(s)	the database value(s) that resulted in the condition being met, for each IF and AND statements defined in the condition (in statement order)

Table 2.66. DFX_cplate - plate conditions met

Usual Name	DFX_cplate
Type	clear text
Created By	**DF_QCupdate**
Used By	**DF_PTvisits**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	4+
Description	This file records the conditions defined in the conditional plate map that were met for each subject. It is updated each time **DF_QCupdate** is run. Table 2.67, "DFX_cplate conditional plate map conditions that were met" describes the data recorded for each of these conditions.
Example	The following example shows 3 conditions (1,4 and 6), that were met for subject 11020. These conditions were met at visits 10,5 and 60 respectively, with data values 2, 98 and 0 respectively. To determine the actions triggered by these conditions we would need to consult the conditional plate map to determine which plates are affected by each condition. 11020|10|1|2 11020|5|4|98 11020|60|6|0

Table 2.67. `DFX_cplate` conditional plate map conditions that were met

Field #	Contains	Description
1	Subject ID	subject ID number
2	Visit Number	visit or sequence number at which the condition was met, taken from the IF statement if the condition includes both IF and AND statements
3	Condition Number	condition number, from the order in which conditions are defined in the conditional plate map
4+	data value(s)	the database value(s) that resulted in the condition being met, for each IF and AND statements defined in the condition (in statement order)

Table 2.68. `DFX_cterm` - termination conditions met

Usual Name	`DFX_cterm`
Type	clear text
Created By	**DF_QCupdate**
Used By	**DF_PTvisits**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	4+
Description	This file records the conditions defined in the conditional termination map that were met for each subject. It is updated each time **DF_QCupdate** is run. Table 2.69, "`DFX_cterm` conditional termination map conditions that were met" describes the data recorded for each of these conditions.

Example	The following example shows 3 conditions (1,4 and 6), that were met for subject 11020. These conditions were met at visits 10,5 and 60 respectively, with data values 2, 98 and 0 respectively. To determine the actions triggered by these conditions we would need to consult the conditional termination map to determine which cycles are affected by each condition.
	
	`11020|10|1|2`
	`11020|5|4|98`
	`11020|60|6|0`

Table 2.69. `DFX_cterm` conditional termination map conditions that were met

Field #	Contains	Description
1	Subject ID	subject ID number
2	Visit Number	visit or sequence number at which the condition was met, taken from the IF statement if the condition includes both IF and AND statements
3	Condition Number	condition number, from the order in which conditions are defined in the conditional termination map
4+	data value(s)	the database value(s) that resulted in the condition being met, for each IF and AND statements defined in the condition (in statement order)

Table 2.70. DFX_keys - key fields for all required plates

Usual Name	DFX_keys
Type	clear text
Created By	**DF_XXkeys**
Used By	**DF_CTvisits**, **DF_PTcrfs**, **DF_QCupdate**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	5
Description	This file records the key fields from all required plates found in the database. It is updated each time **DF_XXkeys** is run. Table 2.71, "DFX_keys key fields from all required plates" describes the data recorded for each of these conditions.

Example	The following example shows 4 records for subject 1044, for plates 3,2,1 and 2 respectively at visits 51,61,92 and 211 respectively. All plates have status 1=final and are at validation level 7.
	
	`1044|3|51|1|7`
	`1044|2|61|1|7`
	`1044|1|92|1|7`
	`1044|2|211|1|7`

Table 2.71. DFX_keys key fields from all required plates

Field #	Contains	Description
1	Subject ID	subject ID number
2	Plate number	CRF plate number
3	Visit Number	visit or sequence number
4	Status	1-7
5	Validation level	1-7

Table 2.72. DFX_schedule - subject scheduling and visit status

Usual Name	DFX_schedule
Type	clear text
Created By	**DF_QCupdate**
Used By	**DF_QCreports**, **DF_PTmissing**, **DF_PTvisits**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	16 for cycle records, and 18 for visit records

Description	This file records the current scheduling and status of all cycles and visits defined in the study visit map, for each subject. It is updated each time **DF_QCupdate** is run. Table 2.73, "field definitions for cycle records in DFX_schedule" describes each field in the cycle records, and Table 2.74, "field definitions for visit records in DFX_schedule" describes each field in the visit records.

Example	The following example shows the current status for one subject (id=1031) in a study having 3 cycle. The screening cycle consists of visits 91 and 92. The in-study cycle is required and has 8 visits beginning with pre-baseline visit 51 and ending with early termination visit 81. The end cycle contains a single abort visit (visit number 80).
	
	`1031|1|0|C|S|1|7|||||03/09/21|37884||`
	`1031|1|0|91|X|1|7||||||03/09/21|37884|||`
	`1031|1|0|92|X|1|1||||||03/09/28|37891|||`
	`1031|1|1|C|R|1|7|||||~03/10/07|37900||`
	`1031|1|1|51|P|1|7||||||03/10/05|37898|03/10/05|37898|`
	`1031|1|1|0|B|4|0|-1|10|51|||||||`
	`1031|1|1|61|r|1|1||||||04/01/06|37991|||`
	`1031|1|1|3|S|2|1||||||04/01/06|37991|||`
	`1031|1|1|6|S|1|0||||||04/04/07|38083|||`
	`1031|1|1|9|S|1|0||||||04/07/07|38174|||`
	`1031|1|1|12|T|1|0||||||04/10/06|38265|||`
	`1031|1|1|81|E|3|0||||||||||`
	`1031|1|2|C|E|0|0|||||||||`
	`1031|1|2|80|A|3|0||||||||||`

Table 2.73. field definitions for cycle records in DFX_schedule

Field #	Contains	Description
1	Subject ID	subject ID number
2	Site ID	clinical site number
3	Cycle Number	cycles are numbered sequentially within the visit map, using 0 for screening, if present, and starting at 1 for the first in-study cycle.
4	C	the capital letter C appears in this field to distinguish cycle records from visit records
5	Cycle Type	cycles are defined in the visit map as one of: S=screening, R=in-study required, O=in-study optional, C=in-study conditional, and E=end
6	Cycle Need	cycle need, after applying all conditional and termination rules, can be one of: 0=unknown, 1=required, 2=next required cycle, 3=optional, and 4=excluded
7	Cycle Status	the current status of the cycle (as of the date on which **DF_QCupdate** was last run) can be one of: 0=not done, 1=overdue, 7=done, 8=cycle has terminated, 9=cycle was aborted
8	Condition need	cycle need set by a condition in the conditional cycle map; one of: 0=optional, 1=required, -1=excluded
9	Condition number	the number of the condition as defined within the conditional cycle map
10	Condition sequence number	visit or sequence number at which the condition was met (from IF statement)
11	Start date	scheduled start date for the cycle
12	Start day	scheduled start day (days since Jan 1,1900) for the cycle

Field #	Contains	Description
13	Baseline date	baseline visit date for the cycle
14	Baseline day	baseline visit day (days since Jan 1,1900) for the cycle
15	Termination date	termination date for the cycle
16	Termination day	termination day (days since Jan 1,1900) for the cycle

Table 2.74. field definitions for visit records in `DFX_schedule`

Field #	Contains	Description
1	Subject ID	subject ID number
2	Site ID	clinical site number
3	Cycle Number	cycles are numbered sequentially within the visit map, using 0 for screening, if present, and starting at 1 for the first in-study cycle.
4	Visit/Sequence Number	a unique subject assessment number in the range 0-65535
5	Visit Type	one of the 12 supported visit types: X=screening, P=pre-baseline, B=baseline, S=scheduled follow-up, T=cycle termination, W=cycle termination windows, F=final, O=optional, E=early cycle termination, A=abort all follow-up, R=required on termination, and r=required on next scheduled visit
6	Visit Need	visit need, after applying all conditional and termination rules, can be one of: 0=unknown, 1=required, 2=next required visit, 3=optional, and 4=excluded
7	Visit Status	the current status of the visit (as of the date on which **DF_QCupdate** was last run) can be one of: 0=not done, 1=overdue, 2=recorded as missed, 7=done, 8=done and cycle terminates, 9=done and aborts all follow-up
8	Condition need	visit need set by a condition in the conditional visit map; one of: 0=optional, 1=required, -1=excluded
9	Condition number	the number of the last condition met within the conditional visit map
10	Condition sequence number	visit or sequence number at which the condition was met (from IF statement)
11	Missed Visit Plate	plate number of missed visit plate received for this visit
12	Early Termination Plate	plate number of early cycle termination plate received for this visit
13	Conditional Termination Number	the number of the last condition met in the conditional termination map
14	Start date	scheduled due date
15	Start day	scheduled due day (days since Jan 1,1900)
16	Visit date	actual date on which the visit was performed
17	Visit day	actual day (days since Jan 1,1900) on which the visit was performed
18	Days Post-Termination	a positive number indicates that the visit was performed this many days following termination

Table 2.75. `DFX_time1` - date and time from receipt to last modification

Usual Name	`DFX_time1`
Type	clear text
Created By	**DF_XXtime**

Used By	**DF_CTcrfs**, **DF_PTqcs**, **DF_WFfaxes**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	21
Description	This file records the date and time each CRF page was processed from fax arrival to last record modification. It is updated each time **DF_XXtime** is run. A related file, named DFX_dfin, contains the same information as DFX_time1, for records that are still in the DFdiscover new queue. These records have not been validated and entered into the study database and thus may contain ICR errors in the key fields. Table 2.76, "DFX_time1 timing data for each CRF page" describes the data recorded for each of these conditions.

Example	The following example shows 4 records for subject ID 1501. The first 2 records are for plate 1 at visit 0, and the second 2 records are for plate 2 at visit 1. In both cases the first record is the primary and the second is a secondary record. In all 4 records the fax arrival date is missing. This will be the case if the record was not submitted by fax or email, but instead entered using raw data entry or ASCII record import, or if the `fax_log` is missing or has been trimmed.
	
	`1|1501|0|1|1|6|1995160154|03/30/95||95/04/24|95/04/24|34787|0|34812|34812||`
	`09:43:37|09:43:37|0|583.61|583.61`
	`1|1501|0|1|4|4|1995130086|03/30/95||95/03/30|95/04/24|34787|0|34787|34812||`
	`18:41:04|09:43:43|0|1121.07|583.71`
	`1|1501|1|2|1|6|1995200106|04/12/95||95/05/19|95/05/23|34800|0|34837|34841||`
	`16:46:37|11:12:18|0|1006.62|672.3`
	`1|1501|1|2|5|5|1995160154|04/12/95||95/04/24|95/05/19|34800|0|34812|34837||`
	`09:43:59|16:46:39|0|583.98|1006.65`

Table 2.76. DFX_time1 timing data for each CRF page

Field #	Contains	Description
1	Site ID	clinical site number
2	Subject ID	subject ID number
3	Visit Number	visit or sequence number
4	Plate Number	CRF plate number
5	Record Status	1-6,0: `1=final`, `2=incomplete`, `3=pending`, `4=FINAL`, `5=INCOMPLETE`, `6=PENDING`, `0=missed`
6	Record Validation Level	1-7
7	fax name	yyyywwssss: yyyy=year, ww=week of the year, ssss=order number of fax within the week
8	visit date	date the visit occurred, from DFX_visit.date, in yy/mm/dd format
9	fax date	date the fax was received in yy/mm/dd format
10	creation date	date the data record was created, in yy/mm/dd format
11	modification date	date the data record was last modified, in yy/mm/dd format
12	visit julian day	date the visit occurred, from DFX_visit.date, in days since Jan 1,1900
13	fax julian day	date the fax was received in days since Jan 1,1900

Field #	Contains	Description
14	creation julian day	date the data record was created, in days since Jan 1,1900
15	modification julian day	date the data record was last modified, in days since Jan 1,1900
16	fax time	time the fax was received in hh:mm:ss format
17	creation time	time the data record was created in hh:mm:ss format
18	modification time	time the data record was last modified in hh:mm:ss format
19	fax minutes	time the fax was received, in number of minutes into the day (0-1440)
20	creation minutes	time the data record was received, in number of minutes into the day (0-1440)
21	modification minutes	time the data record was last modified, in number of minutes into the day (0-1440)

Table 2.77. `DFX_visit.dates` - value in the database of all visit dates

Usual Name	`DFX_visit.dates`
Type	clear text
Created By	**DF_XXkeys**
Used By	**DF_CTvisits**, **DF_PTcrfs**, **DF_QCupdate**
Field Delimiter	|
Record Delimiter	\n
Comment Delimiter	NA
Fields/Record	5
Description	This file records the value of all dates in the database that use the VisitDate attribute. Only one date using the VisitDate attribute may appear on each CRF plate, but different plates for the same visit may contain VisitDate fields, and thus it is possible to have more than one record in for each visit for any given subject. A related file, named , records the preferred visit date for each visit, as defined in the study visit map. These 2 files are updated each time **DF_XXkeys** is run. Table 2.78, "`DFX_visit.dates` the value of all dates using the VisitDate attribute" describes the data recorded for each visit date.

Example	The following example shows 5 records for subject ID 1127, for visits 0,3,6,51. Note that there are 2 entries for visit 51, one from plate 10 and one from plate 13.
	
	`1127|0|03/08/19|37851|3`
	`1127|3|03/11/20|37944|5`
	`1127|6|04/02/18|38034|5`
	`1127|51|03/08/10|37842|10`
	`1127|51|03/08/10|37842|13`

Table 2.78. `DFX_visit.dates` the value of all dates using the VisitDate attribute

Field #	Contains	Description
1	Subject ID	subject ID number
2	Visit Number	visit or sequence number

Field #	Contains	Description
3	date	the date value in the format used by the VisitDate attribute
4	julian value	This is a modified julian value for the date, calculated as the number of says since Jan 1,1900.
5	Plate Number	The plate on which the visit date is recorded.

Chapter 3. Shell Level Programs

3.1. Introduction

The DFdiscover distribution includes several programs that can be executed on their own from a command line, or combined in shell scripts to build other programs (e.g. to export data sets for systems, or create study specific reports). All of the programs described in this section can be found in the DFdiscover executables directory, /opt/dfdiscover/`bin` with the exception of **DFmkdrf.jnl** and **DFmkdrf.ec** which are in /opt/dfdiscover/`ecbin`.

Permission to run these programs is controlled by UNIX file permissions that are set on DFdiscover installation to execute for user 'datafax' and users in group 'studies', but not for 'other' users.

The remainder of this chapter is a reference for each shell program.

3.2. User Credentials

DFdiscover includes many programs. Some operate only on a database server computer (referred to as server-side) while others operate on a user's desktop computer (referred to as client-side). The application of user login and permissions varies slightly in these two environments.

Interactive client-side programs like **DFexplore**, **DFsetup**, **DFsend** and **DFadmin** require the user to interactively provide a valid username and password each time they connect to a database server.

Conversely, the majority of the shell programs require a UNIX-like shell environment to function, and hence they may only be executed directly on a DFdiscover database server machine. Access to specific database information is granted based upon the DFdiscover permissions assigned to the user, where the user is identified by their UNIX login name.

Starting with release 2014.0.0, DFdiscover includes a third type of program. Programs of this type require a command line environment to execute and can be run from either the user's desktop computer (client-side) or from the database server computer (server-side). These programs are **DFbatch**, **DFpdfpkg** and **DFexport**. To authenticate, they require the same credentials that an interactive program does, specifically the username and password required to connect to a database server. Since there is no visual login dialog, these programs require a different interaction for authenticating, and there are two solutions for the user:

1. command-line options, the user can specify `-S` *`servername`*, `-U` *`username`* and `-C` *`password`* when the program is run, or

2. environment variables, the user can set the variables `DFSERVER` *`servername`*, `DFUSER` *`username`* and `DFPASSWD` *`password`* before the program is run.

Specification of command-line options takes priority if both command-line options and environment variables are supplied. It is not possible to mix solutions using a subset of command-line options and a complimentary set of environment variables. If any command-line option is specified, the expectation is that the command-line solution is preferred; otherwise, the environment variable solution is required.

3.2.1. Good Password Management

In many circumstances, it is poor practice to display or store a plain text password. Including a password in a shell script or in a **cron** job is not secure behavior, and is not recommended. Hence we strongly recommend that users do not use either the `-C` *`password`* command-line option or the `DFPASSWD` *`password`* environment variable. Instead, we encourage users to make use of the DFpass program to locally manage their DFdiscover passwords. After creating a matching entry with **DFpass**, a user does not need to subsequently specify a password with either `-C` *`password`* or `DFPASSWD` *`password`*.

The recommended practice then is to create/manage passwords locally using **DFpass** and subsequently use either the two command-line options, `-S` *`servername`* and `-U` *`username`*, or the two environment variables `DFSERVER` *`servername`* and `DFUSER` *`username`*.

Use of locally managed passwords is limited to the **DFattach**, **DFbatch**, **DFpdfpkg**, **DFexport**, **DFreport** and **DFuserPerms** programs.

3.2.2. Order of Evaluation

When determining the authentication credentials to use for one of **DFbatch**, **DFpdfpkg** or **DFexport**, the order of evaluation is as follows and only the first matching combination, if any, is used:

1. If all three command line options `-S` *`servername`*, `-U` *`username`* and `-C` *`password`* are specified, use them.
2. If all three environment variables `DFSERVER` *`servername`*, `DFUSER` *`username`* and `DFPASSWD` *`password`* are defined, use them.
3. If both of the command line options `-S` *`servername`* and `-U` *`username`* are specified, use them together with the matching password entry previously stored via **DFpass**.
4. If both of the environment variables `DFSERVER` *`servername`* and `DFUSER` *`username`* are defined, use them together with the matching password entry previously stored via **DFpass**.

3.3. Organization of Reference Pages

The description of each program in this reference is divided into sections.

- **Name.** The official name of the program.

  The program name is case sensitive and must be typed exactly as specified. This section also provides the brief purpose of the program.

- **Synopsis.** Lists all of the valid options for the program invocation.

  Each option is either optional or required. Most options are, not surprisingly, optional, a few are required, and yet others may require one option from a specific subset. Each option type is indicated with a particular notation. Except for some required options, a program option begins with `-` and is followed by an option letter. In some cases this may be enough to select the option; in other cases, the option letter will be further followed by an option string.

Option Letter

An option letter may be given different meanings in different programs. There is no requirement that the same option letter infers the same meaning when used across different programs.

Table 3.1. Notation for program options

Notation	Meaning
{study}	Required. The program will not function without the specification of this option. The option must be provided at the specified location in the list of options.
[-o]	Optional. The option may be omitted. The program will function, albeit differently, with or without this option.
[-o *`string`*]	Optional, with an additional option string. The option may be omitted, however when it is used, the option letter must be immediately followed by a space and the option string.

Notation	Meaning
	The option string generally ends at the next white-space character, however some option strings may contain spaces, and may or may not require that such strings be delimited by ".
{ [-s] | [-u] }	One of the options from the specified subset is required.
[[-s #] | [-u #]]	Several options are possible but only zero or one from the specified subset may be used.

- **Description.** Describes the program purpose in greater detail.

  This section describes exactly how the program works in terms of environment, input requirements, output format, dependencies, etc. It may also include detailed information about the program behavior for commonly used combinations of options.

- **Options.** Detailed listing of available options, their use, and their meaning.

- **Examples.** Illustrates the program options and output by way of example(s).

- **See Also.** Lists other reference materials, typically other programs, that are relevant to the program. This in an optional section.

- **Limitations.** Describes any limitations in the use or capabilities of the program. This in an optional section.

3.4. Alphabetical Listing

Name

DFaccess.rpc — Change access to a study database or , or query their current access status.

Synopsis

`DFaccess.rpc` { [-s *study*] | [-inbound] } [[-ro] | [-rw] | [-enable] | [-q]] [[-restrict *reason string*] | [-disable *reason string*]]

Description

DFaccess.rpc provides the same functionality from the command line that is available in the **DFadmin** Status View. Like all shell level programs, **DFaccess.rpc** can be executed by `datafax` or any other user with a UNIX login account who is in group `studies`.

Read-Only Mode. While a study is in read-only mode **DFexplore** and **DFsetup** can be used to view but not change study data and setup information. Studies are typically put into Read-Only mode because data collection is complete, all queries have been resolved, and the data has been verified against source documents. Statistical analysis may be ongoing or an FDA audit may be in progress thus the study cannot be disabled, but no further changes are expected or allowed.

By design, read-write access to a study database is only granted to tools that write new data records or update existing data records. All other tools have read-only access. Thus when is used to switch a study sever to read-only mode only those tools that normally have read-write access will be affected. This includes the following:

Table 3.2. Software Components Affected by Read-Only Mode

Program	When Database Server is in Read-Only Mode
DFbatch	exits without executing any edit checks
DFimport.rpc	exits without importing any records
DFinbound.rpc	incoming pages barcoded for the study are moved to the system-wide `identify` directory
DFqcsent.rpc	will not run because the Query database cannot be updated
DFexplore	the study can be used in view-only mode but pages cannot be sent to the study from the unidentified fax router
DFsetup	can be used in view-only mode
DFadmin	can be used by DFdiscover and study administrators to view and change study access
DF_ICqcs	the `-r` (repair) option cannot be used
DF_QCfax	faxes can be sent but post-processing to move external reports to the sent directory and to mark queries as having been sent will fail
DF_QCreports	external reports that include refax (correction) and/or Q&A (clarification) queries cannot be created because the Query database cannot be updated
DF_QCsent	will not run because the Query database cannot be updated
DF_QCupdate	will not run because the Query database cannot be updated

When a study is put into read-only mode it will remain in that mode until reset using **DFadmin** or with the `-rw` option.

While a study is in read-only mode, any incoming pages barcoded for that study will be moved to **DFrouter**'s `identify` directory.

Restricted Access. Access to a study can be restricted for DFdiscover and study administrators only using the `-restricted` option. While a study is restricted other users are not allowed to login, even in view-only mode.

When a study is restricted using or **DFadmin** users who are logged in will be able to continue working until they log off, but only administrators will be able to make new login connections.

While a study is restricted, any incoming pages barcoded for the study will be processed normally and sent to the study new fax queue, but only DFdiscover and study administrators will be able to view or process them.

A study may be made both restricted and read-only, but these options cannot be used together on the same command line, it requires 2 separate executions of ; the order is not important.

When a study is put into restricted mode it will remain in that mode until reset using **DFadmin** or with the `-enable` option or until the study server is restarted.

Disabled Access. A study database may be disabled, making it unavailable to all users, using the `-disable` option.

While a study is disabled, any incoming pages barcoded for the study will be held until the study is enabled, and will not show up in the study new fax queue until processing is triggered by the arrival of the next fax received by the DFdiscover server. It is not necessary for the next fax to contain pages barcoded for the study in question or for any study.

When a study is disabled it will remain in that mode until reset using **DFadmin** or with the `-enable` option.

To complete a change in access mode, must be the only client accessing the server. Thus fails if there are any tools with open connections to the study server.

Options

-s study	the study number
-inbound	used when changing the status of , which processes incoming faxes and PDF files
-ro	change the database server to read-only mode
-rw	change the database server to read-write mode
-enable	reverses -disable or -restrict to return the study or to normal access
-q	query the state of the database server or
-restrict reason string	restrict the database server making it available to DFdiscover and study administrators only, and displaying the reason string in study selection dialogs
-disable reason string	disable the database server making it unavailable to all users, and displaying the reason string in study selection dialogs

Exit Status

DFaccess.rpc exits with one of the following statuses:

0 The mode of the database server was successfully changed to the requested mode, or the mode was successfully queried.

1 The mode of the database server was not successfully changed. The server is currently in a mode that is incompatible with the change.

2 The study server could not be contacted or there was an error in the command-line arguments.

Examples

Example 3.1. Enable read-only access to study #123, do lengthy operation, and then reinstate read-write access

```
# /opt/dfdiscover/bin/DFaccess.rpc -s 123 -ro
```

...some lengthy operation...

```
# /opt/dfdiscover/bin/DFaccess.rpc -s 123 -rw
```

Example 3.2. Restrict study #123 in read-only access to DFdiscover and study administrators only, while they analyze and run reports on a static database, and then reinstate normal access to all users

```
# /opt/dfdiscover/bin/DFaccess.rpc -s 123 -restrict analysis
# /opt/dfdiscover/bin/DFaccess.rpc -s 123 -ro
```

...administrators perform their analyses

```
# /opt/dfdiscover/bin/DFaccess.rpc -s 123 -rw
# /opt/dfdiscover/bin/DFaccess.rpc -s 123 -enable
```

Example 3.3. Query the current status of

```
% /opt/dfdiscover/bin/DFaccess.rpc -inbound -q
```

Name

DFattach — Attach one or more external documents to keys in a DFdiscover study

Synopsis

`DFattach` [-S *`server`*] [-U *`username`*] [-C *`password`*] [[-doc *`docname`*] | [-subject # -visit # -plate # -doc *`docname`*] | [-idrf *`input_drf`*] | [-dir *`directory`*]] [-odrf *`output_drf`*] [-log *`logfile`*] {*`study#`*}

Description

DFattach is a command-line utlity that mimics, and extends, the **Plate** > **Attach Subject Document** facility in **DFexplore**. It's primary function is to permit one or more documents to be attached to one or more record keys from a command-line interface.

In **DFexplore**, it is possible to attach a document to the current data record; using **DFattach** it is possible to attach documents to many records with simple commands.

Permitted document types are the same as those allowed by **DFexplore**.

For each document successfully attached to a key:

- an entry is added to the system `work/fax_log`,
- a DRF entry is appended to *`output_drf`* if `-odrf` *`output_drf`* is given as an option. The DRF entry contains 5 fields: the key of the record in the first 3 fields, the image ID assigned to the document, and the original document name.

Attaching Documents

There are 4 different methods for attaching documents.

1. In it simplest form, **DFattach** attaches a single document to a single key. Specify the document with `-doc` *`docname`*. The key is determined from the filename of the document. The document filename must have the format *`subject_ visit_ plate`* [*`_other`*] [*`.extension`*] where *`subject`*, *`visit`* and *`plate`* are each valid, numeric identifiers for the key.
2. Attach a single document to the key given as arguments. In this method, each of `-subject # -visit # -plate # -doc` *`docname`* must be explicitly specified. This has the advantage that the filename of the document to be attached does not have to change to follow a format.
3. Read the input DRF. For each record in the DRF, the key is in the first three fields and the document name is in the fourth field. Attach the named document to the key. Repeat for each record.
4. Process each file and subdirectory in `-dir` *`directory`*. For each file, if the filename has the format *`subject_ visit_ plate`* [*`_other`*] [*`.extension`*], treat the file as a document to attach to the key. Repeat for all matching files in the directory. Then recursively repeat for each sub-directory.

Permissions

Permissions are enforced for the user identified by the supplied credentials. Minimally, the user must have a study role permission that permits **Server - Attach document** and **DFexplore - Data - Attach subject document**. Additional permissions may be required dependent upon the action

Database Actions

For each document and key, *`[id, visit, plate]`*, to be attached, the steps are:

1. Confirm that the combination of visit and plate are defined in the visit map. If it is not, output an error message and skip this document.
2. Lock the key. If the key cannot be locked, output an error message and skip this document.
3. If the key does not exist in the database, a record with pending status is created. The document becomes the primary image. Create Data permission is required.
4. If the key matches an existing missed record, the missed record is deleted and a record with pending status is created. The document becomes the primary image. Delete Missed record and Create Data permission are required.
5. If the key exists, and there is already a primary image, the document is attached as a secondary image; otherwise, the document is attached as the primary image. Modify Data permission is required.

Options

-S server	DFdiscover server name
-U username	DFdiscover login username
-C password	login password. Refer to Section 3.2, “User Credentials” for recommended/better solutions for safe password handling.
-doc docname	determine the key encoded in *docname* and attach *docname* to that key
-subject # -visit # -plate # -doc docname	attach *docname* to the given key
-idrf input_drf	read *input_drf*, which is in DRF format, and for each record add the document to the given key
-dir directory	read *directory* and recursively each sub-directory, and for each filename that matches the required pattern attach filename to the given key
-odrf output_drf	for each document that is successfully attached, append a DRF record to *output_drf*. Subsequently a task can be built from the DRF to review the attached documents.
-log logfile	write any log messages to *logfile*
study#	the study number where the documents are to be attached; required

Exit Status

DFattach exits with one of the following statuses:

0 The command is successful.

1 One or more errors occurred, and the command has failed. Error messages are written to standard error on the command-line.

Examples

In each of the following examples, the options `-S` *server*, `-U` *username* and `-C` *password* are not shown but are required.

Example 3.4. Attach `1234_1_12.pdf` to subject 1234, visit 1, plate 12 in the database for study 100

```
% DFattach -doc 1234_1_12.pdf 100
```

Example 3.5. Attach `radiograph.pdf` to subject 30001, visit 10, plate 200 in the database for study 22

```
% DFattach -subject 30001 -visit 10 -plate 200 -doc radiograph.pdf 22
```

Example 3.6. Attach all of the documents in directory `/tmp/newdocs` to the matching keys in study 200 and record the successes in `/tmp/results.drf`

```
% ls /tmp/newdocs
250001_0_1.pdf
250002_0_1.pdf
350001_0_1.pdf
350001_0_2.pdf
350001_1_10.pdf
% DFattach -dir /tmp/newdocs -odrf /tmp/results.drf 200
```

Name

DFaudittrace — Used by the **DF_ATmods** report to read study journal files. **DF_ATmods** produces an audit trail report showing database modifications for the specified study.

Synopsis

`DFaudittrace` {-s #} [-d date1[-date2]] [-q] [-r] [-N] [-A] [-I subjectID] [-P #] [-V #] [-f fieldlist] [-v vfence] [-x *`output.xlsx`*]

Description

DFaudittrace reads a record from the study journal files, calculates any changes from the previous record for those keys and then outputs the differences to **DF_ATmods**.

The output from **DFaudittrace** consists of one or more ASCII records, each having 20 fields. Each field is separated by a pipe-delimiter (|). Field contents depend on:

1. whether **DFaudittrace** is describing a new record (type N), a changed field (type C), or a deleted record (type D). This information is found in the first field of each record.

2. whether **DFaudittrace** is describing a data record, query record or a reason record. This information is found in the 8th field of each record.

The tables describe each of the 20 fields for each record type (data, query, reason) for each type of change (new record, changed field, deleted record). Fields 1 to 7 are consistent across all records output by **DFaudittrace** and have been described in the first table. Fields 8 to 20 depend on the record type and the type of change, and are described in tables 2 to 4.

Table 3.3. DFaudittrace Output: Fields 1 to 7

Field	Description
1	Record type (N=new, C=changed field, D=deleted record)
2	Date (yyyymmdd)
3	Time (hhmmss)
4	User
5	Subject ID
6	Visit
7	Plate

Table 3.4. New Records

Field	Data Records	Query Records	Reason Records
8	0	>0: unique field ID of field on which query is located	<0: unique field ID of field on which reason is located
9	0 (summary), or unique field ID	field number of Query record	field number of Reason record
10	status 1-6, 0=new missed record	status 1-6	status 1-6
11	validation level	validation level	validation level
12	maximum validation level reached	maximum validation level reached	maximum validation level reached
13	missed record reason code or blank	Query category code 1-6, 21-23 + `DFqcproblem_map` codes	reason code

Field	Data Records	Query Records	Reason Records
14	missed record reason text or blank	Query usage code 1=internal, 2=external	reason text
15	blank	blank	blank
16	blank	blank	blank
17	blank (summary), ordinal field position	ordinal field position of data field	ordinal field position of data field
18	blank (summary), field name	field name of data field	field name of data field
19	blank (summary), old decoded label for choice/check	blank	blank
20	blank (summary), new decoded label for choice/check	blank	blank

Table 3.5. Changed Field

Field	Data Records	Query Records	Reason Records
8	0	>0: unique field ID of field on which query is located	<0: unique field ID of field on which reason is located
9	0 (summary), or unique field ID	field number of Query record	field number of Reason record
10	status 1-6	status 1-6	status 1-6
11	validation level	validation level	validation level
12	maximum validation level reached	maximum validation level reached	maximum validation level reached
13	blank	Query Category code 1-6, 21-23 + `DFqcproblem_map` codes	reason code
14	blank	Query usage code 1=internal, 2=external	reason text
15	old value	old value	old value
16	new value	new value	new value
17	ordinal field position	ordinal field position of data field	ordinal field position of data field
18	field name	field name of data field	field name of data field
19	blank, old decoded label for choice/check	blank	blank
20	blank, new decoded label for choice/check	blank	blank

Table 3.6. Deleted Record

Field	Data Records	Query Records	Reason Records
8	0	>0: unique field ID of field on which query is located	<0: unique field ID of field on which reason is located
9	0 (summary), or unique field ID	field number of Query record	field number of Reason record
10	status 7	status 7	status 7
11	validation level	validation level	validation level
12	maximum validation level reached	maximum validation level reached	maximum validation level reached

Field	Data Records	Query Records	Reason Records
13	1=missed record, 0=data record	Query category code 1-6, 21-23 + `DFqcproblem_map` codes	reason code
14	blank	Query usage code 1=internal, 2=external	reason text
15	blank	blank	blank
16	blank	blank	blank
17	blank (summary), ordinal field position	ordinal field position of data field	ordinal field position of data field
18	blank (summary), field name	field name of data field	field name of data field
19	blank	blank	blank
20	blank	blank	blank

It is also important to note the following about **DFaudittrace**:

1. If a record or a query is deleted and then re-created, the re-created record or query is considered to be new record (N), not a change (C) to the previous record.

2. In queries, the `user` is sometimes, but not always set when a query is created by the user. The `user` is never set when the query is modified or deleted, or when it is created by the report **DF_QCupdate**. Unknown user names appear in the output as `unknown` for dates before June 1, 1995 and as ?? thereafter.

3. In queries, the validation level is set when the record is created and reset when the record is modified. The validation level of a query does not change when only the record's validation level changes.

4. If the `-v vfence` option is used when running **DFaudittrace**, the effect is different for data records and queries. Data changes are output for records journaled after the case reached or surpassed the *`vfence`* validation level. Query changes are output for queries journaled after the query was modified at or beyond the *`vfence`* validation level.

Options

-s # DFdiscover study number.

-d date1[-date2] date of changes. This option restricts the output to changes made at *`date1`*, unless *`date2`* is also specified, in which case the output is the list of changes made between *`date1`* and *`date2`*. Dates are specified in the format `yyyymmdd` and may include the word `today` to represent the current date.

-q include query details.

-r include reason for change details.

-N include all field details for type N (new) records.

-A output the subject alias, if defined, in place of the subject ID. If there is no subject alias, output the subject ID.

-I # Subject ID.

-P # DFdiscover plate number.

-V # DFdiscover visit or sequence number.

-f fieldlist field number(s). This option restricts the output to the field numbers specified in the list. This may include a single field number, or a range or list of numbers. Range and list specifications may include a dash (-), tilde (~), or comma(,).

-v vfence validation level. In order to be considered for output, the keys on this record must have attained or surpassed the specified validation level at least once. This is useful if the user wants to output all changes that were made to records that have existed at or above the specified validation level. Once the record keys have made it to the *vfence* level, further changes will be output even if the record subsequently drops to a validation level below the *vfence* value.

-x *output.xlsx* Excel output file. Write the output, in Excel format, to the named file. The Excel file contains the same output, 20 columns per row, as the standard output. It includes one additional header row, with column names.

Exit Status

DFaudittrace exits with one of the following statuses:

0 The command was successful.

1 The command failed because the command-line arguments were not present or were incorrectly specified, the database server could not be contacted, or communication with the database server failed.

Examples

Example 3.7. Execute DFaudittrace to output journal information for study 254 between the dates of January 1, 2001 and January 15, 2001.

```
% DFaudittrace -s 254 -d 20010101~20010115
```

Example 3.8. Execute DFaudittrace to output journal information for study 254 between the dates of January 1, 1998 and today, for field numbers 10-13.

```
% DFaudittrace -s 254 -d 19980101-today -f 10-13
```

Example 3.9. Execute DFaudittrace to output all journal information for study 254, for records that have existed at or above a validation level of 2 at some point during the study.

```
% DFaudittrace -s 254 -v 2
```

Example 3.10. Execute DFaudittrace to generate an Excel file containing all changes for data related to subject 44002.

```
% DFaudittrace -s 254 -I 44002 -x 44002history.xlsx
```

Name

DFbatch — Process one or more batch edit check files

Synopsis

`DFbatch` [-S *`server`*] [-U *`username`*] [-C *`password`*] [-b *`batchnames`*] [-p *`stylesheet`*] [-exec] [[-o *`outhtml_file`*] | [-O *`outhtml_dir`*]] [-x *`out_xlsx`*] [-X *`out_dir_name`*] [-e *`error_file`*] {-i *`control_file`*} {*#*}

Description

DFbatch is a framework for edit check execution in command-line or unattended mode. The framework specifies which data records are to be operated upon by edit checks and what is to happen when edit checks are invoked. It uses the same edit checks that are used in interactive edit checks through **DFexplore** and introduces no changes to the language.

Complete reference documentation for **DFbatch** can be found in Batch Edit checks.

Options

-S server — DFdiscover server name

-U username — DFdiscover login username

-C password — login password. Refer to Section 3.2, “User Credentials” for recommended/better solutions for safe password handling.

-b batchnames — selected batches by name from the control file, and/or re-order selected batches for processing.

-p stylesheet — style the output with the specified XSL stylesheet before generating the HTML output. By default, `batchlog.xsl` is applied.

-exec — run dfexecute() and dfmail() when 'no apply' changes is specified in control file.

-O outhtml_dir — will make a default output HTML file in your local outhtml_dir for each batch. The default output file name will be 'outhtml_dir' + 'batch_name' + '_out.html'.

-o outhtml_file — '-o outhtml' output html file name is local and must include the full path. If '-o outhtml' is specified and there are more than one batches within a control file, only the last log will be saved to the given name.

-x out_xlsx — '-x out_xlsx' output excel file name is local and must include the full path. Use -X for multiple batches.

-X out_dir — '-X out_dir' make a default output XLSX in out_dir_name directory for each batch.

-e error_log — will write any errors to the full patch name of error_log. By default, errors are written to stderr.

-i control_file — The input file of instructions (required). These instructions control the behavior of the program including how records are selected, and what actions, if any, are applied.

study# — The study database number (required).

Exit Status

DFbatch exits with one of the following statuses:

0 The command was successful.

>0 An error has occurred. The text of the error will appear in one of the last elements of the log file.

See Also

Batch Edit checks

Name

DFcompiler — Compile study-level edit check programs and output any warnings and/or errors encountered in the syntax.

Synopsis

`DFcompiler` [-o *`compiled_outputfilename`*] {-s *#*} {filename}

Description

DFcompiler is used for syntax checking of edit check files. It can be run in the study **DFsetup** tool or from the command-line.

In **DFsetup**, selecting **Edit checks** from **Study** and selecting the Check Syntax, button in the edit checks window, runs **DFcompiler**. Results are output to the bottom Outputs section of the edit checks window. A user requires permission to use **DFsetup** in order to run **DFcompiler** in this way.

DFcompiler may also be run from the command-line using the options described below. The study number and edit checks file name (with a correct pathname) are both required arguments.

DFexplore has the ability to compile and run edit checks. Edit checks can be compiled (to DFedits.bin) by selecting Publish in **DFsetup** or from the command line using **DFcompiler** as follows:

```
% DFcompiler -s study# -o DFedits.bin DFedits
```

Edit checks are loaded automatically when **DFexplore** starts but can be reloaded following a new compile from the **File** > **Reload - Edit checks** option.

Options

-s *#* DFdiscover study number

-o DFedits.bin the output executable file used to run production edit checks in **DFexplore** and **DFbatch**. If no output file name is specified, syntax checking is performed but no output file is created.

filename the source file in which the edit check programs reside. Typically this will be `$STUDY_DIR/ecsrc/DFedits` containing the edit checks used by **DFexplore** and **DFbatch**

Exit Status

DFcompiler exits with one of the following statuses:

0 The command was successful.

1 The command is not supported by the user's current DFdiscover release.

2 The command failed because the database server could not be contacted, the study is not defined, the input file could not be located, or the server is out of memory.

Examples

Example 3.11. Compile and check the syntax for edit checks defined in `DFedits` for study 254

```
% DFcompiler -s 254 /opt/studies/254/ecsrc/DFedits
```

Name

DFdisable.rpc — Disable a study database server or incoming fax daemon to make them unavailable to clients and incoming faxes

Synopsis

`DFdisable.rpc` { [-s *#*] | [-i *#*] } [-f] [-w *#*] [-r *`string`*] {key}

Description

The study database server must be disabled when a user requires "off-line" access to the database and wishes to ensure that no client connections to the server are permitted.

Equivalent functionality can be obtained using the Studies dialog in **DFadmin**.

A disable request will fail if there are other users with client tools connected to the study server at the time of the request.

When `-i` is used to disable an incoming daemon, the daemon is allowed to complete any fax processing that it might be engaged in, but as soon as this is completed and the daemon exits, it will not be allowed to process another incoming fax.

Following execution of **DFdisable.rpc**, a study server or incoming fax daemon can be re-enabled using **DFenable.rpc**. The command must be executed by the user who executed **DFdisable.rpc**, and the same key must be provided.

When a study server is disabled, the default requirement is that the server shutdown as quickly as possible. In the interest of efficiency, it removes only those index entries that are for obsolete records and sorts only those index files that are unsorted. This is sufficient for correct operation of the server. However, the server does not remove those indices or records that are marked for deletion nor does it perform garbage collection on data records that are obsolete. The result is that it is subsequently possible to export a record that is still scheduled for deletion. This may be undesirable for archival purposes. Use of `-f` will force the server to remove all records marked for deletion and perform garbage collection of obsolete data records. This option is primarily useful when shutting down a database in preparation for archiving.

Options

-s #-i # the study number or the incoming daemon number of the server to be disabled

-f force clean-up of database. This results in a complete garbage clean-up by the server of the database. Usage of this flag will slow down the execution time of **DFdisable.rpc** and is not required for proper server operation.

-w # an optional number of seconds for the command to delay while waiting for the server to shutdown. The default is 60 and the legal range is 10 to 1000. Very large databases may not shutdown in 60 seconds and so should delay longer.

-r string an optional reason string indicating why the study server is being disabled. This reason will appear in the error log file whenever a user attempts to connect to the server while it is disabled.

key a required string, which must be subsequently provided by the same user from the same machine when executing to enable the server again. The key must be the last argument on the command line.

Exit Status

DFdisable.rpc exits with one of the following statuses:

0 The command was successful.

1 The command failed because the required command-line arguments were not present or were incorrectly specified.

> 1 The command failed because the database server could not be contacted, communication with the database server failed, or the database server has already been disabled.

Examples

Example 3.12. Disable study #123 so that database maintenance can be performed

```
% key=`date`
% DFdisable.rpc -s 123 -r "maintenance" $key
```

See Also

DFenable.rpc

Name

DFenable.rpc — Enable a study database server or incoming fax daemon following a previous

Synopsis

`DFenable.rpc` { [-s #] | [-i] } {key}

Description

When a study database server has been disabled, use **DFenable.rpc** to enable the server again and make it available for client connections. Equivalent functionality can be obtained using the Studies dialog in **DFadmin**.

When an incoming daemon is re-enabled it once again becomes available for processing incoming faxes.

Study servers and incoming fax daemons can only be enabled by the user who disabled them, and then only if the correct key is provided.

Options

-s # the study number to be enabled

-i enable incoming daemon

key a required string, which must be subsequently provided by the same user from the same machine when executing to enable the server again. The key must be the last argument on the command line.

Exit Status

exits with one of the following statuses:

0 The command was successful.

1 The command failed because the required command-line arguments were not present or were incorrectly specified.

> 1 The command failed because the database server could not be contacted, communication with the database server failed, or the database server has already been enabled.

Examples

Example 3.13. Enable study #123

In this case, the assumption is that the study was previously disabled and the disable key was saved in a shell variable.

```
% DFenable.rpc -s 123 $key
```

See Also

DFdisable.rpc

Name

DFencryptpdf — Protect a PDF file by encrypting it with the specified password

Synopsis

`DFencryptpdf` { [-c *`password`*] | [-C] } [-i *`string`*] [-o *`string`*]

Description

PDF supports password protection beginning with version 5.0 of Acrobat Reader and version 1.4 of the PDF standard. A PDF document has at least two levels of password: the owner password (which permits the owner to perform actions that another user cannot) and the user password. Since PDF is typically a plain text format, a password protected PDF document is encrypted and stored in binary format. The owner/user password is used as a salt for the encryption.

For DFdiscover purposes, the password is needed to ensure that the document can only be opened and read by known users (those with the password). Since DFdiscover supports delivery of study data/reports by PDF and email, it makes sense that the PDF document be protected from viewing by an unintended recipient. The password is not intended to limit what a user with the password can do with the document, so the owner and user password are the same and no restrictions are applied to any one of the actions available on the document.

DFencryptpdf returns zero upon success, otherwise returns one. **DFencryptpdf** may fail if the input PDF file is invalid PDF, has multiple cross-reference tables, such as linearized or updated PDF files, or is already encrypted. If neither `-c` nor `-C` is specified, it also returns an error.

Options

-c password-C
If `-c` is specified, the command line password is used. If `-C` is specified, **DFencryptpdf** reads the password from password file `~/.dfpdfpasswd`. If neither `-c` nor `-C` is specified, the program exits with an error.

The password file `~/.dfpdfpasswd` may contain multiple lines, but only the first non-empty line will be used. The leading spaces and trailing spaces will be removed. The maximum length of the password is 32 characters.

-i string
The name of the input PDF file that will be encrypted. If no input file is specified, **DFencryptpdf** reads from standard input.

-o string
The name of the encrypted output PDF file. If no output file is specified, **DFencryptpdf** writes to standard output. **DFencryptpdf** will exit with an error if the input filename and output filename are the same.

Exit Status

DFencryptpdf exits with one of the following statuses:

0 The command was successful.

1 The command failed because the required command-line arguments were not present or were incorrectly specified, the input file could not be read, or the output file could not be created/written.

Examples

Example 3.14. Encrypt a set of CRFs stored in `crfs.pdf` and protect with the password "DoNotUse".

```
% DFencryptpdf -c DoNotUse -i crfs.pdf -o protected_crfs.pdf
```

See Also

DFpdf

Name

DFexport — Client-side, command-line interface for exporting data by plate, field or module; exporting change history; or exporting components of study definition

Synopsis

`DFexport` [-S *`server`*] [-U *`username`*] [-C *`password`*] [[-Mname *`moduleName`*] | [-Mnum *`moduleID`*] | [-Pnum [[*#*] | [qc] | [reason] | [new] | [missed]]]] [-status *`#, #-#`*] [-level *`#, #-#`*] [-visit *`#, #-#`*] [[-site *`#, #-#`*] | [-subject *`#, #-#`*] | [-alias *`string`*]] [-plate *`#, #-#`*] [-create *`list`*] [-modify *`list`*] [-resolve *`list`*] [[-Pattern *`string`*] | [-pattern *`string`*]] [-expr *`string`*] [[-ALL *`criteria`*] | [-ANY *`criteria`*]] [[-Fnum *`#, #-#`*] | [-Fname *`fieldname_list`*] | [-Falias *`fieldalias_list`*]] [[-joinALL plt#[*`moduleFields`*]...] | [-joinANY plt#[*`moduleFields`*]...]] [-usealias] [-X] [[-c] | [-j]] [-d] [-p] [-z] [-h] [-D] [-H *`header_list`*] [-L *`lostcode`*] [[-w] | [-a]] [-o [[*`outfile`*] | [-]]] [-e *`errlog`*] {*`study#`*}

DFexport also has a descriptive mode for the output of schema information.

`DFexport` [-S *`server`*] [-U *`username`*] [-C *`password`*] [-listfields] { [[-listmodules] | [-listplates]] [[plt#,plt#~plt#] | [all]] } {*`study#`*}

DFexport has a history mode for the output of change history related to a subject, visit, or plate.

`DFexport` [-S *`server`*] [-U *`username`*] [-C *`password`*] {-history} {-subject *#*} [-visit *#*] [-plate *#*] {*`study#`*}

Options and Description

DFexport exports data from an individual study database. Minimally, the user must specify the study database and also at least one of the plates or modules containing the data of interest. Data records are exported in ASCII plain text format to a specified file, or the command-line output.

Differences and Similarities compared to DFexport.rpc

DFexport and **DFexport.rpc** share many features yet they are also unique in several important ways.

- **DFexport** is available as both a server-side and client-side application; **DFexport.rpc** is server-side only.
- **DFexport** is able to export descriptive information from a study schema with the `-listfields`, `-listmodules` and `-listplates` options.
- **DFexport** is able to export, with the `-history` option, the history of changes for a subject, visit within subject, or plate within visit of a subject.
- **DFexport** includes support for joining data fields from the same module definition that are instanced over one or more plates.
- **DFexport** is able to export all records marked as missed in one command execution using the `-Pnum missed` option. In **DFexport.rpc** this would require looping through each of the plates individually, selecting missed records at each step of the loop.
- User permissions for selecting by validation level are enforced in **DFexport**.
- Selecting queries and reasons by creation and modification date is supported in **DFexport**; in **DFexport.rpc** only data records may be selected in this way.
- Many options are specified using the same notation as **DFexport.rpc**, while others are specified using unique notation.

- It is possible for **DFexport** and **DFexport.rpc** to produce different results for the same selection criteria. **DFexport** enforces user permissions for the user specified with the `-U username` option or the DFUSER environment variable. **DFexport.rpc** uses the UNIX login name of the command-line.

General Approach

DFexport can export data in a plate-centric manner, like **DFexport.rpc**, using `-Pnum`, or in a module-centric manner that is unique to **DFexport** using `-Mname` or `-Mnum`. Many options are available to create data sets for a wide variety of needs. To get the most out of **DFexport** it can be useful to approach it's use with the following in mind:

1. **Preparation.** Access to exported data is available only to authenticated users with appropriate database permissions, Authentication and Database Permissions. Plate, module and field name information is available from **DFexport** itself, Schema Listings.

2. **Where is the data?** Specifying the source of the data, whether it is plate-based or module-based, is required, Data Source.

3. **Do the data records need to be filtered?** In many cases not all of the rows in a data set are of interest and need to be filtered further, Record Selection by Keys and Filters.

4. **Data Fields.** By default, all of the data fields in the specified data source will be exported. It is possible to specify a subset of the fields to export, Extracting/Combining/Concatenating Fields for Output. It is also possible to add field, module, plate, visit, image, site, and study metadata (including custom properties) to the export data, Including Metadata in Output.

5. **Output Formatting.** For export, the appearance of data fields can be modified without modification of the data source, Output Formatting.

6. **Output Destination.** Finally, the export data is written to a destination, Output Options.

Authentication and Database Permissions

Authentication. To authenticate, **DFexport** requires the username and password for connection to a specific database server. These may be supplied as:

1. command-line options, the user can specify `-S servername`, `-U username` and `-C password` when the program is run, or

2. environment variables, the user can set the variables DFSERVER *servername*, DFUSER *username* and DFPASSWD *password* before the program is run.

Specification of command-line options takes priority if both command-line options and environment variables are supplied. Refer to User Credentials for more information.

Database Permissions. Subsequent to authentication with a specific database server, use of **DFexport** is allowed (or disallowed) by the **Server - Export Data** permission, or the intersection of both **DFexplore - List view** and **DFexplore - Print/Save Data** permissions. These permissions are granted to a role (and then user) by an administrator on a study-by-study basis (see *System Administrator Guide, Server*). An authenticated user with one of these role permissions will then be able to export data records from the set of site and subject IDs granted by their user permissions, which may further be limited by visit, plate and level restrictions associated with the user's role. **DFexport** provides no warning that some records cannot be exported due to permission restrictions as this would itself provide information about the existence of restricted data records. For roles without 'Show Hidden Fields' permission and fields with the Hidden or Masked property enabled, **DFexport** will output an empty (NULL) value when exporting such data fields, and it will also skip over reasons and queries attached to such fields.

Schema Listings

This feature is unique to **DFexport** and is not available in **DFexport.rpc**. **DFexport** is able to output database schema information. The available information includes plate numbers and module names, and may optionally also include field number, name, alias and data type for data fields in the requested plates or modules. This descriptive information can be useful reference material when a user wishes to further refine an export.

To obtain a listing of all defined plate numbers, use `-listplates all`. [1] To obtain a listing of all defined module names, use `-listmodules all`. In both cases:

- the output is a space-delimited list of values (either plate numbers or module names) matching the requested criteria,
- a subset can be specified by replacing `all` with individual, lists, or ranges of plate numbers in the format *#, #-#*.

Example 3.15. List all module names used in plates 100 through 200

```
%  DFexport -listmodules 100-200 10
Chemistry Eligibility Enrollment Header LabData PhysicalExam SocialImpact Urinalysis
```

The output is sorted by module name and each module is listed exactly once, even when instanced more than once. Modules that are not instanced on one of the selected plates are not included in the output.

Information about data fields in the specified plates or modules can be requested by additionally including the `-listfields` option. This option may only be used in conjunction with the `-listmodules` and `-listplates` options.

Example 3.16. List schema information for data fields of all plates

```
%  DFexport -listfields -listplates all 253
Plate 001: Blood Pressure Screening Visits
 Field  Name                    Alias                   Type
 -----  ----------------------  ----------------------  -------
    1   DFSTATUS                DFstatus1               Choice
    2   DFVALID                 DFvalid1                Choice
    3   DFRASTER                DFraster1               String
    4   DFSTUDY                 DFstudy1                Number
    5   DFPLATE                 DFplate1                Number
    6   DFSEQ                   DFseq1                  Number
    7   ID                      ID001                   Number
    8   PINIT                   PINIT001                String
    9   AGE                     AGE                     Number
   10   SEX                     SEX                     Choice
   11   RACE                    RACE                    Choice
   12   RACEOTH                 RACEOTH                 String
   13   S1DATE                  S1DATE                  Date
...
```

This is the beginning of the output - actual output would be much longer as the user has requested this information for all defined plates. Field information is included both for user-defined fields and the fixed DFdiscover fields.

Example 3.17. List schema information for data fields of all modules

```
%  DFexport -listfields -listmodules all 253
Module: BloodPressure (ID=5022): Blood Pressure Readings
```

[1] This output format matches the output from DFlistplates.rpc.

```
Field  Name                 Alias                Type     Used in Plates
-----  -------------------  -------------------  -------  ------------------
    1  DFSTATUS             DFSTATUS             Choice
    2  DFVALID              DFVALID              Choice
    3  DFRASTER             DFRASTER             String
    4  DFSTUDY              DFSTUDY              Number
    5  DFPLATE              DFPLATE              Number
    6  DFSEQ                DFSEQ                Number
    7  DFPID                DFPID                Number
    8  DFMNAME              DFMNAME              String
    9  DFMID                DFMID                Number
   10  DFMREF               DFMREF               Number
   11  SBP1                 SystolicReading1     Number   1,5
   12  SBP2                 SystolicReading2     Number   1,5
   13  SBP3                 SystolicReading3     Number   1
   14  DBP1                 DiastolicReading1    Number   1,5
   15  DBP2                 DiastolicReading2    Number   1,5
   16  DBP3                 DiastolicReading3    Number   1
   17  SDAT                 ReadingDate          Date     1
   18  BPARM                BPwhichArm           Choice   5
...
```

This is the beginning of the output - actual output would be much longer as the user has requested this information for all defined modules.

The module listing provides the module name, `BloodPressure` (useful in conjunction with `-Mname`), the module number, `5022` (useful in conjunction with `-Mnum`) and the field numbers and names defined in the module, `DFSTATUS, ...` (useful in conjunction with `-Fname` or `-Fnum`).

History of all Changes

This feature is unique to **DFexport** and is not available in **DFexport.rpc**. **DFexport** is able to output the history of all changes made to the data for a specific subject, visit or plate. The available information includes when the change was made, who made the change, what was changed, any reason associated with the change and any queries related to the data. The output is always to a file, in Excel format, and hence option `-o outfile.xlsx` is required.

To obtain a history listing use `-history`. The history of changes is specific to a single subject, and includes all data, query and reason changes for all data elements in records idenitfied by the subject ID. The output can be further filtered by visit, `-visit #`, and plate, `-plate #`.

DFexport is designed to export history of changes for exactly one subject. To export history for multiple subjects, DFauditrace is available.

Data Source

Specifying the data source for the records to export is required. Data can be exported by plate number, using the `-Pnum` option, or by module, using either the `-Mname` or `-Mnum` option. Within any of these data sources, the default behavior is to export all of the defined fields. It is possible to further select the exported fields using one of the `-Fname`, `-Falias` or `-Fnum` options. Field name, alias and number information can be obtained from a previous invocation that includes the `-listfields` option.

-Pnum # Plate number. This is equivalent to the required plate number in **DFexport.rpc**. Exactly one plate number value may be specified. The value is the actual plate number or from this list of keywords:

- qc: export all queries

- `reason`: export all reason records
- `new`: export all records awaiting first validation
- `missed`: export all records marked as missed across the entire database

If a plate selector is not given, the data source must be specified by module name or module number.

-Mname or -Mnum Module name or module number. Export data from the specified module. Exactly one module name or module number may be specified. Schema listing options `-listfields -listmodules` may be used to determine the module name or number of interest.

If a module selector is not given, the data source must be specified by plate number.

Record Selection by Keys and Filters

There are many options available for selecting subsets of data records for export. Several of these options are similar or identical to their counterparts in **DFexport.rpc**. [2] In all cases, record selection and filtering is from the set of records allowed by the user's database permissions.

The available selection mechanisms and filters are:

-level *`#, #-#`* validation level. By default, records at all validation levels permitted by the user permissions are exported. This option further selects a subset of those records, namely those having a validation level that falls within the specified range.

-site *`#, #-#`* site number. This option selects records by site number, site numbers, site number range or any combination thereof. The site number of any data record is derived by dereferencing the subject ID in the study's sites database.

This option may not be combined with `-subject` *`#, #-#`* or `-alias` *`string`* - doing so will cause **DFexport** to exit with an error message.

-subject *`#, #-#`* subject ID. This option selects records by subject ID, subject IDs, subject ID range or any combination thereof.

This option may not be combined with `-site` *`#, #-#`* or `-alias` *`string`* - doing so will cause **DFexport** to exit with an error message.

-X This option excludes data from sites marked `test only`.

-alias ***`string`*** subject alias. This option selects records for a single subject alias.

This option may not be combined with `-subject` *`#, #-#`* or `-site` *`#, #-#`* - doing so will cause **DFexport** to exit with an error message.

-visit *`#, #-#`* visit/sequence number. This option selects records by visit number, visit numbers, visit number range or any combination thereof.

-status status record status. Select records by status keyword or status numeric value. The recognized status keywords are `final`, `incomplete`, `pending`, `missed`, `all`. [3] The default is all statuses, using keyword `all`, or by excluding this selector. A single status keyword

[2] **DFexport** typically uses a word to specify an option while **DFexport.rpc** uses an option letter.
[3] For backwards compatibility, the legacy status keywords (`clean`, `dirty`, `error`, `CLEAN`, `DIRTY`, `ERROR`, `missed`, `primary`, `secondary`, `all`) are currently supported but will be removed in a future release. Do not rely upon the availability of the legacy status keywords.

or multiple, comma-delimited status keywords can be specified but it is not possible to specify a range of statuses. It is also possible to reference a status by it's numeric value, and in that case a range of numeric values may be specified.

If plate 511 is exported, the available status keywords are the same but their meaning (as related to query status) is translated by the table:

Table 3.7. Numeric value, record status keyword, query status and reason status equivalence

Numeric value	Record status keyword	Query status equivalent	Reason status equivalent
1	final	new	approved
2	incomplete	in unsent report	rejected
3	pending	resolved NA	pending
4	secondary [a]	resolved irrelevant	-
5	secondary [b]	resolved corrected	-
6	secondary [c]	in sent report	-

[a] For backwards compatibility, old keyword `CLEAN` is supported.

[b] For backwards compatibility, old keyword `DIRTY` is supported.

[c] For backwards compatibility, old keyword `ERROR` is supported.

-plate ***#, #-#*** plate number. Select from module instances, queries, new, missed or reason records by plate number.

It is important to note that this is not the same as the required plate number selector in **DFexport.rpc**. In that environment, the plate number selects the data file source for the export. In **DFexport**, this option filters the data source which may be modules, complete data records, queries, reason, new or missed records.

Example 3.18. Export all missed records in plates 1 through 10

```
%  DFexport -S server -U username -Pnum missed -plate 1-10 -o -
 254
```

Example 3.19. Export all ESIG modules in plates 100 through 110 and 200

```
%  DFexport -S server -U username -Mname ESIG -plate 100-110,200
 -o esigmodules.txt 123
```

The output, from study 123, is written to the file `esigmodules.txt` in the current directory.

-create ***yy/mm/dd-yy/mm/dd*** creation date. Select data, query or reason records by their creation date. The keyword `today` can be used to include records that were created today.

-modify ***yy/mm/dd-yy/mm/dd*** modification date. Select data, query or reason records by their last modification date. The keyword `today` can be used to include records that were last modified today.

-resolve ***yy/mm/dd-yy/mm/dd*** resolution date. Select query records by their resolution date. Queries that are not yet resolved will not have a resolution date and hence will always be excluded if this selection

filter is used. The keyword `today` can be used to include query records that were resolved today.

-Pattern|pattern string

Filter records to export only those that match the specified pattern string. For inclusion in the export, a fragment of the record must exactly match the entire pattern string. The `-Pattern` option requests a case sensitive match, while `-pattern` requests a case insensitive match. [4]

-expr

Include only records that match the expression. The expression has the same format and meaning as the expression builder in **DFexplore**. For a complete description of the available expression syntax refer to *DFexplore User Guide, Searching Data Records*.

-ALL, -ANY

Specify one or more, simplified filter criteria. Each filter references fields from one plate and multiple filters may be combined to include fields from other plates. The result of these selection criteria is a set of subject IDs matching all of the criteria (`-ALL`) or at least one of the criteria (`-ANY`). That set of subject IDs is then used to further filter the output.

Each criterion must be specified using the notation:

```
plate#:$(fieldname) op value
```

where:

- **`plate#`** is a plate number from the set of plate numbers defined for the study, followed by a `:` separator,
- **`$(fieldname)`** is the name of a user data field defined for the plate number,
- **`op`** is an operator from the set of operators: `>, >=, ==, !=, <, <=`, and
- **`value`** is a single value consistent with the data type of the field (string and data values should be enclosed in `""` to prevent interpretation by the command environment).

To specify multiple criteria use `|` as a delimiter. The `-ANY` and `-ALL` options specify the resulting match behavior: with the `-ALL` option, every criterion must evaluate to true for a match to occur; otherwise, at least one criterion must evaluate to true.

Example 3.20. Export eSignature records for eligible, african-american males

The `SEX` (1=male) and `RACE` (2=african-american) are defined on plate 1 while `ELIG` (1=yes) is defined on plate 2.

```
-Mname eSignature -ALL '1:$(SEX) == 1 | 1:$(RACE) == 2 | 2:
$(ELIG) == 1'
```

The fields used in the criteria are, by default, not part of the output, nor are they required to be. In fact, unless the criteria are all from the same source, this is not possible with this option.

Extracting/Combining/Concatenating Fields for Output

Frequently, only a subset of the fields in the data source are of interest. These can be selected using one of the `-Fnum`, `-Fname` or `-Falias` options. Special handling of data fields that are defined in a module which is then instanced across more than one plate is required.

[4] Matching occurs before any output formatting (such as variable decoding or string splitting) is applied.

`-Fnum #, #-#.` Select by field number. From each exported record, select for output only those fields requested by their number. Output fields can be re-ordered by specifying the field numbers in the desired order. Field numbers can be repeated. It is possible to request field numbers using `NF` notation which selects by field number relative to the last field of the record. Some examples of `NF` usage are:

- **2-NF.** field numbers 2 to the last field inclusive
- **NF-1.** the second last field
- **5-NF-1.** fields 5 to the second last field, inclusive
- **NF-5-NF-1.** fields fifth from the last to the second last field, inclusive

This option may not be combined with `-Fname` or `-Falias` - doing so will cause **DFexport** to exit with an error message.

`-Falias fieldname_list`, `-Fname fieldname_list`. Select by field name or field alias. From each exported record, select for output only those fields requested by their name or alias. Output fields can be re-ordered by specifying the field names or aliases in the desired order. Field names/aliases can be repeated. This option may not be combined with `-Fnum` - doing so will cause **DFexport** to exit with an error message. Similarly, only one of `-Falias` or `-Fname` may be specified - any other specification or combination will cause **DFexport** to exit with an error message.

`-joinANY`, `-joinALL`. The default behavior of **DFexport** is to export data from one source, a plate or a module. However special handling is needed in the cases where a module instance is distributed across multiple plates. With the `-joinALL` and `-joinANY` options it is possible to combine and export data from a data source that is defined across plates in one invocation and into one output file. The join keys (the "join key triple") are always the subject ID, the sequence number and the module reference instance number and must match across data sources. These keys are always exported as the first three fields in each output record when joining occurs. Multiple data sources are specified using `|` as a delimiter. The specification for a single data source uses the notation:

```
plate#[fieldlist]
```

where:

- **`plate#`** is a plate number from the set of plate numbers defined for the study,
- **`fieldlist`** is a list of one or more comma-separated field numbers or names, enclosed with `[` and `]`.

The `-joinANY` and `-joinALL` options specify the resulting output behavior: with the `-joinALL` option, the database must contain a data record for every data source; otherwise, no data is output for that join key triple. Conversely, specifying `-joinANY` will export data so long as the join key triple appears in at least one data source.

Example 3.21. Re-construct the demographics module for output

The `DEMOGRAPHICS` module is instanced with fields on plates 1 and 2. Export the data, with a specific field ordering and some output formatting.

```
-Mname DEMOGRAPHICS -joinANY '1[PINIT, SEX] | 2[RACE, RACE:d, RACEOTH] | 1[AGE, DOB:c]'
```

Concatenation with +. By default, each selected field is output with optional formatting (see the section called “Output Formatting” and is separated from adjacent selected fields by the delimiter. Alternatively, selected fields can be concatenated, output with no delimiter at all. To specify concatenation, use the special concatenation symbol, +, between fields to concatenate. For example, to concatenate the site identifier and the subject identifier, use

```
DFSITE_ID+SUBJID
```

or to concatenate fields 9 and 12, use

```
9+12
```

It is also possible to concatenate a range of fields. In this case, concatenation has precedence over field range so,

```
8+9-12
```

or

```
8-11+12
```

or

```
8+9+10+11+12
```

are all equivalent. Note that there is no notation to concatenate a range of fields by specifying only the minimum and maximum field numbers; at least one of the numbers must be inidividually specified so that the concatenation operator can be used.

Including Metadata in Output

Study metadata is available for export as columns in each output record. Metadata is specified for inclusion in the output by inserting metadata keywords in the list of fields for export. In all cases, the exported value has the string data type.

The available metadata keywords are grouped by 6 categories: field, page, visit, image, site and study.

1. **field.** These metadata keywords reference field definition properties of a data field. For these keywords only, the keyword is appended to a field name to request a specific property of that specific data field. For example, `MHENDAT.DFVAR_PROMPT` requests the `DFVAR_PROMPT` property (the field prompt from the study definition) of the `MHENDAT` data field.

   The field properties that are available are:

   - `DFVAR_DESC`: field description
   - `DFVAR_TYPE`: field type
   - `DFVAR_PROMPT`: field prompt
   - `DFVAR_UNITS`: field units
   - `DFVAR_COMMENT`: field comment
   - `DFVAR_MODNUM`: module instance number containing field (Module Instance in setup definition)
   - `DFVAR_MODNAME`: module name containing field (Module Name in setup definition)
   - `DFVAR_MODDESC`: module description containing field (Module Description in setup definition)
   - `DFVAR_USER#`: field custom property value, where # is 1-20. Custom property tags may be used in place of the default name

2. **module.** These metadata keywords reference properties of the module instance.

   - `DFMODULE_NAME`: module name (Module Name in setup definition)
   - `DFMODULE_DESC`: module description (Module Description in setup definition)
   - `DFMODULE_USER#`: module custom property value, where # is 1-20. Custom property tags may be used in place of the default name

3. **plate.** Metadata keywords for a plate include DFPLATE_DESC (plate description) and DFPLATE_USER# (plate custom property value, where # is 1-20. Custom property tags may be used in place of the default name).

4. **page.** These metadata keywords reference page properties of the plate associated with the current data record. There is currently one page property available: DFPAGE_LABEL. The value is the descriptive label of the page. This label is taken from DFpage_map if there is a matching entry for the combination of visit and plate (field number substitution is also performed if requested with the # or #:d notation); otherwise, it is the plate description taken from the study database definition.

5. **visit.** These metadata keywords reference visit properties of the visit associated with the current visit. The current visit is determined by the visit number of the data record, even if the visit number is not included in the export. The visit properties that are available are: DFVISIT_DATE, DFVISIT_TYPE, DFVISIT_ACRONYM, DFVISIT_LABEL, DFVISIT_DUE, DFVISIT_OVERDUE, DFVISIT_REQUIREDPLATES, DFVISIT_OPTIONALPLATES, DFVISIT_ORDERPLATES and DFVISIT_MISSEDPLATE. The value of each property is detailed in *Study Setup User Guide, Visit Map*.

6. **image.** Each data record has an image attribute, which will have a value if there is an image associated with the data record. For those records, the image properties that are available are:

   - DFIMAGE_ARRIVAL: arrival date/time of the image
   - DFIMAGE_FIRSTARRIVAL: arrival date/time of the image; if there were multiple images over time, the chronologically first image
   - DFIMAGE_LASTARRIVAL: arrival date/time of the image; if there were multiple images over time, the chronologically last (most recent) image
   - DFIMAGE_FORMAT: image format
   - DFIMAGE_SENDER: sender ID for the document that included this image
   - DFIMAGE_PAGES: number of pages in the document that included this image

7. **site.** The site metadata associated with each data record can be determined by connecting the subject ID of the data record with the site record that includes the subject ID in the list of subjects. The site properies that are available are: DFSITE_ID, DFSITE_NAME, DFSITE_CONTACT, DFSITE_ADDRESS, DFSITE_FAX, DFSITE_PHONE, DFSITE_INVESTIGATOR, DFSITE_SUBJECTS, DFSITE_TEST, DFSITE_COUNTRY, DFSITE_BEGINDATE, DFSITE_ENDDATE, DFSITE_ENROLL, DFSITE_PROTOCOL1, DFSITE_PROTOCOLDATE1, DFSITE_PROTOCOL2, DFSITE_PROTOCOLDATE2, DFSITE_PROTOCOL3, DFSITE_PROTOCOLDATE3, DFSITE_PROTOCOL4, DFSITE_PROTOCOLDATE4, DFSITE_PROTOCOL5, DFSITE_PROTOCOLDATE5 and DFSITE_REPLYTO. The value of each property is detailed in *Programmer Guide, DFcenters - sites database*.

8. **study.** The study metadata is static for the entire study, it is defined at the study database level and does not change for different data record keys. The study properies that are available are: DFSTUDY_NUMBER (study number), DFSTUDY_NAME (study name) and DFSTUDY_YEAR (4-digit year of study start, defined by study admin as a global setting). In addition, DFSTUDY_USER# provides the study custom property value, where # is 1-20. Custom property tags may be used in place of the default name.

Output Formatting

Date Modifiers. By default, date fields are output "as is" in their defined format. The options -c and -j may be used to cause imputation and to alter/normalize that defined format for all date fields that are exported. The -c (calendar format) option requests that any 2-digit year be replaced with a 4-digit year and imputation be applied. The -j (julian format) option requests that imputation be applied and dates be exported as their equivalent julian value - this is primarily useful for mathematical calculations and comparisons with other date values. On an individual field basis, it is also possible to override the defined format with field level date modifiers. By following the field number, name or alias specification with a

`:c` or `:j` modifier, it is possible to export the same calendar or julian format result for a single field. The `:o` modifier requests the "original" date value, and can be useful where `-c` or `-j` has been previously specified. `DateField` and `DateField:o` produce the same result. Similarly, `DateField:c` also produces the same result if the field's format already specifies 4-digit years and no imputation is needed.

Example 3.22. Calendar and Julian Date Modifiers

For the field named `VisitDate`, export the value in default, original, calendar and julian formats.

```
-Fname "VisitDate, VisitDate:o VisitDate:c, VisitDate:j"
```

If `VisitDate` is defined with "imputation to the beginning" and an instance of that field in a data record has the data value `16/01/00`, this specification will produce `16/01/00|16/01/00|2016/01/01|2456963`.

A field level date modifier cannot be applied to a non-date field nor can it be applied to a range of field numbers, names or aliases; it may only be applied to a single field number, name or alias at a time.

Label Decoding. For any field that is defined with coding, it is possible to output the decoded label for a field's value by appending the `:d` modifier to the field number, name or alias.

Example 3.23. Output coded and decoded values

```
-Falias "sex, sex:d"
2|female
```

Any coded value that cannot be decoded is output as is. The modifier cannot be applied to a field that has no coding nor can it be applied to a range of field numbers, names or aliases; it must be applied to a single field number, name or alias at a time.

Header Record. Specifying `-h` forces the inclusion of a descriptive record, the header, as the first row of output. If `-h` is specified with `-D`, the header contains each field's description. Otherwise, if `-h` is specified with `-Fname`, the header contains each field alias. If `-h` is combined with `-Fnum`, or no field selection criteria are needed:

- the header contains each field alias if the data source is a plate, as specified with `-Pnum`
- the header contains each field name if the data source is a module, as specified with `-Mname` or `-Mnum`.

During export it is possible to create one or more new data fields by including options to string split (see String Splitting), extract substrings (see Extracting Sub-Strings) or include fixed, literal values (see Literal, constant values). If `-h` is specified then these new fields also need names to appear in the header record. This is done with the `-H` *`header_list`* option. This option specifies the variable names to appear in the header record for any new fields. If *`header_list`* contains fewer names than there are new fields, the remaining fields are assigned names identical to their original field names.

String Splitting. It is possible to split a string field into multiple, shorter string fields by appending a `:numxcharscw` modifier to a field number, name or alias selection. The modifier includes a specification of the number of fields to split the input string into (`num`), the literal `x` as a separator, the maximum width in characters of each output field (`chars`), and whether or not splitting should be done on character (`c`) boundaries or word (`w`) boundaries. If word boundaries are used, a word is delimited by any combination of space or tab characters. Word splitting will always split at the word boundary closest to but less than the maximum width. If there is no word boundary in the substring, the string will be split at the character boundary.

Example 3.24. Split a string field into 5 fields

This example splits the `comments` field into 5 200-character fields at character boundaries:

```
-Fname "comments:5x200c"
```

If a field to be split contains a missing value code, the first output field will contain the same missing value code and the remaining fields will be blank. If a field is split to create additional fields and a header record is requested with `-h`, field

names for the new fields are identical to the original field name unless `-H` is also specified. If `-H` *`header_list`* is given, the field names for the new fields are assigned in order from the *`header_list`*.

Extracting Sub-Strings. New fields can be created from substrings while exporting fields. The modifier notation `:xS.L` indicates that a substring is being extracted (x), starting at character position S (the first position is 1) and having length L characters. The modifier can be applied to any field number, name or alias selection.

New fields can be created from substrings while exporting fields. The modifier notation `:xS.L` indicates that a substring is being extracted (x), starting at character position S (the first position is 1) and having length L characters. The modifier can be applied to any field number, name or alias selection. Substrings can be extracted from any field type: string, date, time or numeric. Substrings are extracted from the string value equivalent of the field. Numeric field values are leading zero-padded to their store width before substring extraction is performed. [5]

Example 3.25. Digit extraction from subject ID

In some settings, the subject ID is a concatenation of site ID and a numeric subject identifier. In this example, the leading three digits are the site ID and the trailing four digits. Given PID values of `50001`, `60401` and `1232003`, the extraction would yield these results.

```
-Fname "PID:x1.3,PID:x4.4"
005|0001
006|0401
123|2003
```

Literal, constant values. A constant value may be inserted into the data export by including it in one of the `-Fnum`, `-Fname` or `-Falias` specifications. The value must always be enclosed with single-quotes, as in `'AB'`, to prevent any confusion with a matching field name or alias. To insert a blank field into the export, it must be represented by 2 adjacent single quotes, specifically `''`.

Example 3.26. Insert AD into the data export

```
-Falias "EnrollDate,'AD',SubjInit"
2014/12/12|AD|STN
2013/06/15|AD|PRP
2015/03/12|AD|KKW
```

The constant value `AD` is inserted between the `EnrollDate` and `SubjInit` fields in every exported record.

Enclosed by single-quotes, **DFexport** ignores the special meaning of any characters that would otherwise be delimiters. For example, `'a,b'` is the constant value `a,b`, not two separate constants. If `-h` is present, the name used in the header record is the value itself. If `-H` *`header_list`* is also present, the name used in the header record for each constant value will be the next value from *`header_list`*, if one is available; otherwise, the value itself will again be used.

Example 3.27. Specify a field name for the header record

```
-h -H "When" -Falias "EnrollDate,'AD',SubjInit"
EnrollDate|When|SubjInit
2014/12/12|AD|STN
2013/06/15|AD|PRP
2015/03/12|AD|KKW
```

Output Subject Alias. If `-usealias` is present, output the subject alias, if defined, in place of the subject ID. If there is no subject alias, output the subject ID.

[5] Choice and check field values are NOT zero-padded and hence substring extraction for those data types may yield unexpected or unreliable results.

Exclude Test Site Data. If `-X` is present, any data for sites that have been marked as `Test Only` sites in the sites dialog in **DFsetup**

Trailing Field Delimiter. For backwards compatibility, exported data records can be terminated by a trailing `|` if one is not already present. This is specified with the `-p` option. [6] With the trailing delimiter, exported data records maintain the original DFdiscover record format so that they can be, for example, easily re-imported into DFdiscover in a subsequent step.

Missed Record Handling. Missed records are include in the export if either `-status all` or `-status missed` are specified. To export missed records, there are two output options:

1. Internal to DFdiscover, missed records are handled in a different structure than other data records (see plt###.dat - missed records and Table 2.7, "Missed record field descriptions" for further information). Exporting them in this structure, when intermingled with plate- or module-based data records, does not result in normalized records - most records have the data structure, while some have the missed record structure. The result is that these records can be difficult to work with post-export.

2. By specifying the `-L` *`lostcode`* option, **DFexport** will export missed records by matching the structure of the corresponding plate and inserting *`lostcode`* into all of the user-defined data fields. This results in exported records that are normalized and all share the same structure. Post-export, missed records can be identified by the `missed` status in the status field, or the *`lostcode`* in all of the user-defined data fields.

When missed records are exported along with one of the field selection options `-Fnum`, `-Fname`, or `-Falias`, the second output option is always used. If the option `-L` *`lostcode`* has not been specified, the standard DFdiscover missing value code (`*`) is automatically inserted in each user-defined field of the exported record.

The *`lostcode`* specified with `-L` must be comprised of one or more alphanumeric characters. It is not permissible to use control characters. Also, the DFdiscover delimiter (`|`) may not be used, unless data is also being exported in CSV format with the `-z` option. Note that specifying the `-L` *`lostcode`* option will not, by itself, cause missed records to be exported. That is controlled entirely by the `-status` option. The `-L` option only indicates that the second, "normalized" output format is desired and is to be used with the specified substitution code.

Output Options

Output File. By default, output from **DFexport** is written to standard output (the command-line output). To write the output to a specific file, specify the filename with `-o` *`outfile`*. The user must have filesystem permission to create or modify the file. If *`outfile`* is specified as a relative pathname, the file is created relative to the **DFexport** command invocation directory.[7] It is also possible to be explicit that standard output is the output destination by specifying `-o -` although this is not necessary.

Output Mode. Options `-w` and `-a` control the output mode. The output is written (`-w`) or appended (`-a`) to the output file. This option is ignored if exported records are written to standard output rather than a file. If the output file does not exist, it is first created. If the output file already exists, it is either overwritten or appended to, depending upon the output mode.

Error Output. Re-direct any error messages to a specific file with the `-e` *`errorfile`* option. By default, error messages are written to standard error and hence would get intermixed with data if the data is being exported to standard output.

Comma-Separated Values (CSV) Format. CSV is a popular format used for sharing data records between different software programs. By including the `-z` option, **DFexport** will generate output that is compliant with this format. The unique requirements of the format are:

- Each field within a record is separated by a comma.

- Leading and trailing spaces adjacent to comma separators are ignored.

[6] This option has no effect when applied to exported query or reason records.
[7] If **DFexport** is invoked from a cron facility, absolute pathnames are highly recommended.

- Fields containing commas as part of their value are enclosed in double quotes.
- Fields containing double quotes are enclosed within double quotes, and the embedded double quotes themselves are each represented by a pair of consecutive double quotes.
- Fields with leading or trailing spaces are enclosed in double quotes.
- The record delimiter is a newline character (this is also true of records exported in the default, non-CSV format).

Exported records, in CSV or traditional (non-CSV), format are always delimited by a newline character.

If the `-h` option is also specified, the CSV requirements are applied to the header record and all of the values in the header.

Exit Status

DFexport exits with status 0 if the command was successful. Exit status 1 indicates that an error occurred - errors are written to standard error or the *`errlog`* file if `-e` was specified.

> **Important**
>
> Successful command execution can generate no output. This can happen if the selection criteria do not match any available data or match available data which the user does not have permission to view. If output to file is requested, such a command will create a file with no contents and size 0.

Examples

In the following examples, only the options unique to the example are specified. For clarity, required options such as authentication credentials, output destination and study number are omitted.

Example 3.28. Select and filter using data from two different plates

Export complete data records from plate 6. Filter those records to include only instances where records with matching keys on plate 1 have a date variable, `S1DATE` with a value of `01/01/06`.

```
-Pnum 6 -ANY "1:$(S1DATE) == 01/01/06"
```

Example 3.29. Module-based export

The structure of data exported from a module varies dependent upon whether all of the fields are instanced on a single plate, or on multiple plates.

Consider a study containing a module, `BASE`, that collects baseline data in fields `HEIGHT`, `WEIGHT`, the data across two records as in:

```
-Mname BASE
73|180||
||120|70
65|145||
||110|65
```

To generate the previous single record output requires a little more work, specifically:

```
-Mname BASE -joinALL "1[HEIGHT,WEIGHT] | 2[SYSTOLIC,DIASTOLIC]"
73|180|120|70
65|145|110|65
```

Example 3.30. Export eSignature records with a specific name

The eSignature name is stored in the `eSignature` module. Export records signed by 'Jack'. Several specifications are possible as illustrated here.

```
-Mname eSignature -expr '$(SigName) == "Jack"'
```

This is the most specific filter - the signature name field must contain exactly "Jack" and nothing else.

```
-Mname eSignature -expr 'tolower($(SigName)) ~ "jack"'
```

This is a less specific filter - the signature name field can contain a case insensitive variation of "Jack" somewhere in the value. Note that this also selects values like "Jackson", "Alex Jack" and "Wojack".

```
-Mname eSignature -pattern "jack"
```

This is the least specific filter and selects each eSignature module record that contains a case insensitive match for "jack" anywhere in the record.

Name

DFexport.rpc — Export data records from one or multiple plates from a study data file

Synopsis

`DFexport.rpc` [-A] [-X] [[-w] | [-a]] [[-c] | [-j]] [-d] [-e] [-J] [-m] [-p] [-q] [-h] [-k] [-z] [-s *`status_list`*] [-v *`#, #-#`*] [-n *`#, #-#`*] [-I *`#, #-#`*] [-V *`#, #-#`*] [-C *`yy/mm/dd-yy/mm/dd`*] [-M *`yy/mm/dd-yy/mm/dd`*] [-L *`lostcode`*] [[-U *`fieldname_list`*] | [-G *`fieldname_list`*]] [-f *`fieldnum_list`*] [-H *`header_list`*] {study} {plate(s)} {outfile}

Description

DFexport.rpc can be used to export whole data records or selected fields, from specified plates of a specified study database. Data records are exported in ASCII text format. **DFexport.rpc** does not provide support for joining fields from different plates or studies. To use **DFexport.rpc** users must have 'Export Data' permission, which is granted by an administrator on a study-by-study basis (see *System Administrator Guide, Server*). Users with export permission will only receive records for which they have get permission, which may be restricted by level, site, subject, assessment and plate. **DFexport.rpc** provides no warning that some records cannot be exported as this would itself provide information about the existence of restricted data records.

DFexport.rpc may appear in a shell script used to create reports stored in the study reports directory, to be run in **DFexplore** from the Reports View, or in a shell script run using `dfexecute` in an edit check. In these cases the permissions of the **DFexplore** user running the report or edit check will be applied. Thus the behavior and output may differ depending on the permissions of the user who runs the script.

If the same script is run from the UNIX shell, the permissions associated with the UNIX login name apply. Thus, if a user has different UNIX and **DFexplore** login accounts with different permissions, the user may get different results depending on whether they run the script in the UNIX shell or **DFexplore** environments.

Options

-A output the subject alias, if defined, in place of the subject ID. If there is no subject alias, output the subject ID.

-X Exclude output of data from sites marked `test only`).

-w-a output mode. The output is written (`-w`) to or appended (`-a`) to the output file. If the output file does not exist, it is created and written to for either output mode. If the output file already exists, it is overwritten with the `-w` mode or appended to with the `-a` mode. The output mode is ignored if the output file is standard output (indicated by `-`).

-c-j default date format. Without this option, date values are output in the format specified by their variable definition, and for partial date values, without any date imputation. With this option, date values are output in calendar (`-c`) format or julian (`-j`) format. In calendar format, the existing variable format is preserved except that 4-digit years are substituted for occurrences of 2-digit years. If the date value is not present, a blank value, "", is output, or if the date value cannot be imputed, the value `*` is output. In julian format, the date value is output as the number of days since a fixed point in the past. The fixed point in the past is the same for all invocations of the command allowing for date arithmetic. If the date value is not present, the value `0` is output, or if the date value is illegal, the value `-1` is output. In both types of formatting, date rounding is also performed as specified by the variable definition.

-d decode coded variables. With this option, all requested variables that are coded are output with their decoded labels. The default behavior, without this option, is to output the code itself. This option can be invoked at the individual variable level by appending the `:d` qualifier to the variable.

-e outfile extension. With this option, the output filename specified will have a text file extension (.txt) added to the end of the user defined outfile name. Outfile extension is ignored if the output file is standard output indicated by '-'. The

outfile extension is also ignored if only a single plate is specified. In the case of a single plate, the outfile name will be exactly as specified.

If this option is used along with the csv (`-z`) option, the csv extension (.csv) is added to the end of the specified output instead of the text extension (.txt).

-J Outer join with requested fields that may not exist for current plate. With this option, if the user specifies one or more fields that do not exist for a plate that is requested, data for that plate will still be exported but non-existent fields will have a data field containing the missed subsitution code and a header containing "NOT_DEFINED". If this option is omitted, plates that do not contain one or more of the fields requested will not be exported.

-m match data record validation level. This option is only relevant when exporting metadata records: reasons (plate 510) and queries (plate 511); and is ignored when exporting data records.

Meta-data records may have different validation levels from the underlying data records to which they are attached. When metadata records are exported using the -m option, the validation level of each exported metadata record is changed to match the validation level of the data record to which it is attached.

-p trailing pipe. For backwards compatibility, exported data records can be terminated by a trailing `|`, if one is not already present. This allows exported records to maintain the original DFdiscover record format so that they can be, for example, easily imported. A trailing pipe is only needed to make data records compatible.

> **Important**
>
> DFdiscover does not expect a trailing pipe to be present in query records (plate 511) or reason for change records (plate 510). Hence, the `-p` option should not be used when exporting query records or data change records if the intention is to re-import them into the database using **DFimport.rpc**.

-q quiet mode. This option instructs the program to execute in quiet mode, silencing all warning messages. The default, without this option, is to write warning messages to standard error. Warning messages are generated upon a request to export a field that does not exist in the record.

-h header. Include as the first record in the output file, a delimited record of variable names for the columns in the data records. The variable names are, by default, the alias variable names defined in the study data dictionary combined with `-H`. If fields are extracted using `-G`, the header contains the variable names combined with `-H`.

This option cannot be used with an export of the new record queue, plate 0, as the variable names are not fixed. It can however, be used with the export of query records (plate 511) and reason for data change records (plate 510). The headers for query and reason for data change records are defined in the study schema.

The trailing character is different in data records and queries. Data records are terminated by a final `|` while queries are not. This also applies to the header records. Thus, when exporting data records the header record is terminated by a trailing `|` while this is omitted when exporting queries.

If multiple plates are requested and the `-h` option is used, a warning message will appear if the output is written to standard output. The warning message will notify users that the per plate headers will be interleaved with multiple plate output data.

-k keys only. Output only the key fields for each data record. This includes, in order: id, plate, visit, status, and validation level, as `|` delimited fields. This option is a shorthand notation for the equivalent option `-f "7,5,6,1,2"`. This option cannot be used in conjunction with `-f`, `-G`, or `-U`.

-z Comma Separated Variables (CSV) format. This option exports all records so that they are compliant with this popular format. If this option is used in conjunction with the file extension option, the extension added to the end of the outfile name is the csv extension (.csv).

Required Options

The following three options are required and must appear in order at the end of the option list:

study — the DFdiscover study number, from which data records are to be exported.

plate(s) `#, #-#` all — plate numbers of the data files to export. A single plate can be specified or a list of plates can be specified to run in one invocation. If the same plate is listed more than once, the plate data is only exported once. The keyword 'all' can be used to export all existing plates within the specified study including the special reserved plates.

Special reserved plate numbers include: 0 for new records (received but not yet reviewed), 501 for returned Query reports, 510 for reason for data change records, and 511 for queries. If plate 511 is exported, the validation level of all exported records is updated to reflect the current validation level of the record that the notes are attached to.

outfile — output file that the exported records are written to. The user executing **DFexport.rpc** must have permission to create or modify this file. In the case of multiple plates being exported, the outfile name is used as the base filename from which a unique filename is constructed by appending each three digit, zero-padded plate number. If the output file is given as `-`, exported records are written to standard output rather than a file.[1]

Record Selection Options

The following options allow specific records to be selected from the output. With no options specified, all records are output. With options specified, only records matching the selection criteria are output. If multiple options are specified, only those records that match all criteria are output.

-s status — record status. The recognized status keywords consist of the legacy terminology: `clean`, `dirty`, `error`, `CLEAN`, `DIRTY`, `ERROR`, `missed`, `primary`, `secondary`, `all` and the current terminology: `final`, `incomplete`, `pending`, `missed`, `all`. Any combination of legacy and current terminology can be given as a quoted string. The default is records of all statuses.

If plate 511 is exported, the available status keywords are the same but their meaning (as related to query status) is translated by the table:

Table 3.8. Record and query status equivalence

record status	delete	final	incomplete	pending	secondary [a]	secondary [b]	secondary [c]
query status	delete	new	in unsent report	resolved NA	resolved irrelevant	resolved corrected	in sent report

[a] For backwards compatibility, old keyword `CLEAN` is supported.
[b] For backwards compatibility, old keyword `DIRTY` is supported.
[c] For backwards compatibility, old keyword `ERROR` is supported.

-v `#, #-#` — validation level. By default, records at all validation levels are exported, independent of the maximum validation level defined for the user. Specifying this argument causes only those records that match a validation level or are within a validation level to be exported.

-I `#, #-#` — subject ID. If this option is specified, only those records which have a subject ID matching the selection criteria are output. It is not valid to select records using `-I` in the same invocation as `-n` (selection by site). If this is done, **DFexport**rpc; will exit with an error message.

[1] Data written to standard output will also include "inline" header metadata if either of the `-h` or `-x` options are specified.

-n *#, #-#*
site ID. This option allows selection by site ID, site range or any combination thereof. However, it is not valid to specify `-n` in the same invocation as `-I` (subject ID). If this is done, **DFexport.rpc** will exit with an error message.

-V *#, #-#*
visit/sequence number. Specifying this option selects records to output by the visit number. Only those records matching the visit selection criteria are output.

-C *yy/mm/dd-yy/mm/dd*
creation date. If this option is specified, only those records which have a creation date matching the selection criteria are output.

Note that the selection criteria apply only to the creation date of data records and not queries.

-M *yy/mm/dd-yy/mm/dd*
modification date. If this option is specified, only those records which have a modification date matching the selection criteria are output.

Note that the selection criteria apply only to the modification date of data records and not queries.

For both `-C` and `-M`, the term `today` can be used to represent today's date.

-L lostcode
missing value code for missed records.

Missed records are exported if the keywords 'missed', 'lost', or 'all' are specified with the status option, `-s`. Missed records can be exported in 2 different formats. The first format is comprised of the missed data fields (i.e. including the missed category code and the text field containing the reason the record was classified as missed). The second format is comprised of all of the user defined data fields that appear on the CRF for that plate. The first format is the default and will be used whenever missed records are requested and the `-L` option is not used. If missed records are requested and the `-L` option is specified, missed records are exported with the *lostcode* value inserted into each user data field after field 7 (subject ID) - the trailing 3 system fields are exported with status 0, and the missed record creation and modification timestamps. The *lostcode* will also be used if the user specified fields using the `-f` and/or `-U|G` options along with the `-J` option and if one or more of those fields do not exist.

The only exception to this is when missed records are requested along with one of the field selection options (`-f`, `-G`, or `-U`). In this case, the second format is always used. If a substitution code has not been specified with the `-L` option, the generic DFdiscover default missing value code (*) is used, and a warning message is written to standard error, each time the substitution is made.

The *lostcode* specified with the `-L` option may consist of one or more alphanumeric characters. It is not permissible to use control characters. Also, the DFdiscover delimiter (`|`) cannot be used, unless data is being exported in CSV format with the `-z` option.

Note that specifying the `-L` *lostcode* option will not, by itself, cause missed records to be exported. This decision is controlled entirely by the status option. The `-L` option only indicates that the second format is desired and is to be used with the specified substitution code.

Argument parsing

Argument parsing in **DFexport.rpc** ignores extra, repeated delimiters. Any combination of space and comma is collapsed to one delimiter. For example:

```
DFRASTER,,,DFVALID = DFRASTER,DFVALID
DFRASTER  DFVALID = DFRASTER,DFVALID
DFRASTER ,,  ,,DFVALID = DFRASTER,DFVALID
```

```
,,DFRASTER ,,  ,,DFVALID = DFRASTER,DFVALID
```

are equivalent.

Field (variable) Selection Criteria

The following options allow fields (variables) to be selected from the output. With no options specified, all fields are output, unless `-k` has already been specified. With options specified, only the requested fields are output. If multiple options are specified, all of the requested fields are output, in the order requested.

-f #, #-# field number. Specifying this option selects for output from each record only those fields requested by their number. Output fields can be re-ordered by specifying the field numbers in the desired order. Fields can be repeated within the option. This option cannot be repeated in the command-line.

Command-line referencing of field numbers using `NF` (last field) or relative to `NF` is also possible. Some examples of `NF` usage are as follows:

- **2-NF.** include fields 2 to the last field inclusive
- **NF-1.** include the second last field
- **5-NF-1.** include fields 5 to the second last field, inclusive
- **NF-5-NF-1.** include fields fifth from the last to the second last field, inclusive

-U fieldname_list-G fieldname_list field name. Specifying this option selects for output from each record only those fields requested by their field name. If `-U` is used, fields are selected by their alias variable name. If `-G` is used, fields are selected by their variable name. Field names can be repeated within the option. These options cannot be mixed or repeated.

-H header_list field name headers. This option specifies the variable names to appear in the header (`-h` must also be specified) for new fields that are created as a result of one or more split modifiers.

Wherever a field number or field name is expected in field selection criteria, a constant value may also be referenced by inserting it in single quotes, as in `'AB'`. The purpose of this is to insert the constant value in the specified field location into the output records. The 'value' notation allows constant values to be exported in much the same way that a variable value can be. Since it is possible for a constant value and variable name to be the same, a constant value must always use the 'value' notation. For example, the specification:

```
-G "date,'AD',DFRASTER"
```

requests the variable with the name `date`, followed by the constant value `AD` and the raster image ID number. The output might appear as:

```
99/06/17|AD|9924/00001001
```

If a blank field is being exported, it must be represented by 2 single quotes with nothing inside.

DFexport.rpc will ignore the special meaning of any characters that would otherwise be delimiters. For example, `'a,b'` is the constant value `a,b`, not two separate constants.

If `-h` is present, the column name for each constant value will be the value itself, as in the following specification and output:

```
% DFexport.rpc -h -G "date,'AD',DFRASTER" 254 1 - | head -2
date|AD|DFRASTER
```

```
99/06/17|AD|9924/0001001
```

If `-H` is also present, the column name for each constant value will be replaced with the next `-H` value, if one is available. For example:

```
% DFexport.rpc -h -G "date,'AD',DFRASTER" -H "when" 254 1 - | head -2
date|when|DFRASTER
99/06/17|AD|9924/0001001
```

Date Modifiers

By default, date fields are output in the format defined for the field in the study data dictionary. If `-c` or `-j` is specified, the default output format is changed to 4-digit year format with imputation (`-c`) or julian format (`-j`). It is possible to override the default format for selected fields by following the field number or field name specification with a `:c`, `:j` or `:o` modifier. For example, the specification: **`-G "VisitDate, VisitDate:c, VisitDate:j"`** requests the variable with name `VisitDate` to be output in its default format, in calendar date format, and finally in julian format. The `:c` modifier applied to a field that already uses a 4 digit year format applies date imputation only. When using `-c` or `-j` to change the default output format for dates, note that there is no field level modifier that restores the original date format defined in the study data dictionary.

The `:o` modifier can be used in an analogous fashion to `:c` and `:j`. The effect of the `:o` modifier will be to cause the original date value to be output without any imputation.

A modifier cannot be applied to a non-date variable nor can it be applied to a range of field numbers or field names; it must be applied to a single field number or field name at a time.

Variable Decoding

It is possible to output the decoded label for a variable's value by appending the `:d` modifier to any variable that is defined with coding.

Example 3.31. Output the coded and decoded values for the sex variable

```
-G "sex, sex:d"
```

Any coded value that cannot be decoded is output as is.

The modifier cannot be applied to a non-coded variable nor can it be applied to a range of field numbers or field names; it must be applied to a single field number or field name at a time.

String Splitting

It is possible to split a string field into multiple, shorter string fields by appending a `:numxcharscw` modifier to the field number or field name specification. The modifier includes a specification of the number of fields to split the input string into (`num`), the maximum width in characters of each output field (`chars`), and whether or not splitting should be done on character (`c`) boundaries or (`w`) boundaries. If word boundaries are used, a word is delimited by any combination of space or tab characters. Word splitting will always split at the word boundary closest to but less than the maximum width. If there is no word boundary in the substring, the string will be split at the character boundary.

Example 3.32. Split a string field into 5 fields

This example splits the `comments` field into 5 200-character segments at character boundaries:

```
-G "comments:5x200c"
```

If a field to be split contains a missing value code, the first output field will contain the complete missing value code and the remaining fields will be blank.

If a field is split to create additional fields and a header record is requested with `-h`, field names for the new fields are identical to the original field name unless `-H` is specified. If `-H` is given, the field names for the new fields are assigned in order from the option list. If the option list contains fewer names than there are new fields, the remaining fields are assigned names identical to their original field names.

Extracting Sub-Strings

New fields can be created consisting of substrings of database fields. The following example creates a data field from the 4th and 5th characters of field 22.

```
-f 22:x4.2
```

Substrings can be extracted from any field type: strings, dates, or numbers. Substrings are extracted from the string value of the field. Numeric fields will be zero-padded to their store width before the substring extraction is done. In the following example, the first three digits of the subject ID field are extracted.

```
-f 7:x1.3
```

Comma Separated Variables (CSV) Format

CSV is a popular format used for sharing data records between different software programs. By selecting the `-z` option, **DFexport.rpc** will generate output records that are compliant with this format. The requirements of the format are:

- The record delimiter is a newline character (this is also true of records exported in the default, non-CSV format).
- Each field within a record is separated by a comma.
- Leading and trailing spaces adjacent to comma separators are ignored.
- Fields containing commas as part of their value are enclosed in double quotes.
- Fields containing double quotes are enclosed within double quotes, and the embedded double quotes themselves are each represented by a pair of consecutive double quotes.
- Fields containing embedded line breaks are enclosed within double quotes.
- Fields with leading or trailing spaces are enclosed in double quotes.

The first record in the CSV output file may consist of a header record containing field names. Each field in the header will also be comma-delimited and follow the requirements above.

Exit Status

DFexport.rpc exits with one of the following statuses:

0 The command was successful.

24 The user does not have the necessary permission to execute the command.

31 The requested plate does not exist in the database.

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The command failed because the database server could not be contacted, or communication with the database server failed.

Examples

Example 3.33. Export all records from plate 1 of study 255 to standard output

```
% DFexport.rpc -s all -h 255 1 -
DFSTATUS|DFVALID|DFRASTER|DFSTUDY|DFPLATE|DFSEQ|PID|INIT|VDATE|DFSCREEN|DFCREATE|DFMODIFY|
1|1|9807/1234567|255|1|0|99001|SCL|98/01/25|1|98/02/10 12:34:12|98/02/12 12:34:12|
2|4|9811/0005001|255|1|1|99002|RRN|98/02/12|2|98/02/10 15:03:34|98/03/01 11:23:14|
5|2|9831/0004012|255|1|1|99002|RRN|98/12/12|2|98/07/02 13:45:20|98/07/05 09:21:44|
1|3|9809/0044002|255|1|0|99003|*|98/02/03|1|98/02/10 14:23:01|98/02/10 14:23:01|
```

Example 3.34. Export, with header, all primary records at validation levels 1-2 from plate 1 of study 255 to standard output

```
% DFexport.rpc -h -s primary -v "1-2" 255 1 -
DFSTATUS|DFVALID|DFRASTER|DFSTUDY|DFPLATE|DFSEQ|PID|INIT|VDATE|DFSCREEN|DFCREATE|DFMODIFY|
1|1|9807/1234567|255|1|0|99001|SCL|98/01/25|1|98/02/10 12:34:12|98/02/10 12:34:12|
1|3|9809/0044002|255|1|0|99003|*|98/02/03|1|98/02/10 14:23:01|98/02/10 14:23:01|
```

Example 3.35. Export the first 3 and the 7th fields from plate 1 to standard output

```
% DFexport.rpc -f "1-3,7" 255 1 -
1|1|9807/1234567|99001
2|4|9811/0005001|99002
5|2|9831/0004012|99002
1|3|9809/0044002|99003
```

Example 3.36. Export the VDATE date field in 4-digit year format and export the subject initials in 3 single-character fields. Include the header record and define names for the newly created fields

```
% DFexport.rpc -c -G "VDATE,INIT:3x1c" -H "middle,last" 255 1 -
VDATE|INIT|middle|last
1998/01/25|S|C|L
1998/02/12|R|R|N
1998/12/12|R|R|N
1998/02/03|*||
```

Example 3.37. Export the primary records for subject IDs 99001 and 99002 selecting the fields from DFSTUDY to VDATE inclusive

```
% DFexport.rpc -s primary -I "99001,99002" -G "DFSTUDY-VDATE" 255 1 -
255|1|0|99001|SCL|98/01/25
255|1|1|99002|RRN|98/02/12
```

Example 3.38. Show all forms of manipulation for a partial date value in the variable DateCompleted1 for study 251

```
% DFexport.rpc -j -G "DateCompleted1,DateCompleted1:c,DateCompleted1:o" 251 1 -
2450845|1998/02/01|98/02/00
2451297|1999/04/29|99/04/29
```

Example 3.39. Create a DFdiscover Retrieval File (ID99001_plate10.drf) for study 254, all primary records for plate 10, for subject ID 99001

```
% DFexport.rpc -f "7,6,5" -I 99001 254 10 ID9901_plate10.drf
```

The following is the contents of the file ID9901_plate10.drf.

```
99001|1|10
99001|2|10
99001|3|10
99001|6|10
99001|9|10
99001|12|10
```

Example 3.40. Export all primary records for plates 1-3, 7 and 8 to standard output

```
% DFexport.rpc -f "7,6,5,3" 254 "1-3,7,8" -
99001|0|1|0915/000T001
99003|0|1|0915R000S001
99004|0|1|0915/000V001
99001|1|2|0915/000T002
99004|1|2|0915/000V002
99001|1|3|0915/000T003
99004|1|3|0915/000V003
99005|1|3|0000/0000000
99001|30|7|0915/000T009
99004|30|7|0915/000V009
99001|51|8|0915/000T010
```

When exporting multiple plates in one invocation, the outputs are always sorted in ascending order of the plate numbers, for example if the plate argument is changed to "7,8,3-1", the same output will be seen.

Example 3.41. Export all primary records for all plates in a study and create separate text files for each set of plate data.

```
% DFexport.rpc -e -f "7,6,5,3" 254 all Study254_
```

The following are the output files created by the above command

```
Study254_000.txt
Study254_001.txt
Study254_002.txt
Study254_003.txt
Study254_004.txt
Study254_005.txt
Study254_006.txt
Study254_007.txt
Study254_008.txt
Study254_009.txt
Study254_010.txt
Study254_011.txt
Study254_020.txt
Study254_501.txt
Study254_510.txt
```

```
Study254_511.txt
```

As seen above, all plates are exported in one invocation of the command. Special reserved plates are also included when the keyword 'all' is specified for the plates argument. A three digit, zero padded, plate number is also appended to the end of the outfile name, and is optionally followed by a file extension.

Example 3.42. Export, in CSV format, a subset of fields for plate 3 of study 254 and write the results to standard output

```
% DFexport.rpc -s all -z -f 1-7,59,63-66 254 3 -
2,1,9807/0047003,254,3,1,99001,,0,0,"knee surgery, hip replacement",2
1,1,0347R0012001,254,3,1,99101,"""other"" surgery",1,1," carotid   endarterectomy  ",2
```

Note that field values containing commas (`knee surgery, hip replacement`) are enclosed within double quotes. Fields containing double quotes (such as `"other" surgery`) are enclosed within double quotes and the embedded double quotes themselves are represented by a pair of consecutive double quotes.

Example 3.43. Export only missed records for plate 1, inserting the missing value code "NA" into the fields of each missed record exported. Export the results to standard output.

```
% DFexport.rpc -s missed -L "NA" 254 1 -

0|7|0000/0000000|254|1|0|20100|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|
NA|NA|NA|NA|NA|0|2018/01/15 12:35:23|2018/01/15 12:35:23
0|7|0000/0000000|254|1|0|20101|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|NA|
NA|NA|NA|NA|NA|0|2018/01/15 12:35:23|2018/01/15 12:35:23
```

Note that missing value code insertion is only performed for user-defined fields after field 7 (subject ID).

Limitations

DFexport.rpc and **DFexport** are the recommended ways to export data records from the study database for subsequent examination or analysis. Never read the data files directly as they may contain old copies of records scheduled for removal.

Since **DFexport**rpc; may only be run server-side by an authenticated user, it does not enforce user permissions as strictly as **DFexport** does. For example, **DFexport**rpc; ignores the Hidden/Masked field property while exporting field values.

Name

DFfaxq — Display the members of the outgoing fax queue

Synopsis

`DFfaxq` [*`#, #-#`*] [*`username`*...]

Description

DFfaxq reports on the status of requested faxes, either by their fax IDs, or by all faxes owned by the user(s) specified. When invoked with no arguments, **DFfaxq** reports on all faxes in the queue. For each outgoing fax, **DFfaxq** reports the unique fax ID number (by which it is referred to when using **DFfaxrm**), the user name of the fax owner, the scheduled time of sending, the file to be sent, the current status of the entry in the queue, the number of attempts at sending, and the phone number (or email address) to be sent to.

In the case of a fax that is being sent to multiple recipients, the fax ID, owner, scheduled time, and file to be sent, are all displayed on the first line together with the status, attempt, and phone number/email address of the first recipient. For the second and subsequent recipients, only the status, attempt and phone number/email address are displayed. The possible status values are:

- `New`: in queue and waiting for scheduled time to arrive
- `Sending`: in process of being sent to recipient
- `Retry`: in queue as previous tries have failed and waiting for retry delay to expire
- `Sent`: successfully sent to recipient
- `Failed`: failed and maximum number of retries was exceeded

If the recipient is an email address, the only possible status values are `Sending` or `Sent`. It is not possible to reliably track the delivery status of an email message and so the other statuses cannot be reported.

DFfaxq displays the queue information sorted by increasing fax ID#.

Options

`#, #-#` report on the status of faxes with the requested fax id numbers.

username report on the status of faxes owned by *`username`*. Multiple usernames can be specified.

Exit Status

DFfaxq exits with one of the following statuses:

0 The command was successful.

> 0 The required command-line arguments were not present or were incorrectly specified.

Examples

Example 3.44. Scheduled but not yet sent fax

```
% DFfaxq
```

```
FaxId Owner Scheduled Time  File       Status Try To
  307 usr1  Nov 30 16:18:23 /etc/fstab New    0   1234567
```

Example 3.45. In-progress fax to multiple recipients

Here is a queue entry for an in-progress fax to multiple recipients:

```
% DFfaxq
FaxId Owner Scheduled Time  File       Status Try To
  202 root  Nov 30 16:18:23 /etc/magic New    0   5432198
                                      Sent   1   abc@hotmail.com
                                      Retry  1   9876543
```

See Also

DFfaxrm

Name

DFfaxrm — Remove faxes from the outgoing fax queue

Synopsis

`DFfaxrm` { [-] | [*FaxId#*...] | [-a] }

Description

DFfaxrm removes faxes from the outgoing fax queue, that is, those faxes that have been scheduled for sending but have not yet been sent.

A specific fax can be removed by supplying its *faxid#*, which can be obtained using **DFfaxq**.

Example 3.46. Removing a fax by its faxid

```
% DFfaxq
FaxId Owner Scheduled Time  File       Status Try To
  307 usr1  Nov 30 16:18:23 /etc/fstab New    0   1234567
  308 usr1  Nov 30 16:18:23 /etc/fstab New    0   555-1212
% DFfaxrm 307
```

DFfaxrm reports the names of any faxes it removes, and is silent if there are no applicable faxes to remove.

When **DFfaxrm** removes a queue entry, faxes that are scheduled to be sent (status `New`) or retried (status `Retry`) in the future will not be sent or retried. However, any entries that have a status `Sending` are currently being transmitted and cannot be aborted. These faxes may be transmitted successfully, but any success command arguments specified to **DFsendfax** will not be executed. If a `Sending` status transmission fails, it will not be retried if it has been removed.

Options

Exactly one of the options is required. It is an error to mix these options. It is also an error to not supply any option.

- remove all faxes owned by the user executing the command. Fax ownership is determined by the user's login name on the machine where the fax was originally queued for sending.

faxid# remove the fax specified by *faxid#*. Multiple *faxid#*s can be specified.

-a remove all faxes from the outgoing fax queue. This option can only be invoked by users `datafax` and root.

Exit Status

DFfaxrm exits with one of the following statuses:

0 The command was successful.

> 0 The required command-line arguments were not present or were incorrectly specified.

Examples

Example 3.47. Removing a fax by its faxid

```
% DFfaxq
```

```
FaxId Owner Scheduled Time  File       Status Try To
  314 usr1  Dec 02 12:04:07 /etc/magic New    0   1234567
                                      New    0   9876543
% DFfaxrm 314
STATUS  FaxId Owner File       Status Try To
DELETED   314 usr1  /etc/magic New    0   1234567
                               New    0   9876543
```

See Also

DFfaxq

Name

DFget — Get specified data fields from each record in an input file and write them to an output file

Synopsis

`DFget` [-w] [-i *`delim`*] [-o *`delim`*] [-f *`#`*] {*`#, #-#`*}

Description

DFget reads records from the standard input and writes records to the standard output. Each input record is assumed to contain one or more fields delimited by the input delimiter. For each input record **DFget** applies the field specification string to create a new output record that is written to the standard output.

The field specification is constructed from one or more field specifiers. Each field specifier can be a single field number, a range of field numbers or a string.

One or more constant string fields can be inserted in output records. String fields can contain numbers and characters, and can also contain blank spaces. If the constant string field is a number (or begins with a number) it must be enclosed in a pair of single-double quotes (e.g. '"55"') or double-single quotes (e.g. "'55'"). This prevents **DFget** from interpreting those numeric strings as field specifiers.

Only those fields included in the field specification will be written to the new output record. Fields in the output record are delimited by the output delimiter and are written in the order given in the field specification.

The field number `NF` can be used to reference the last field in a record, and `NF-n` can be used to reference the n^{th} from last field in a record.

DFget is a convenient way to extract fields from exported database records. Remember to first export the desired data files using **DFexport.rpc**.

Combining the tools **DFexport.rpc**, **DFget**, and **DFimport.rpc** is a powerful way to manipulate data.

Options

-w warn about records that are too short to contain one or more of the requested fields. By default, no warnings are written and the requested fields that are not available are filled with blanks.

-i delim the specified character is the field delimiter in the input records. The default is `|`.

-o delim use the specified character as the field delimiter in the output records. The default is `|`.

-f *`#`* skip any records that do not contain the specified number of fields.

`#, #-#` the fields to retrieve from each record, and any constant values that are to be inserted (required).

Exit Status

DFget exits with one of the following statuses:

0 The command was successful.

36 The required command-line arguments were not present or were incorrectly specified.

Examples

Example 3.48. Retrieving specified fields from input records

Consider the following two line input file:

```
102|2|2|0101|gh|2|mellaril|t|100|1|90/03/01|0|
102|2|9|0101|bc|2|noctec|c|500|1|90/07/12|0|
```

To retrieve fields 1, 4 through 7, a constant string and the last 2 fields from each record, with a colon as the output delimiter, **DFget** could be used as follows:

```
% DFget -i '|' -o ':' 1 4~7 "'12 gm'" NF-1 NF < infile
102:0101:gh:2:mellaril:12 gm:90/03/01:0
102:0101:bc:2:noctec:12 gm:90/07/12:0
```

See Also

DFexport.rpc

Name

DFgetparam.rpc — Retrieve and evaluate the value of the requested configuration parameter

Synopsis

`DFgetparam.rpc` [-n] [-s *#*] {*param*}

Description

DFgetparam.rpc is the recommended way of determining the value of the master daemon's or a study server's configuration parameter. The current value of the parameter is printed on the standard output without a trailing new line character, unless `-n` is given. This is a format suitable for command line substitution by the shell.

When **DFgetparam.rpc** is running as user `datafax`, if the environment variable `DFUSER` is set, **DFgetparam.rpc** runs as that user. Thus for example requesting `USER_PERMISSION` will get the permissions associated with `DFUSER`, not the permissions for user `datafax`. This is important in **DFexplore** for shell scripts run by `dfexecute` in edit checks, and in study reports run under the Reports View.

The following configuration parameters can be retrieved from the master configuration:

AUTO_SLAVES hostnames on which slaves are started when DFdiscover is started

MAILEE email address for delivery of important system messages

PRINTER default printer for **DFadmin** application

PASSWORD_RULES a tuple of values in the following format: `length,complexity,expiry,reuse,lockout,failures,email,reset`. The meaning of these values can be found in *System Administrator Guide, DFmaster.cf*

ROUTER_USERS list of users that have permission to use the router

The following parameters can be retrieved from a study configuration:

AUTO_LOGOUT a compound value containing two numbers that represent, in minutes, the minimum and maximum settable automatic logout intervals

SITES database of participating clinical sites (`CENTERS` has been deprecated)

DATABASE_DIR study database directory

FILE_MAP lists all plates defined for the study

PAGE_DIR CRF page images root directory

PRINTER default printer for the study and all study applications

REPORTS_DIR study reports directory

SCHEMA study database schema

SETUP study setup defintion (JSON format)

STUDY_DIR study home directory

STUDY_HINTS information for ICR to locate data fields

STUDY_NAME descriptive study title, or acronym

STUDY_NUMBER DFdiscover study number

USER_PERMISSION the restrictions, if any, on which records the current user can access. The output is:

- the word `unrestricted` if the user has no access restrictions, or
- one or more concatenated 5-tuples describing the access restrictions. In each | delimited 5-tuple, the ordered fields identify the restrictions: 1st field is site ID, 2nd is subject ID, 3rd is visit number, 4th is plate number, and 5th is validation level.

VISIT_MAP subject assessment schedule

WORKING_DIR study work directory

Options

-n append a newline character to the end of the output. The default is to not emit a trailing newline.

-s # the DFdiscover study number. If this argument is missing, the parameter request is made of the master daemon's configuration.

param the name of the configuration parameter to be retrieved and evaluated (required).

Exit Status

DFgetparam.rpc exits with one of the following statuses:

0 The command was successful.

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The command failed because the master/server could not be contacted, or communication with the master/server failed.

Examples

Example 3.49. Determine the working directory for study 123

In this case, the value is assigned to a new shell variable, `work`.

```
% work=`DFgetparam.rpc -s 123 WORKING_DIR`
```

Example 3.50. Echo the value of the default printer for the master daemon

```
% echo `DFgetparam.rpc PRINTER`
```

Example 3.51. Determine the access permissions for study 253 for the current user

```
%  DFgetparam.rpc -s 253 USER_PERMISSION
1-10||||||0,1||||||1-44,46-90||
```

In this example, 3 access permission rules apply to the user:

- `1-10||||||`: all records for sites 1 through 10, inclusive

- `||0,1|||`: all records for visits 0 or 1
- `||2|1-44,46-90||`: all records for plates 1 through 44 and 46 through 90, inclusive, at visit 2

The user will be granted access to data records that meet at least one of these permission rules.

Name

DFhostid — Display the unique DFdiscover host identifier of the system

Synopsis

```
DFhostid
```

Description

DFhostid prints the unique DFdiscover host identifier of the system on the standard output. The output is a 20-character/digit identifier displayed in 5 blocks of 4. Note that the identifier will never contain any of 0 (zero), 1 (one), I (capital i), or O (capital o).

The host identifier of the DFdiscover master machine is required for licensing purposes.

Options

None.

Exit Status

DFhostid always exits with status 0, indicating that the command was successful.

Examples

Example 3.52. Determine the DFdiscover host identifier

```
% DFhostid
SG8D-QM2L-V8TK-PFB5-DDEG
```

Name

DFimageio — Request a study CRF image from the database

Synopsis

`DFimageio` [-hd] [-f *`string`*] {-s *#*} {*`imageID`*}

Description

DFimageio fetches a specific, single CRF image from the requested study database and writes it in its native format to a file, or standard output.

The study number and the unique CRF image identifier are required arguments. The CRF image identifier must be one of:

- a database image identifier, written in the *YYWW/SSSSPPP* notation,
- a **DFsetup** background identifier, written using the notation `$plt###.png` [1] where *###* is the plate number, or
- an **DFexplore** background identifier, written using the notation `$DFbkgd###.png` [1] where *###* is the plate number

Study CRF images are stored in the study file system and hence can also be accessed using standard shell commands. However, shell commands will fail to access the CRF image if:

- the CRF image resides on a file system which is not visible to the current computer
- filesystem permissions prevent the file from being read
- the CRF image was previously deleted when the database record which it references was deleted

DFimageio is the correct, accepted method for accessing CRF image contents from the study database. Future releases of DFdiscover will further tighten the permissions on the CRF image files so that **DFimageio** will be the *only* method for retrieving them reliably.

Options

-hd Request the HD version of the database image. If available, the HD version is returned; if not available, or if HD is not requested, the standard definition image is returned. This is applicable to database images only - the **DFsetup** and **DFexplore** backgrounds are available in only one definition. [2]

-f string write the retrieved CRF image to the named file. Without this option, the retrieved CRF image is written to standard output where it should be re-directed using shell syntax.

-s *#* the study number (required).

imageID the unique identifier for the CRF image (required).

Exit Status

DFimageio exits with one of the following statuses:

0 The command was successful.

[1] The $ character may need to be escaped with a backslash to avoid interpretation as a shell variable.
[2] Combining `-hd` with `$plt###.png` or `$DFbkgd###.png` will silently ignore the `-hd` argument.

36 The required command-line arguments were not present or were incorrectly specified.

1 The requested CRF image could not be located using the supplied image identifier.

Examples

Example 3.53. Get and write a requested CRF image to a file

```
% DFimageio -f image1 -s 254 1525/0008001
```

The CRF image with the unique identifier `1525/0008001` is written to the file named `image1` in the current directory.

Example 3.54. Get and re-direct a requested CRF image to a file

```
% DFimageio -s 254 1525/0008001 > image1
```

The CRF image with the unique identifier `1525/0008001` is written to the file named `image1` in the current directory. The result is identical to that in the previous example but uses shell re-direction to achieve it.

Example 3.55. Get and write a DFsetup background image to a file

```
% DFimageio -f image1 -s 254 \$plt001.png
```

The **DFsetup** background image with the unique identifier `plt001` is written to the file named `image1` in the current directory.

Name

DFimport.rpc — Import database records to a study database from an ASCII text file

Synopsis

`DFimport.rpc` [-v] [-N] [-R] [[-n] | [-q] | [-c]] { [-a] | [-m] | [-r] } [-s] {*#*} {*`string`*}

Description

DFimport.rpc imports records from the input file into a DFdiscover study database. To use **DFimport.rpc** users must have permission to import data, defined by the study administrator in role permissions. To import new records (using the `-a` or `-m` options) users must have create permission and to replace existing records (using the `-r` or `-m` options) users must have modify permission. Remember that create and modify permission may be specified by level, site, subject, assessment and plate. **DFimport.rpc** will reject any records it cannot import with an error message indicating that the user does not have the necessary permissions.

When reading records from the input file, each record must be delimited by a newline ('\n') character. Additionally, each record can be at most 4095 characters in length. If 4095 characters are read without encountering a newline, the record is truncated at 4095 characters. It will subsequently fail record checking and be rejected.

DFimport.rpc may be used in a shell script stored in the study reports directory and run in the **DFexplore** Reports View, or in a shell script stored in the study `ecbin` directory and run `dfexecute` in an edit check. In these cases the permissions of the **DFexplore** user running the report or edit check will be applied. Thus the behavior and output may differ depending on the permissions of the user who runs the script.

If the same script is run from the UNIX shell the permissions associated with the UNIX login name apply. Thus, if a user has both UNIX and DFdiscover login accounts, and these accounts have different permissions, the user may get different results when they run the script in the UNIX and **DFexplore** environments.

DFexplore uses the environment variable `DFUSER` to implement user permissions. It is possible to set and export this variable in the shell script to fix the permissions to those of any specified user, thus rendering the results constant for all users despite their specific **DFexplore** permissions.

Input records can be new data records that need to be reviewed in Fax View, new or previously entered data records for direct entry to the study database, or metadata records (data queries or reasons). It is not possible to mix these different record types in a single import operation. The type of records being imported is specified using one of the following options:

- `-n` : new records to be added to the new fax queue
- `-q` : queries for specified data fields
- `-c` : reasons for specified data fields

If none of these options is specified, the records must be new or replacement data records to be imported into the study database according to the plate number specified in the fifth field of each data record.

In addition to the record type options, there are 3 import mode options (add, replace and merge) to specify whether records are new and being added to the database (`-a`), replacement records (`-r`), or a combination requiring a merge operation during which new records are added to the database and existing records are replaced (`-m`).

To locate existing records in the database, **DFimport.rpc** searches for a record with matching keys (id, visit, plate) and image ID. This will always result in the identification of a record uniquely, if it exists, independent of whether the record has primary or secondary status. Dependent upon the record's presence in the database, the requested import mode will result in either an 'Add' or 'Replace' operation as shown in Table 3.9, “Deriving operations from import mode”.

Table 3.9. Deriving operations from import mode

Import mode	Exists	Does not exist
`-a`	**error	Add
`-r`	Replace	**error
`-m`	Replace	Add

If the operation is not in error, then the primary or secondary status of the import record is considered subject to the following rules:

Table 3.10. Add operation

Import record status	Existing record status	Ending State
primary	none	imported record becomes primary
secondary	none	**error
primary	primary	existing primary becomes secondary; imported record becomes primary
secondary	primary	imported record is added as secondary
primary	missing	**error

Table 3.11. Replace operation

Import record status	Existing record status	Ending State
primary	secondary	**error
secondary	secondary	imported record replaces existing
primary	primary	imported record replaces existing
secondary	primary	**error

Imported records are verified against the study data dictionary if `-v` is given. Without this option, imported records are only verified for the correct number of fields.

Formatting Records for Import

Records must be correctly formatted for the DFdiscover plate to which they will be imported. The standard field delimiter, `|`, must appear between data fields. The first 7 fields must include valid values for: status, level, image ID, study, plate, visit and subject ID respectively, and the last 3 fields must have valid values for: status, creation and modification. The only exception is for data records being imported to the new fax queue (using the `-n` option), for which the subject ID and visit keys may be blank.

The third field, image ID, must be unique for all data records in the study database. This field contains the image identifier if the record has an associated image file, or a raw record identifier if there is no image. When importing new records that have no image (e.g. lab data from an external source) this field should contain a placeholder image ID, `0000/0000000`. Specifying `-R`, will instruct **DFimport.rpc** to generate a new raw record identifier and insert it in the record, replacing the placeholder.

When importing metadata records (queries and reasons) the image ID field must also contain `0000/0000000`, but this value is not converted to a unique identifier by **DFimport.rpc** (`0000/0000000` is valid in metadata records).

A trailing delimiter is required at the end of all data records but must not be present on metadata records, i.e. queries (plate 511) and reasons (plate 510). Thus, care should be taken not to use the `-p` option, which ensures

there is a trailing pipe on exported records, when using **DFexport**rpc; to export queries and reasons if the intention is to re-import them into the database.

If the validation level of an imported record is higher than the user's maximum write level, it is adjusted down to the maximum, a warning message is generated, and the record import proceeds.

If an input record has a # or a newline in the first column position, **DFimport.rpc** treats the entire record as a comment and skips over it.

If **DFimport.rpc** completes without error, it echoes the number of records imported and the number of warning messages and exits with status 0. If **DFimport.rpc** encounters errors, which are unrelated to the records being imported, it exits with a message to stderr and a positive exit status. If **DFimport.rpc** encounters errors with the records it is importing, it writes each offending record to stdout, a problem description to stderr, and increments a counter of failed records. Upon exit, **DFimport.rpc** sets its exit status to the failed record counter. If all records are successfully imported, the exit status is 0.

Note

- **DFimport.rpc** does not complete successfully if the study server has been disabled or put into read-only access mode.
- If the study server is in exclusive access mode, only the user who put it into this mode can import data.
- If the study is in restricted access mode, only study and DFdiscover administrators are able to import data.

Options

-v Verify that the imported records match the database record format as specified in the study data dictionary. It is highly recommended that this argument be used under most circumstances. Without this option, minimal record checking is performed on the number of fields (must be at least 7), the record status, and the record validation level. The verification performed by `-v` is equivalent to the consistency checking performed by the DFdiscover utility program **DFcmpSchema** when run with the `-v` option.

-N Test that the data records verify correctly but do not import them.

-R Convert `0000/0000000` in field 3 to a new raw record identifier before importing data records to the study database. This option cannot be used when importing metadata records (queries and reasons).

-n-q-c Imported record type: if none of these options is specified the input file must contain data records to be imported into the study database according to the plate number field in each data record. Specifying:

- `-n`, New: add records to the new record queue, `DFin.dat`. When importing to `DFin.dat`, the import mode must be `-a` or `-r`.
- `-q`, queries: add records to the Query database, `DFqc.dat`. When importing to `DFqc.dat`, the import mode must be `-a` or `-r`.
- `-c`, Reason for change notes: add records to the reasons database, `DFreason.dat`. When importing to `DFreason.dat`, the import mode must be `-a` or `-r`.

-a-m-r Import mode (required) specifies one of three possible actions:

- `-a`, Add: fail if a record with matching keys and image ID already exists in database.
- `-m`, Merge: if a primary record with matching keys exists in the database, replace it if the image ID is the same, make it secondary if the image ID is different, otherwise proceed as if adding.
- `-r`, Replace: fail if a record with matching keys and image ID does not exist in the database, otherwise replace it.

-s Skip plate arrival triggers. This option can only be specified in conjunction with the `-n` (new record) import option. By default, plate arrival triggers (defined in Plate View in **DFsetup**) are executed when data records are imported to the new record queue. The combination of `-n -s` options allows new records to be imported without executing plate arrival triggers.

Plate arrival triggers are only executed if the record import is successful. If a trigger fails, a warning message is written to the DFdiscover error log.

The study database number into which the records are to be imported (required).

string The input file containing the records to be imported (required), or `-`, in which case the input records are read from standard input.

Exit Status

DFimport.rpc exits with one of the following statuses:

0 The command was successful.

24 The user does not have the necessary permission to execute the command.

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The command failed because the study schema or the input file could not be read, the database server could not be contacted, or communication with the database server failed.

Limitations

DFimport.rpc attempts to enforce database integrity as best it can. As a result, the following constraints are enforced:

- **DFimport.rpc** does not allow the import of type 21 (missing page), 22 (overdue visit) and 23 (edit check missing page) queries for which there is a primary record (missing, final, incomplete) in the database. Attempts to do this will result in a message that the record already exists.
- **DFimport.rpc** will delete any corresponding type 21 (missing page), 22 (overdue visit) and 23 (edit check missing page) queries when a primary record (missing, final, incomplete) is imported into the database.
- **DFimport.rpc** does not allow the import of new query records with category codes that are not defined in the Query Category Map in **DFsetup**. However, it does allow modification or deletion of records with undefined category codes.
- **DFimport.rpc** can be used to import data records that contain fields from an e-signature module but each of the e-signature fields will be blanked during the import. It is not possible to programmatically add/replace data records that have pre-filled e-signature fields. Such records must be reviewed in **DFexplore** after the import so that they can be e-signed.
- **DFimport.rpc** does not allow the import of queries for which the primary record is locked. Attempts to do this will result in a message that the record is currently in use.
- **DFimport.rpc** does not allow the import of data values for choice and check fields that do not exactly match one of the codes defined for those fields in the study schema.
- **DFimport.rpc** will not import secondary records with a raw or zeros image ID (e.g. `0922R00023001` or `0000/0000000`). The only supported function for secondary records is to reference additional images attached to the primary data record. Thus secondary records must have an image ID that points to an image file.

However, there are situations where a knowledgeable user may want to import records out of order, for example, so that referential integrity is initially violated, and then subsequently restored. The following operations are permitted as they allow a knowledgeable user to fully utilize **DFimport.rpc**.

- **DFimport.rpc** allows the import of queries for which there is no primary record in the database. This is to allow an out-of-sequence import of queries followed by their data records in a subsequent import. The correct sequence of steps is to first import the primary records followed by the queries.
- **DFimport.rpc** allows the primary record to be imported with a `delete` status, effectively deleting the primary record and all secondary records, queries and reasons associated with it. If the primary record is deleted, its secondary records and metadata will also be deleted to avoid having orphaned secondary, query and reason records in the database. During deletion, the record currently in the database is compared with the record being imported. All fields (other than status) must match for the operation to succeed. The number of fields can be different than the current definition for a given plate. This allows for the deletion of possibly corrupt records with field counts that differ from the current plate definition by exporting the record, changing its status to `delete`, and importing the record in question.
- **DFimport.rpc** allows query and reason records to be imported with a `delete` status, effectively deleting the queries and reasons. All fields (other than status and validation level) must match for the operation to succeed. The deletion of queries and reasons does not delete the primary record to which they are attached.

Name

DFlistplates.rpc — List all plate numbers used in the study

Synopsis

`DFlistplates.rpc` [-n] [-p *#, #-#*] {-s *#*}

Description

DFlistplates.rpc creates a list of the plate numbers defined for the study and writes that list to the standard output. The list is sorted in increasing numeric order. Each plate number is output with leading zero-padded to three digits and is delimited from the next plate number by a single space character. The complete list of plate numbers is output in one line without a trailing new line, unless `-n` argument is given.

Both the plate numbers for user-defined plates, and 501 (the plate number reserved for returned Query Reports), are output by **DFlistplates.rpc**. However, the special plate numbers, 0, which is reserved for new records in `DFin.dat`, 510, which is reserved for reason for data change records, and 511, which is reserved for records in the query database `DFqc.dat`, are not included in the list.

With `-p` *#, #-#*, the list of known plates for the study is intersected with the argument list to create an output list. If this option is not specified, the program lists all of the defined plate numbers for the study.

Options

-n append a new line character to the end of the output.

-p ***#, #-#*** include only the specified plates in the range of plates to output.

-s ***#*** the DFdiscover study number (required).

Exit Status

DFlistplates.rpc exits with one of the following statuses:

0 The command was successful.

> 0 The command failed because the database server could not be contacted, or communication with the database server failed.

Examples

Example 3.56. List the plates defined for study 123 to the standard output

```
% DFlistplates.rpc -s 123
 001 002 003 004 005 006 007 008 009 010 020 501%
```

Notice how the prompt has been affected by the lack of a trailing newline.

Example 3.57. List all plate numbers, one per line, for study 254 - Bourne shell method

```
% for p in `DFlistplates.rpc -s 254`
? do
? echo $p
```

```
? done
001
002
003
004
005
006
007
008
009
010
020
501
```

Name

DFlogger — Re-route error messages from non-DFdiscover applications to `syslog`, which in turn writes the messages to the system log files, as configured in `/etc/syslog.conf`.

Synopsis

`DFlogger` [-t *`string`*] [-f *`string`*] {-s *#*}

Description

DFlogger reads the standard input, or the file specified with `-f` *`string`*, treating each input line as an error message to be forwarded to `syslog`.

DFlogger should be used, in a pipeline fashion, at the end of commands that might generate error messages that you want to record in the system error log. **DFlogger** sends each input line to `syslog` and counts how many lines were written. The number of lines is used as the exit status of **DFlogger**. This has the benefit that, if **DFlogger** is used at the end of a pipeline, the exit status of the pipelined command will always be the number of error messages generated.

Options

-t string the name of the program that **DFlogger** should prepend each message with. This is the program name that will appear in the header information for the message when it is written to the error log. The default is `DFlogger`.

-f string the name of a file that contains error messages to be sent to the error log. Each line of the file is assumed to be an individual error message. If this option is not provided input is assumed to come from the standard input.

-s *#* the DFdiscover study number (required).

Exit Status

DFlogger exits with one of the following statuses:

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The command was successful. The exit status is the number of input lines that were transferred to `syslog`.

Examples

Example 3.58. Capture any error output from to the system error log

```
% DFtiff2ras /tmp/TIFFfile /tmp/rasterfile_ 2>&1 | \
DFlogger -t DFtiff2ras
```

Both the standard output and standard error are directed to **DFlogger** (this is C-shell syntax).

Name

DFpass — Locally manage user credentials for client-side command-line programs.

Synopsis

`DFpass` {[-add] | [-replace] | [-remove]} {*`servername:username`*}

Description

Several command-line programs, namely **DFattach**, **DFbatch**, **DFexport**, **DFpdfpkg**, **DFreport** and **DFuserPerms**, connect to study databases and require valid database credentials for the database connection to succeed. Each of these programs already permits the use of command-line options `-S`, `-U` and `-C` for specifying the needed servername, username and password credentials. Similarly, the `DFSERVER`, `DFUSER` and `DFPASSWD` environment variables may be assigned values and used.

DFpass is a convenience program that allows a user to locally store the password part of these credentials in a secure manner. Use of **DFpass** is not required but it is recommended for command-line users, and is strongly encouraged for users that write shell scripts and/or schedule program execution with facilities like UNIX **cron**.

DFpass manages credentials for the current user by keeping a local, user-specific database file of servername, username and password triples. Each record in the database is an encrypted representation of the credentials for one unique combination of servername, username and password. With **DFpass** one can add new records, update existing records with a new password and remove records.

Use of **DFpass** requires command-line specification of the action to be taken (one of: add, replace or remove) and the servername and username to which the action applies:

- if the `-add` action is specified, the combination of servername and username must not match a previously added entry that is already being managed locally by **DFpass**. The user is prompted to enter their password. **DFpass** obscures the password as it is typed in and requires the user to confirm by entering the password again. If the passwords match exactly, the password is accepted and saved locally for the user.
- if the `-replace` action is specified, the combination of servername and username must match a previously added entry that is already being managed locally by **DFpass**. The user is prompted to enter their new password. **DFpass** obscures the password as it is typed in and requires the user to confirm by entering the password again. If the passwords match exactly, the password is accepted and saved locally for the user.
- if the `-remove` action is specified, the combination of servername and username must match a previously added entry that is already being managed locally by **DFpass**.

In all cases, **DFpass** prints a message confirming that the requested action was action, or an error message if the action could not be completed.

> ### Important
>
> **DFpass** does not confirm that the supplied servername, username and password combination is valid. This is the responsibility of the user.

Password management

DFpass is not a replacement for the existing DFdiscover tools for managing user credentials, nor does it offer the same functionality. User credentials must still be created and managed within DFdiscover using standard methods. **DFpass** simply allows you to write and read those credentials locally in a way that does not expose passwords as clear text.

Adding entries with **DFpass** does not add credentials for the user to DFdiscover. It is vitally important that the entries made with **DFpass** match existing DFdiscover credentials, otherwise those entries are of no value. Users must also be aware that updating a password in DFdiscover does not update the local information managed by **DFpass**; this must be done separately with the `-replace` action.

Options

-add | -replace | -remove action to take (required).

servername:username the specific credentials to add, replace or remove (required). For the `-add` and `-replace` actions, the user will be prompted to enter their password and confirm the password by entering it again.

Exit Status

DFpass exits with one of the following statuses:

0 The command was successful.

1 The command was not successful.

Examples

Example 3.59. Add credentials

```
% DFpass -add testserver:testuser
Password: xxxxxxx
testserver:testuser added
```

Example 3.60. Remove credentials

```
% DFpass -remove testserver:testuser
testserver:testuser removed
```

See Also

User Credentials

Name

DFpdf — Generate bookmarked PDF documents of CRF images

Synopsis

`DFpdf` [[-c *password*] | [-C]] [-d] [-i *string*] [-o *string*] [-f *string*] [-v *string*] [-g *string*] [-s *string*] [-t *string*] [-j *string*] [-k *string*] [-n] [-b *string* [-a *string*] [-m #]] {#}

Description

DFpdf generates an optionally password-protected PDF document containing one or more pages, where each page is a study CRF, bookmarked within the complete PDF. The resulting PDF document follows the Adobe PDF specification, version 1.4.

If a password is provided, the entire file is encrypted and stored in binary format. Otherwise, the file is stored in plain text format.

DFpdf requires a study number argument and an input file. The input file, which must be in either DFdiscover data export or DRF format, lists the images that are to be included in the PDF output document. Sort order in the output matches the order that records appear in the input file. If the `-s` *`sortmap`* option is specified, sort order within subject will follow the rules specified by the contents of *`sortmap`*.

Bookmarks are created at the document root, subject, visit, and plate levels. The label for the document root bookmark is `ID, Visit, Plate` but can be over-ridden through the use of `-t`. A new bookmark is created as each new ID is encountered in the input and the label is of the form `ID #####`. A visit bookmark is created for each new visit number within the current ID. The label is created from field 3 of the study visit map if the visit is defined in the visit map; otherwise, it has the form `Visit #####`. Finally, a plate bookmark is created for each CRF in the input file. The label is created from the matching page map entry, if it is defined; from field 2 of the study `DFfile_map` if the plate is defined (which it should always be); or, it has the form `Plate #####`. For secondary records, an asterisk (`*`) is appended to the end of the page bookmark label. Hence it is easy to scan the list of expanded bookmarks and identify those records that are secondaries.

Using the `-j` and `-k` options, custom page header and footer labels, respectively, can be created for each CRF page in the output document. If no labels are specified, the default header label is `ID %DFID : %DFPMLBL` and there is no footer label. The desired label is specified in a string [1] and may contain any combination of fixed text and zero or more of the following keywords, which are replaced at output creation time with the matching database value:

- `%DFSTATUS` - record status (the status label is returned, rather than the status number)
- `%DFVALID` - record validation level
- `%DFRASTER` - image ID
- `%DFSTUDY` - DFdiscover study number
- `%DFPLATE` - plate number
- `%DFSEQ` - visit or sequence number
- `%DFID` - subject ID
- `%DFCREATE` - record creation time stamp

[1] If the string contains characters that are meaningful to the shell, such as space, quote, percent, etc., then the entire string must be enclosed in double quotes. The string can always be enclosed in double quotes, to ensure that no characters are interpreted by the shell.

- %DFMODIFY - record modification time stamp
- %DFPMLBL - page map label for the current keys as defined in DFpage_map
- %DFVLBL - visit label for the current keys as defined in DFvisit_map
- %DFPLBL - plate label for the current keys as defined in DFschema

A warning message is written to stderr for each record in the input file that does not reference an image file. No output is written to the PDF file for such records.

For records exported from the new fax queue, bookmarking will only be as good as the accuracy of the ICR on the record keys.

It is possible to override the default labeling for study visits and plates by providing alternative visit map, file map, and page map files with the -v, -f, and -g options respectively.

PDF document size

The output PDF document contains copies of the CRF images and hence each file can be quite large. The images are compressed so that the space requirements are not as onerous as for the source CRF images, but still, an input file listing 500 CRF images will create a PDF document that is approximately 5MB in size.

DFpdf exits with a status 0 if a PDF output file was successfully created; otherwise, a non-zero exit status is returned.

Options

-c password-C If -c is specified, the command line password is used. If -C is specified, **DFpdf** reads the password from password file ~/.dfpdfpasswd.

The password file ~/.dfpdfpasswd may contain multiple lines, but the first non-empty line will be used. The leading spaces and trailing spaces will be removed. The maximum length of password is 32 characters.

-d the input file is in DFdiscover Retrieval File (DRF) format

-i string the input file of data records that reference the CRF image to be included. Data records are assumed to be in data export format, unless -d is also used. If no input file argument is present, standard input is read.

-o string the output file that will contain the resulting PDF document. If no output file argument is present, the resulting PDF document will be written to standard output.

-f string an alternative file location for the study filemap. This file is read to determine plate labels for bookmarking. If the argument is not present, the FILE_MAP value of the study configuration will be used.

-v string an alternative file location for the study visit map. This file is read to determine visit labels for bookmarking. If the argument is not present, the VISIT_MAP value of the study configuration will be used.

-g string an alternative file location for the study page map. This file is read to determine visit labels for bookmarking. If the argument is not present, the STUDY_DIR/lib/DFpage_map value of the study configuration will be used.

-s string allows the specification of sort order by an external file. The file is expected to be in query sort order format. Without this option, no sorting of the input file is performed and images appear in the PDF document in the order that records appear in the input file. With this option, consecutive records for the same ID are sorted to follow the rules stated by the sortmap file. Note that no sorting is performed across IDs, only within IDs, and only when the IDs appear consecutively in the input file.

-t string the title to appear at the top of the bookmark list. If a title is supplied, in addition to setting the text of the bookmark title object, the title is also set in the PDF document information. If the title contains any characters that are meaningful to the shell, including spaces, the title must be enclosed in double quotes. If no title is supplied, the default title of `ID, Visit, Plate` is used.

-j string customize the page header label using a combination of fixed text and references to key and meta information. The default header is `ID %DFID : %DFPMLBL`, where `%DFID` and `%DFPMLBL` are replaced by the subject ID and page map label, respectively.

-k string customize the page footer label using a combination of fixed text and references to key and meta information. The default footer is blank.

-n reverses the order of nesting of visits and plates. Without this option, the preferred order is to nest plates within visits, unless the visit cannot be found in the visit map, in which case the visit (sequence) is nested within the plate. If `-n` is used, the preferred order is to nest visits within plates, independent of whether the visit can be found in the visit map or not.

-b string allows the specification of fields to be blinded (blanked out) in the output PDF file. The *`string`* is specified in the following format:

```
plate:field,field,field;plate:field,field
```

where `plate` is a valid plate number and `field` is a comma-delimited list of field numbers that are to be blinded on that plate (ranges of field numbers are specified by enumerating each field in a comma-delimited list). Field numbers must use DFdiscover schema numbering.

Field numbers that are not valid for the plate are skipped. Where multiple plates are required, plate specifications are separated by semi-colons.

To implement the blindlist, **DFpdf** must read the study setup file. The study setup file may be provided with `-a` *`string`*. If the setup file is not provided, the study server will be contacted to locate and supply the setup file.

`-m #` can be used to pad by the specified number of pixels, the blinded area. The default margin is 0 pixels, and the blinded areas are drawn in exactly the dimensions specified by the study setup. Legal values for margin must be > 0 and reasonable values are less than 10. For a margin greater than 0, the margin is added to each side of the setup dimensions and these new dimensions are used to blind the request field.

the DFdiscover study number (required)

Exit Status

DFpdf exits with one of the following statuses:

0 The command was successful.

1 The command was successful, but the resulting PDF file contained 0 pages.

2 The user does not have the necessary permission to execute the command. *This will be changed in the next release to exit status 24.*

2 The input file cannot be read, the setup definition cannot be read, the database server could not be contacted, or communication with the database server failed.

36 The required command-line arguments were not present or were incorrectly specified.

Examples

Example 3.61. Use DFpdf without the use of the DFexplore Save As PDF option

This example involves creating a DRF using **Save Data Retrieval File** from the **File** menu in **DFexplore**, and then running **DFpdf** from the command line to generate a PDF file of the saved record set.

To start the process, **DFexplore** was used to retrieve a set of records from the study database. The retrieved records were then saved to the DRF `dde.drf`. Example contents of `dde.drf` are shown below.

```
#user1 16/02/22|Records ready for DDE
#Id|Visit|Plate
1002|0|1
1006|0|1
2035|1|2
2035|1|3
2035|1|4
2035|21|5
2035|23|5
2035|24|5
```

Next, **DFpdf** was run from the command line to create a PDF document from the DRF having a custom header label for each record in the PDF document. In this example, **DFpdf** was invoked by the following command:

```
% DFpdf -d -t "Subjects" -i /opt/studies/val254/drf/dde.drf \
-j "Subject %DFID, Image %DFRASTER" -o /opt/studies/val254/drf/dde.pdf 254
```

To generate the same file with password protection, the following command was invoked using the password "4aY3gh98B":

```
% DFpdf -c 4aY3gh98B -d -t "Subjects" -i /opt/studies/val254/drf/dde.drf \
-j "Subject %DFID, Image %DFRASTER" -o /opt/studies/val254/drf/dde.pdf 254
```

It is also possible to pipe the output from **DFexport.rpc** directly into **DFpdf** as illustrated in the following example:

```
% DFexport.rpc 254 1 - | DFpdf -t "Screening Data" \
-j "Subject %DFID, Image %DFRASTER" -o /opt/studies/val254/work/Screening.pdf 254
```

See Also

DFencryptpdf

Name

DFpdfpkg — Generate multiple bookmarked PDF files for specified subject IDs or sites

Synopsis

DFpdfpkg [-S *server*] [-U *username*] [-C *password*] [-A] [-n] [-color] [-hd] [-b *blind_spec*] [-f *filemap*] [-v *visitmap*] [-g *pagemap*] [-s *sortmap*] [-t *title*] [-j *header*] [-k *footer*] [[-P *pdfpasswd*]] [-history [-bookmark *label*] [-excel | -legacy]] { [-data *data,missed*] [-image *primary*|*all*] } {-output *out_dir_name* } [-prefix *file_prefix*] { [-subject *pid_list*] [-alias *alias_list*] [-site *site_list*] } [-visit *visnum_list*] [-plate *pltnum_list*] [-e *errlog*] {study#}

Description

DFpdfpkg generates a set of optionally password-protected PDF documents (one per subject) containing one or more pages representing data records (EDC, fax, email, **DFsend**), and images and audit trail information. The resulting PDF documents follow the Adobe PDF specification, version 1.4, and as a result can be read by Acrobat Reader versions 5.X and greater.

If a password is provided, files are encrypted and stored in binary format. Otherwise, the file is stored in plain text format.

DFpdfpkg requires a study number argument and an output folder name. Records are output ascending numeric order by visit and plate. If the `-s` option is specified, sort order will follow the rules specified by the DFsortmap file.

Bookmarks are created at the document root, ID, visit, and plate levels. The label for the document root bookmark is `ID, Visit, Plate` but can be over-ridden through the use of `-t`. A visit bookmark is created for each new visit number within the current ID. The label is created from field 3 of the study visit map if the visit is defined in the visit map; otherwise, it has the form `Visit #####`. A plate bookmark is created for each CRF in the visit. The label is created from the matching page map entry, if it is defined; from field 2 of the study DFfilemap if the plate is defined (which it should always be); or, it has the form `Plate #####`. For secondary records, an asterisk (*) is appended to the end of the page bookmark label. Hence it is easy to scan the list of expanded bookmarks and identify those records that are secondaries.

Using the `-j` and `-k` options, custom page header and footer labels, respectively, can be created for each CRF page in the output document. If no labels are specified, the default header label is `ID %DFID : %DFPMLBL` and there is no footer label. The desired label is specified in a string [1] and may contain any combination of fixed text and zero or more of the following keywords, which are replaced at output creation time with the matching database value:

- `%DFSTATUS` - record status (the status label is returned, rather than the status number)
- `%DFVALID` - record validation level
- `%DFRASTER` - image ID
- `%DFSTUDY` - DFdiscover study number
- `%DFPLATE` - plate number
- `%DFSEQ` - visit or sequence number
- `%DFID` - subject ID
- `%DFCREATE` - record creation time stamp
- `%DFMODIFY` - record modification time stamp

[1] If the string contains characters that are meaningful to the shell, such as space, quote, percent, etc., then the entire string must be enclosed in double quotes. The string can always be enclosed in double quotes, to ensure that no characters are interpreted by the shell.

- %DFPMLBL - page map label for the current keys as defined in DFpage_map
- %DFVLBL - visit label for the current keys as defined in DFvisit_map
- %DFPLBL - plate label for the current keys as defined in DFschema

It is possible to override the default labeling for study visits and plates by providing alternative visit map, file map, and page map files with the -v, -f, and -g options respectively.

Options

-S server DFdiscover server name

-U username DFdiscover login username

-C password login password. Refer to Section 3.2, “User Credentials” for recommended/better solutions for safe password handling.

-A output PDF in A4 size

-n nest visits within plates

-color apply field color to completed pages

-hd output the PDF file with images in higher definition (HD), which is 300dpi while the default standard definition (SD) is 100dpi.

-b string allows the specification of fields to be blinded (blanked out) in the output PDF file. The *string* is specified in the following format:

```
plate:field,field,field;plate:field,field
```

where plate is a valid plate number and field is a comma-delimited list of field numbers that are to be blinded on that plate (ranges of field numbers are specified by enumerating each field in a comma-delimited list). Field numbers must use DFdiscover schema numbering.

Field numbers that are not valid for the plate are skipped. Where multiple plates are required, plate specifications are separated by semi-colons.

To implement the blindlist, **DFpdf** must read the study setup file. The study setup file may be provided with -a *string*. If the setup file is not provided, the study server will be contacted to locate and supply the setup file.

-m # can be used to pad by the specified number of pixels, the blinded area. The default margin is 0 pixels, and the blinded areas are drawn in exactly the dimensions specified by the study setup. Legal values for margin must be > 0 and reasonable values are less than 10. For a margin greater than 0, the margin is added to each side of the setup dimensions and these new dimensions are used to blind the request field.

-f filemap alternate study filemap

-v visitmap alternate study visitmap

-g pagemap alternate study pagemap

-s string allows the specification of sort order by an external file. The file is expected to be in query sort order format. Without this option, no sorting of the input file is performed and images appear in

	the PDF document in the order that records appear in the input file. With this option, consecutive records for the same ID are sorted to follow the rules stated by the sortmap file. Note that no sorting is performed across IDs, only within IDs, and only when the IDs appear consecutively in the input file.
-t string	the title to appear at the top of the bookmark list. If a title is supplied, in addition to setting the text of the bookmark title object, the title is also set in the document information (which is accessed from the Reader's "Document Info-General-Title" attribute. If the title contains any characters that are meaningful to the shell, including spaces, the title must be enclosed in double quotes. If no title is supplied, the default title of `ID, Visit, Plate` is used.
-j string	customize the page header label using a combination of fixed text and references to key and meta information. The default header is `ID %DFID : %DFPMLBL`, where `%DFID` and `%DFPMLBL` are replaced by the subject ID and page map label, respectively.
-k string	customize the page footer label using a combination of fixed text and references to key and meta information. The default footer is blank.
-P password	If `-P` is specified, the password is used to encrypt the PDF. The recipient will need to supply the same password to decrypt the file before reading.
-history	include data and metadata audit trail. This outputs the default simplified change history for each record in each PDF.
-bookmark label	bookmark label for history
-excel	create detailed Excel history file for each subject. This outputs the audit trail for each subject in a separate file.
-legacy	include DF_ATmods change history in each PDF. This outputs the audit trail in legacy format.
-data data,missed	data record options. Data records are included for the record types listed - data for records that include EDC and image-based, or missed which includes any records marked as missed.
-image primary|all	image options. Include only primary images or include all images attached to a record.
-output dirname	output folder for PDFs (required). This must be the full path to an existing directory or folder that is writable by the user.
-prefix file_prefix	PDF file prefix. Each file written to the output directory with a filename comprised of the prefix and the subject ID.
-subject pid_list	subject ID list. Output packages for the subject IDs in this comma-delimited list.
-alias alias_list	subject alias list. Output packages for the subject aliases in this comma-delimited list.
-site site_list	site number list. Output packages for the subject IDs that belong to sites in this comma-delimited list.
-visit visnum_list	visit number list. Include pages with the specified visit numbers.
-plate pltnum_list	plate number list. Include pages with the specified plate numbers.
-e errlog	error log file. Write any error or warning message to this filename. The default is to write any error or warning messages to stderr.
#	the DFdiscover study number (required)

Exit Status

DFpdfpkg exits with one of the following statuses:

0 The command was successful, one or more PDF output files were created.

1 The command was not successful.

Examples

Example 3.62. Use DFpdfpkg without the use of the DFexplore Create Subject Packages... option

The following example creates subject packages for subject ID 2035 and 2049 from Site 2.

```
% DFpdfpkg -S example.server.com -U example_user -C passwd \
-t "Site 2 Subject Packages" -color -data data -image primary \
-output /opt/studies/demo253/work -prefix "Site2_" \
-subject 2035,2049 253
```

See Also

DFpdf

Name

DFprint_filter — Format input file(s) for printing to a PostScript® capable printer, and print to a specified printer

Synopsis

`DFprint_filter` [-p *`string`*] [-c *#*] [-o *`string`*] [-f *`string`*]

Description

DFprint_filter is the main print interface. DFdiscover programs that send output to a printer may use **DFprint_filter** to format the output into PostScript® format, if necessary, and then spool the output to a printer.

DFprint_filter is capable of re-formatting PNG and Sun rasterfiles (the image formats used in DFdiscover), ASCII text files, and PostScript® files.

Options

-p string direct the output to the specified printer. If this argument is missing, and the environment variable `PRINTER` is defined, the value of the environment variable will be taken as the name of the printer. Otherwise, the default printer is the first printer specified in `/opt/dfdiscover/lib/DFprinters`, if the file is present and non-empty. If this is not customized locally, the system default printer, `lp`, is used.

-c *#* the number of copies to print. The default is 1.

-o string pass the user-supplied options to the print pre-processor. The print pre-processor is **DFpsprint** (for image files) and **DFtextps** (for all other files). **DFtextps** accepts additional user options that can be passed via this option. For example, `-o -p8` will cause the input text file to be printed in 8-point font rather than the default 10-point font.

-f string the name of the input file. If the filename is not provided, or is given as `-`, the input is assumed to come from the standard input.

Exit Status

DFprint_filter exits with one of the following statuses:

0 Always.

Examples

Example 3.63. Print the UNIX password file to the printer "hplj"

```
% /opt/dfdiscover/lib/DFprint_filter -p hplj -f /etc/passwd
```

Name

DFprintdb — Print case report forms merged with data records from the study database

Synopsis

`DFprintdb` [-d] [-A] [-usealias] [-p *`string`*] [-i *`string`*] [-o *`string`*] [-t *`string`*] [-e *`platelist`*|*`all`*] {-s *#*}

Description

DFprintdb prints case report forms merged with data records from a study database. One page is printed for each data record in the input file, and is bookmarked by the record keys: subject ID, visit and then plate. Printed output is either sent directly to the printer or the named output file.

DFprintdb uses the high resolution backgrounds previously generated by **DFsetup** during a **Study - Import CRFs** operation. A background, named DFbkgd###.png is created for each CRF plate, where ### is the plate number. If tagged backgrounds also exist, e.g. DFbkgd###_all_SPA.png for a Spanish background used at all visits for plate ###, they can be requested using the -t option.

If the high resolution PNG background does not exist for a plate, **DFprintdb** will print the field widgets and the data they contain on a blank background.

Options

-d — the input file is in DFdiscover Retrieval File (DRF) format where each input record contains only the record keys. Without this option, each record is assumed to be in data export format.

-A — size the output pages for A4 paper rather than the default US-letter size.

-usealias — output the subject alias, if defined, in place of the subject ID. If there is no subject alias, output the subject ID.

-p string — the name of the printer that the output should be sent to. The default is the printer defined by the study configuration.

-i string — the input file of data records that are to be merged for printing. Records are assumed to be in the format output by a previous **DFexport.rpc**, unless `-d` has been specified. The default is standard input.

-o string — the name of the output file. Instead of printing directly to the printer the output can be re-directed to a file with this argument. If both `-o` and `-p` are specified, only `-o` is honored. The output is in PostScript® format (with bookmarks) suitable for subsequent printing. If the `.pdf` or `.PDF` file extension is used in the output file name, then the output is in PDF format (without bookmarks).

-t string — the CRF background type. If the study setup includes backgrounds tagged with different type names, this option can be used to select the type to be used for printing. For example, -t SPA to use Spanish backgrounds, if a Spanish version of the CRFs was imported and tagged with 'SPA'. If this option is omitted, or used but the specified type does not exist for a particular plate, the default CRF background (i.e. untagged version) will be used if one exists.

-e platelist|all — plates for which text fields may expand beyond their display size. Without this option printed text is truncated if it exceeds the field display size. For example,

```
-e 10-15,22
```

allows text field expansion, if necessary, on plates 10 to 15 and 22; while

```
-e all
```

allows text expansion on all plates. NOTE: expanded text may cover other data fields on the plate and thus should be used only on plates with empty space into which text fields can expand.

-s # the DFdiscover study number (required).

Exit Status

DFprintdb exits with one of the following statuses:

0 The command was successful.

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The database server could not be contacted, communication with the database server failed, the study number is not defined, the database setup cannot be read, the input file cannot be read, or the output file cannot be written.

Examples

Example 3.64. Print all primary adverse event report records (plate 50) for study 222

```
% DFexport.rpc -s primary 222 50 - | DFprintdb -s 222 -o test.pdf
```

Name

DFpsprint — Convert one or more input CRF images into PostScript®

Synopsis

`DFpsprint` {*infile*...}

Description

DFpsprint is a utility program that converts input CRF image(s) to PostScript® suitable for printing. When multiple CRF images are given as options, the resulting PostScript® file contains one CRF image per page.

The resulting PostScript® document is always sent to standard output where it can be re-directed to a file.

> ### Note
>
> To convert CRF images files for immediate printing, **DFprint_filter** provides a simpler interface.

Options

infile one or more input CRF images. If only one input file is being printed, the filename argument can be given or the file can be re-directed in via standard input. If there are multiple input files, each input file name must appear as an option. The file name `-` can be used as a placeholder for standard input.

Exit Status

DFpsprint exits with one of the following statuses:

0 The command was successful.

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The command was successful but one or more input files could not be read. The exit status is the number of input files that could not be read.

Examples

Example 3.65. Simple use of DFpsprint for printing the file `/tmp/rasterfile`

```
% DFpsprint /tmp/rasterfile | lp -dlp
```

This command line subsequently re-directs the output to the printer.

Example 3.66. Concatenating 3 image files where the second is read from standard input

```
% cat /tmp/ras2 | DFpsprint /tmp/ras1 - /tmp/ras3 > /tmp/ps.out
```

See Also

DFprint_filter

Name

DFqcps — Convert a Query Report, previously generated by **DF_QCreports**, into a PDF file with barcoding, prior to sending the report to a study site

Synopsis

`DFqcps` [-A4] [-new] [-l *`string`*] [-f *`string`*] [-h *`string`*] [-r *`string`*] [-n *#*] [-p *#*] {-s *#*}

Description

DFqcps is used by **DF_QCfax** and **DF_QCprint** to format the Query Reports created by **DF_QCreports**, before they are sent or printed. It takes its input from the standard input, and translates it into a PDF document with the standard DFdiscover barcoding. Barcoding permits returned Query Reports to be routed to the correct study database, in the event that they contain queries in DFdiscover Q&A (question and answer) format, or in case an investigator decides to make a comment on the Query Report and fax it back.

Options

-A4 format for A4 size paper. The default is US letter.

-new use the new format for Query Reports introduced in DataFax version 4.2.0. This option applies only to external Query Reports; internal reports will always use the pre-4.2 format with a single Query Report ID field.

-l string customize the label associated with the investigator signature line at the top of each page. The string specified must be enclosed in double quotes. The investigator signature line may be omitted entirely by specifying the `-l` with empty double quotes. The default label for the signature line is "Study Coordinator Sign and Date".

-f string font to be used. If the specified font is not installed on the DFdiscover server the default fonts (Times, Helvetic, Courier, Century Gothic) will be used.

-h string the header name to appear in the top-left corner of each formatted page. Typically this is the study name.

-r string the report name that appears as the report identifier field on each formatted page. This value should be a 3 or 4-digit site ID, followed by a hyphen, followed by the 6-digit Query Report date. The default is no report name.

-n *#* the total number of pages in the Query Report. This number appears at the bottom of each formatted page in a `Page m of n` label.

-p *#* the point size to print the report text in. The default is 10 point.

-s *#* the DFdiscover study number (required). The study number is barcoded across the top of each page, together with the plate number (always 501) and the page number of the output.

Exit Status

DFqcps exits with one of the following statuses:

0 The command was successful.

> 0 The command failed because the required command-line arguments were not present or were incorrectly specified.

See Also

Standard Reports Guide, DF_QCprint

Name

DFreport — Client-side, command-line interface for executing reports

Synopsis

`DFreport` [-S *`server`*] [-U *`username`*] [-C *`password`*] [-JS *`js`*] [-CSS *`css`*] [-usealias] [-logo] [-e *`errfile`*] [-o *`outfile`*] {-CMD *`cmd`*} {*`study#`*}

Options and Description

DFreport runs DFdiscover reports outside of **DFexplore**, making them available to run from a command-line or scheduled via the UNIX cron facility.

Authentication and Database Permissions

Authentication. To authenticate, **DFreport** requires the username and password for connection to a specific database server. These may be supplied as:

1. command-line options, the user can specify `-S` *`servername`*, `-U` *`username`* and `-C` *`password`* when the program is run, or

2. environment variables, the user can set the variables `DFSERVER` *`servername`*, `DFUSER` *`username`* and `DFPASSWD` *`password`* before the program is run.

Specification of command-line options takes priority if both command-line options and environment variables are supplied. Refer to User Credentials for more information.

Database Permissions. Subsequent to authentication with a specific database server, use of **DFreport** is allowed (or disallowed) by the **DFexplore - Reports view** or **Server - Run reports** permissions.

An authenticated user with one of these role permissions will then be able to run reports. The reported data is filtered by user permissions, which may further be limited by visit, plate and level restrictions associated with the user's role.

DFreport provides no warning that some records cannot be exported due to permission restrictions as this would itself provide information about the existence of restricted data records.

Report Options

-CMD command — resource request sent to server, specifying report to execute

-JS command — matching javascript resource for report interactivity

-CSS command — matching stylesheet resource for report styling and presentation

-usealias — output the subject alias, if defined, in place of the subject ID. If there is no subject alias, output the subject ID.

-logo — include the study logo in the top-left corner of the HTML output. If not defined, or not available, the study name is used

Output Options

Output File. By default, output from **DFreport** is written to standard output (the command-line output). To write the output to a specific file, specify the filename with `-o` *`outfile`*. The user must have filesystem permission to create or modify the file. If *`outfile`* is specified as a relative pathname, the file is created relative to the **DFreport** command invocation directory.[1]

Output from legacy reports is written as is (plain text) while output from standard DFdiscover reports is in HTML or JSON format, determined by the file extension of the argument file.

Error Output. Re-direct any error messages to a specific file with the `-e` *`errfile`* option. By default, error messages are written to standard error and hence would get intermixed with data if the data is being exported to standard output.

Exit Status

DFreport exits with status 0 if the command was successful. Exit status 1 indicates that an error occurred - errors are written to standard error or the *`errfile`* file if `-e` was specified.

Examples

DFexplore includes a convenience feature, available from **Help** > **Show Command**, to display the command required to run a report. For example, run the **Enrollment by Site** report within **DFexplore** and select **Help** > **Show Command** to obtain this command (line breaks are for presentation only):

```
DFreport -S explore.dfdiscover.com -U demo_user1 -CMD "/DFedc?
cmd=getreport&name=enrollment&title=Enrollment%20by%20Site&json&compress"
-JS "https://cdn.dfdiscover.com/v5.2/js/DF_Enrollment.min.js" -CSS "https://
cdn.dfdiscover.com/v5.2/css/DF_ReportStyles.css"
252 -logo -o DF_Enrollment_20191028140508.html -C xxx
```

Substitute the username for *`demo_user1`*, user password for *`xxx`* and provide an output filename in place of *`DF_Enrollment_20191028140508.html`*.

[1] If **DFreport** is invoked from a cron facility, absolute pathnames are essential.

Name

DFsas — Prepare data set(s) and job file for processing by SAS®.

Synopsis

`DFsas` {*`jobfile`*} [-f] [-dbx] [[[-c] | [-C]] *`study#`*] [-p *`platelist`*] [-l [check] | [choice]] [-d csjo] [-s *#*] [-t *#*] [-I *`pidlist`*] [-n *`cidlist`*] [-v *`visitlist`*] [-w] [-SAS *#*] [-a] [-A] [-X] [-r *`rundir`*] [-z]

Description

DFsas is an intermediary between DFdiscover and SAS®. It can be used to extract summary data files from a study database and to create the corresponding SAS® job file for subsequent processing by SAS®.

Complete reference documentation for **DFsas** can be found in DFsas: DFdiscover to SAS®.

Options

jobfile — **DFsas** job file, specifies details of the translation between DFdiscover and SAS® (required).

-f — force **DFsas** to include all specified plates, even those that have no data.

-dbx — debug; do not remove the data export script *`jobfile`*`.dbx` after program completion.

-c|C *#* — create mode; create a default **DFsas** jobfile for the argument study number. Specifying `-c` includes all user-defined data fields, while `-C` includes all user-defined data fields plus DFdiscover header and trailer fields.

-p platelist — in create mode, the list of plates to include.

-l check,choice — export labels instead of codes for check and/or choice fields.

-d csjo — output one or more date fields from each date variable using these specified formats:

- c=calendar (imputation and 4 digit years)
- s=convert date to a string field as is (no imputation)
- j=convert date to a julian number (with imputation)
- o=use original value and date informat (no imputation)

-s *#* — split string field data containing more than *#* characters into 2+ fields on word boundaries.

-t *#* — truncate string field data containing more than *#* characters at exactly *#* characters.

-I sidlist — include only records for the specified subject IDs.

-n cidlist — include only records for the specified site IDs.

-v visitlist — include only records for the specified visit/sequence numbers.

-w — suppress warning messages.

-SAS *#* — apply SAS® version *#* rules/limits.

-a use the DFdiscover field alias, instead of field name, for SAS® variable names.

-A output the subject alias, if defined, in place of the subject ID. If there is no subject alias, output the subject ID.

-X exclude data from sites marked `test only`.

-r rundir set RUNDIR, e.g. -r 'C:\mydir\mysas'

-z use STUDYDIR/dfsas and do not overwrite existing **DFsas** job files

Exit Status

DFsas exits with one of the following statuses:

0 The command was successful.

1 The command was not successful.

Examples

Example 3.67. Create a default DFsas job file for study 11

```
% DFsas mytestjobfile -c 11
```

Example 3.68. Create a DFsas job file for study 11, include only a subset of plates and request labels for check fields

```
% DFsas mytestjobfile -c 11 -p 1-5 -l check
```

Name

DFsendfax — Fax or email a plain text, PDF, or TIFF file to one or more recipients

Synopsis

`DFsendfax` [-2] [-A4] [-F *from*] [-w *#*] [-r *#*] [-d *#*] [[-p *password*] | [-P]] [-c *string*] [-sANY *string*] [-sEACH *string*] [-sALL *string*] [-sFIRST *string*] [-fANY *string*] [-fEACH *string*] [-fALL *string*] [-fFIRST *string*] {*file*} {*recipients*...}

Description

DFsendfax transmits any plain text, PDF, or TIFF file to one or more recipients.

DFsendfax interacts with a DFdiscover outbound daemon. You must have at least one outbound daemon configured before **DFsendfax** will work. **DFsendfax** makes a temporary copy of the file to be sent. By default, this is in `/usr/tmp`, although it may be your home directory if there is no space available in `/usr/tmp`. The temporary copy of the file becomes owned by user `datafax`. **DFsendfax** places its options into a structure that it then sends to the outbound daemon. Which outbound daemon is used is determined by the DFdiscover master using a round-robin scheduling algorithm. The outbound daemon then makes a queue entry for the fax request in its work directory. It also copies (or remote copies, if necessary) the temporary file to a data file in its work directory. The outbound daemon then manages the queue entry until the scheduled time for sending arrives. At this point, the data file is passed to the system email service, **DFprotusfax** or HylaFAX, which attempts delivery of the document. If the transmission is successful, that status is forwarded to the outbound daemon which then executes zero or more of the success commands. If the transmission has failed, the outbound daemon either waits the number of minutes specified by the retry delay if one or more retries are still possible, or executes one or more of the failure commands. Finally, if the outbound daemon never receives a reply regarding the disposition of a fax, the outbound daemon de-queues the fax and executes the appropriate failure commands.

When specifying success or failure commands to execute at the completion of a fax session, you can reference the values of various arguments that you supplied in your original **DFsendfax** command. The values that you can reference are:

$FaxID the faxid# of the outgoing fax

$DataFile the name of the file to be sent, <file> argument

$Requestee the username of the person executing **DFsendfax**

$Callees the <recipient list> argument

$Comments the <comments> argument

$Number the fax number (or email address) that the success or fail reply was generated from. This will be one of the fax numbers (or email addresses) from the original <recipients list> ($Callees).

If your fax is successfully queued, **DFsendfax** echoes back the name of the file to be sent, the phone number of the recipients, the scheduled fax time, and the faxid of the queue entry. This faxid is unique within the system and can be used to monitor the status of the fax with **DFfaxq**, or to de-queue the fax with **DFfaxrm**. You should be aware that depending on how your outbound daemons are configured, it may take several seconds for a fax queued with **DFsendfax** to be detected so that it appears in the output of **DFfaxq**.

DFsendfax and DF_QCfax

The standard DFdiscover report program, **DF_QCfax**, uses **DFsendfax** to send Query Reports to participating sites in a study. If a Query Report is successfully transmitted, **DFqcsent.rpc** is executed (via the `-sANY` option)

to mark the quality control notes as having being successfully sent to the investigator site. This is needed so that DFdiscover will display the correct status of queries in **DFexplore**, and is also needed if you intend to use the overdue allowance option when creating Query Reports. Thus you should always use **DF_QCfax** to send quality control reports and not **DFsendfax**.

Delayed Sending

DFsendfax can schedule a fax for transmission at a specified time, rather than the default which is immediately. This is specified by the `-w` option. The possible arguments to this option can have the following syntax:

```
now | today | tomorrow | <time spec> [<offset>]
                          ❶                ❷
```

❶ **<time spec>** may be any one of **noon | midnight | hh[:mm] | <month> <day> [,<year>]**
❷ and **<offset> = + # {seconds | minutes | hours | days | weeks}**

If the time specified is in the past then this is the same as specifying `now`.

Options

-2 transmit the fax in fine mode. The default is standard mode.

-A4 transmit the fax using A4 sizing. The default is US letter size.

-F *from* identify any files transmitted via email as originating from sender *from*.

-w # the time that the file should be sent or emailed. The default is now. The specification of the time is similar to that allowed by the UNIX **at**.

-r # the number of attempts to refax the file if the first attempt fails. The default is 2. The total number of attempts is the number of retries plus 1. Multiple attempts do not apply to emails as DFdiscover has no way of determining whether or not an email was delivered.

-d # time, in minutes, between refax attempts. The default is 10 minutes. If the number of retries is 0, this value is ignored.

-p *password*-P encrypt the file to be emailed using the supplied `password` or using the password specified in the password file `~/.dfpdfpasswd`. This option applies only to PDF attachments. Other file formats are sent unencrypted.

-c *string* any comment string that you want to attach to the fax command. You can reference this comment field later when executing success or failure commands.

file the file to be sent (required). It can be any text, PostScript®, TIFF, or PDF file. For faxing, DFdiscover uses HylaFAX to convert any non-TIFF file into a TIFF file. For emailing, PostScript® files are converted to PDF first (other formats are sent unchanged), and then sent as a MIME attachment to the specified email address. You must have at least read permission on any file to be sent.

recipients a white-space delimited list of fax numbers or email addresses for recipients of the file (required). For each fax number include all long distance codes, etc. as required. Be careful not to include white-space characters inside a fax number as it will be interpreted as multiple fax numbers. Each email address must be in the format `mailto:`*`email_address`* where `mailto:` is fixed and required, and *`email_address`* is a valid email address.

Warning

DFdiscover does not perform validity checking on email addresses. Further, if the outbound service is configured to send documents via email only, any recipients that are not email addresses are quietly ignored.

DFsendfax provides commands that can be executed upon successful or unsuccessful completion of the transmission. Completion occurs after the specified number of retries have been attempted, if necessary. The command is executed in a Bourne shell as a background child process of the outbound daemon on the machine that the **DFsendfax** command was originally specified. There are four levels of commands that can be specified. They can be specified individually or in any combination. It is the user's responsibility to ensure that any concurrency issues that may arise as a result of more than one command executing simultaneously are planned for.

`-sANY` ***`string`*** execute the command specified in *`string`* as soon as the file is sent to any recipient in the recipients list. The command is executed only once, immediately after the fax is sent to one recipient.

`-sALL` ***`string`*** execute the command as soon as the file is successfully sent to all recipients in the recipients list.

`-sEACH` ***`string`*** execute the command each time the file is successfully sent to a recipient.

`-sFIRST` ***`string`*** execute the command as soon as the file is successfully sent to the recipient specified first in the recipients list.

`-fANY` ***`string`*** execute the command when the file cannot be successfully transmitted to a recipient. The command is executed only once, immediately after the first failure.

`-fALL` ***`string`*** execute the command if the file cannot be sent to any of the recipients in the recipients list; that is, all send attempts to all recipients have failed.

`-fEACH` ***`string`*** execute the command for each recipient that the file cannot be successfully sent to.

`-fFIRST` ***`string`*** execute the command if the file cannot be successfully sent to the recipient first specified in the fax list.

Exit Status

DFsendfax exits with one of the following statuses:

`0` The command was successful.

`2` The requested fax could not be scheduled for sending.

Examples

Example 3.69. Send the file `/etc/printcap` to one recipient at 5551212

```
% DFsendfax /etc/printcap 5551212
Fax /etc/printcap
scheduled for sending to 5551212
at Thu Dec 3 08:45:26 1992
->Faxid is 317
```

Example 3.70. Schedule a fax for transmission at 11:00pm tonight and send it to two recipients, one via email (with a specific from email address)

```
% DFsendfax -w 23:00 -F repltyo@company.com /etc/fstab 9876543
 mailto:luckyuser@hotmail.com
```

```
Fax /etc/fstab
scheduled for sending to 9876543 mailto:luckyuser@hotmail.com
at Thu Dec 3 23:00:00 1992
->Faxid is 318
```

Example 3.71. Schedule a fax for transmission 30 minutes from now and be informed via email that the fax was either successfully transmitted or failed

The line break is for presentation purposes only.

```
% DFsendfax -w 'now + 30 minutes' \
-sEACH 'echo $DataFile faxed to $Number | mail $Requestee' \
-fEACH 'echo $DataFile FAILED to $Number | mail $Requestee' \
/etc/magic 1-800-555-1212 9876543
```

Name

DFsqlload — Create table definitions and import all data into a relational database

Synopsis

`DFsqlload` [-flavor *`oracle`*|*`postgresql`*|*`mysql`*|*`mssql`*] [-d *`drfname`*] [-q] [-X] [[-ignore_mssql_priv] | [-ignore_mysql_priv]] [-type *`typed`*|*`untyped`*|*`both`*] [-coding *`code`*|*`label`*|*`both`*] [-missing *`code`*|*`label`*] [-date *`typed`*|*`untyped`*|*`both`*] [-noimpute] [-missed] [-table *`all`*|*`DFcoding,DFnullvalue,DFsubjectalias]`*] {*`param`*} {study}

Options

-flavor oracle|postgresql|mysql|mssql
Type of target database. The default is `-flavor` *`oracle`*.

-d drfname
A DFdiscover retrieval file to use to record problems encountered during data import.

-q
Quiet mode. Instructs the program to suppress all warning messages. The default, without this option, is to write warning messages to standard error.

-X
Exclude data from sites marked `test only`.

-ignore_mssql_priv|ignore_mysql_priv
Ignore administrator privileges. For MS SQLServer or MySQL, allows tables to be loaded without requiring administrator privileges on the database.

-type typed|untyped|both
Type of SQL tables to be created. If set to `typed` (or by default) then tables use field data types as defined in `DFschema`. Table names used are `DFTABLE_###` for regular plates, `DFQC` for plate 511 and `DFREASON` for plate 510. The field names use unique names for user data fields (8 ~ `NF`-3, where `NF` is the total number of fields defined for a given plate), and generic names for DFdiscover fields. If set to `untyped`, all user data fields for regular plates are converted to VARCHAR. Table names used are `DFPLATE_###` for regular plates, `DFQC` for plate 511 and `DFREASON` for plate 510. The field names use unique names for user data fields, and generic names for DFdiscover fields. If set to `both`, both typed and untyped tables are created for regular plates. Only one `DFQC` for plate 511 and one `DFREASON` for plate 510 are created. Both of these tables adhere to typed rules.

-coding code|label|both
Coded field specification. If set to `code` (or by default), then there is no translation for coded fields. if set to `label`, then the label corresponding to a given code is imported, including QCs and REASONs. If no label is defined for a given value, then the value is used. If both are requested, then two columns are imported for the coded field, one for the value and the other for the corresponding label.

-missing code|label
Missing value specification only applies to untyped tables. If set to `code` (or by default), then no translation is done for missing codes. If set to `label`, then codes are translated to their corresponding label. If no label is defined for a given code, the code itself is imported. If the target tables are typed, missing value codes are automatically replaced with `NULL` values in all cases.

-date typed|untyped|both
Date type specification for user date fields. If set to `typed`, then the true type defined in `DFschema` for dates is used (the default setting). If set to `untyped`, then dates are converted to strings and imported as type `VARCHAR`. If set to `both` then two columns are imported for the date field, one for the typed date and one for the untyped string representation.

-noimpute No imputation for partial dates replaces partial dates with NULL values for typed dates only. The default is to impute partial dates for typed dates according to the imputation method specified in `DFschema`.

-missed Include missed records from the database in the output. Typically missed records are not included as they contain no actual data.

-table all|DFcoding,DFnullvalue,DFsubjectalias] List of optional tables to create. If set to `DFcoding`, the optional table `DFCODING` is created. Value and label pairs are imported to this table. If set to `DFnullvalue`, the optional table `DFNULLVALUE` is created. All problem fields that are converted to `NULL` are imported to this table. If the option `-d drfname` is specified, this table is created by default. If set to `DFsubjectalias`, the optional table `DFSUBJECTALIAS` is created. Columns `DFpid` and `DFalias` are imported to this table. If set to `all`, then all optional tables are created and imported.

Required Options

The following two options are required and must appear in order at the end of the option list:

param A set of parameters of the form `server:database:schema[.tablespace][:username:password]`. The value of these parameters vary depending on the target database, and are detailed in Table 3.12, "Database Parameters".

study the DFdiscover study number, from which data records are to be exported.

Table 3.12. Database Parameters

Parameter	Description	Postgres	MySQL	Oracle	MS SQLServer
server	The server name to connect to	required	required	a place holder. Oracle will lookup `tnsnames.ora` based on database name	required
database	The database name	required	see Schema	required	required
schema	The DFdiscover study name	required	required	required	required (must be the same as the database name)
tablespace	The alternative storage tablespace for Oracle	ignored	ignored	see Schema	ignored
username:password	The database login user name and password	optional. 1. If both username and password specified, login as specified username with specified password. 2. If only username	optional. 1. If both username and password specified, login as specified username with specified password. 2. If only username	optional. 1. If both username and password specified, login as specified username with specified password. 2. If only username specified, discard the specified username, using OS user's name and lookup the	optional. 1. If both username and password are specified, login as the specified username with the specified password. 2. If only username is

Parameter	Description	Postgres	MySQL	Oracle	MS SQLServer
		specified, login as specified username, lookup the the specified user's password from file `~/.pgpass`. 3. If neither username nor password specified, lookup OS user's name and OS user's password from file `~/.pgpass`. 4. If only password is specified, this is an error.	specified, discard the specified username and using OS user's name and lookup OS user's password from file `~/.my.cnf`. The same applies if neither username nor password are specified. 3. If only password is specified, this is an error.	password from file `~/.orapass` identified by database name. If `~/.orapass` does not exist or cannot find the password, use Oracle external credential. The same applies if neither username nor password are specified. 3. If only password is specified, this is an error. **Oracle external credentials** The user must have an OS account. In the Oracle initialization file, parameter `initDB_NAME.ora` must be set as follows `remote_os_authent = true`	specified, login using the OS user's name and lookup the OS user's password from the file `~/.mssqlpass`. 3. If neither username nor password is specified, login using the OS user's name and lookup the OS user's password from the file `~/.mssqlpass`. 4. If only password is specified, login using the OS user's name and the specified password.

Exit Status

DFsqlload exits with one of the following statuses:

0 **DFsqlload** was able to (re-)create the schema, create all of the tables, and import all of the data without error.

1 The schema and tables were created and the data were imported, but one or more errors were encountered in the imported data.

2 A more serious error was encountered which prevented some or all data from being imported.

Description

DFsqlload is a command-line solution that creates all of the table definitions and imports all of the data into a relational database. One SQL table is created for each DFdiscover plate. In addition, three tables are added to record logging information, qc and reason for change data plus four tables and a view are created to store study schema information. Optional tables are created to note any problem fields or store value and label pairs for coded fields.

When run repeatedly, existing SQL tables are compared with the current `DFschema` file. Unchanged tables are truncated i.e., the data is removed but the table definitions remain. If any changes were made, the existing DFdiscover-defined table

is dropped and re-created. **DFsqlload** calls **DFexport.rpc** to export all primary records to a temporary file, and then loads the database tables plate by plate.

SQL Database Setup

The following operations are performed on the target database.

1. At least five and optionally three meta tables are created in the target database.

   a. `DFSQLLOAD`: Each **DFsqlload** run creates an entry in this log table. This table is also the lock table that prevents more than one **DFsqlload** process from operating on the same schema. A `NULL` value for column `DFFINISH` indicates that a **DFsqlload** process is running. If **DFsqlload** terminates abnormally, this record must be removed manually before starting a new **DFsqlload** process. The following SQL statements are used internally to create this table. The statements use syntax specific to PostgreSQL. Similar tables are created for MySQL, MS SQLServer and Oracle implementations of **DFsqlload**.

```
CREATE TABLE <schema>.dfsqlload
(
  dfuser varchar(30) NOT NULL,    -- the database user
  dfstart timestamp(0) NOT NULL, -- the start date and time
  dffinish timestamp(0),          -- the finish date and time (NULL if process running)
  dfoption varchar(500),          -- the options used with the DFsqlload command
  dfnull int4,                    -- the total number of problem fields converted to
 null
  dferror int4,                   -- the total number of records discarded or rejected
  dfstatus int2,                  -- the status: 0=process completed, 1=running
  CONSTRAINT dfsqlload_pk PRIMARY KEY (dfstart)
) WITH OIDS;
```

   b. `DFSTUDY, DFPLATE, DFMOULE, DFFIELD and DFSCHEMA_VIEW`: Each **DFsqlload** run creates four tables and a view to store study schema information. Study, plate and field level user-defined tag-value pairs are written to the appropriate table. Since there are no module group identifiers in `DFschema`, module level user-defined tag-value pairs are ignored. Each DFsqlload run will clear and reload these tables.

      The following SQL statments are used to create these tables and view. The statements below use syntax specific to MS SQLServer. NOTE: MS-SQL loader: The default TDS_VERSION='7.0', used to support MS SQL Server 7.0 and 2000, now updated to TDS_VERSION='7.4'. User can overwrite default version and port by environment TDSVER=ver# and TDSPORT=port#.

```
CREATE TABLE <schema>.DFSTUDY (
    DFNUM              INTEGER NOT NULL,
    DFNAME             VARCHAR(256),
    DFYEAR             INTEGER,          -- %B: study begin year
    DFSETUP_VER        VARCHAR(10),      -- %u: current setup version
    DFSCHEMA_DT        VARCHAR(10),      --     DFschema file timestamp: yyyy-mm-dd
 (ISO)
    DFSCHEMA_TM        VARCHAR(8),       --     DFschema file timestamp: hh:mi:ss
    DFHOST             VARCHAR(256),     --     short name from /opt/dfdiscover/lib/
DFedcservice.cf
    DFSTUDY_TAGS       VARCHAR(500),     -- %z: tag=alias, tag=alias, ... (DFSTUDY_)
    DFPLT_TAGS         VARCHAR(500),     -- %z: tag=alias, tag=alias, ... (DFPLATE_)
    DFMOD_TAGS         VARCHAR(500),     -- %z: tag=alias, tag=alias, ... (DFMODULE_)
    DFVAR_TAGS         VARCHAR(500),     -- %z: tag=alias, tag-alias, ... (DFVAR_)
    DFSTUDY_TAG_VALUE  VARCHAR(500),     -- %y: tag=value, tag=value, ...
```

```
  CONSTRAINT DFSTUDY_PK PRIMARY KEY (DFNUM))

CREATE TABLE <schema>.DFPLATE (
    DFPLT_NUM          INTEGER NOT NULL,
    DFPLT_DESC         VARCHAR(100),
    DFNUM_FILEDS       INTEGER,          -- %n: number of fields
    DFSEQ_CODE         INTEGER,          -- %E: seq in barcode vs first field
    DFARRIVAL_TRIG     VARCHAR(200),     -- %R: plate arrival trigger
    DFTERM_TRIG        VARCHAR(6),       -- %t: plate termination trigger
    DFPLT_TAG_VALUE    VARCHAR(500),     -- %y: tag=value, tag=value, ...
  CONSTRAINT DFPLATE_PK PRIMARY KEY (DFPLT_NUM))

CREATE TABLE <schema>.DFMODULE (
    DFMOD_NAME         VARCHAR(30) NOT NULL,
    DFMOD_DESC         VARCHAR(100),
  CONSTRAINT DFMODULE_PK PRIMARY KEY (DFMOD_NAME))

CREATE TABLE <schema>.DFFIELD (
    DFNUM              INTEGER NOT NULL,
    DFPLT_NUM          INTEGER NOT NULL,
    DFVAR_NUM          INTEGER NOT NULL,
    DFVAR_UID          INTEGER,          -- %i: field unique id
    DFVAR_SPEC         VARCHAR(9),       -- %A: required, essential, optional
    DFVAR_NAME         VARCHAR(80),
    DFVAR_ALIAS        VARCHAR(80),
    DFVAR_DESC         VARCHAR(40),
    DFVAR_TYPE         VARCHAR(6),
    DFVAR_FORMAT       VARCHAR(100),
    DFVAR_LEGAL        VARCHAR(100),
    DFVAR_CODE_LABEL   VARCHAR(2000),    -- %c %C: code=label, code=label, ...
    DFVAR_TAG_VALUE    VARCHAR(500),     -- %y: tag=value, tag=value, ...
    DFVAR_STORE        INTEGER,
    DFVAR_DISPLAY      INTEGER,
    DFVAR_HELP         VARCHAR(500),
    DFEC_FIELD_ENT     VARCHAR(500),
    DFEC_FIELD_EXT     VARCHAR(500),
    DFEC_PLATE_ENT     VARCHAR(500),
    DFEC_PLATE_EXT     VARCHAR(500),
    DFSTYLE            VARCHAR(80),
    DFMOD_NAME         VARCHAR(30),
    DFMOD_INSTANCE     INTEGER,
  CONSTRAINT DFFIELD_PK PRIMARY KEY (DFNUM, DFPLT_NUM, DFVAR_NUM))

CREATE VIEW DFSCHEMA_VIEW AS SELECT
    DFSTUDY.DFHOST DFHOST,
    DFFIELD.DFNUM DFSTUDY_NUM,
    DFSTUDY.DFNAME DFSTUDY_NAME,
    DFSTUDY.DFSCHEMA_DT DFSCHEMA_DT,
    DFSTUDY.DFSCHEMA_TM DFSCHEMA_TM,
    DFFIELD.DFPLT_NUM DFPLT_NUM,
    DFPLATE.DFPLT_DESC DFPLT_DESC,
    DFFIELD.DFVAR_NUM DFVAR_NUM,
    DFFIELD.DFVAR_SPEC DFVAR_SPEC,
    DFFIELD.DFVAR_ALIAS DFVAR_ALIAS,
```

```
    DFFIELD.DFVAR_NAME DFVAR_NAME,
    DFFIELD.DFVAR_DESC DFVAR_DESC,
    DFFIELD.DFVAR_TYPE DFVAR_TYPE,
    DFFIELD.DFVAR_FORMAT DFVAR_FORMAT,
    DFFIELD.DFVAR_LEGAL DFVAR_LEGAL,
    DFFIELD.DFVAR_CODE_LABEL DFVAR_CODE_LABEL,
    DFFIELD.DFVAR_TAG_VALUE DFVAR_TAG_VALUE,
    DFFIELD.DFEC_FIELD_ENT DFEC_FIELD_ENT,
    DFFIELD.DFEC_FIELD_EXT DFEC_FIELD_EXT,
    DFFIELD.DFEC_PLATE_ENT DFEC_PLATE_ENT,
    DFFIELD.DFEC_PLATE_EXT DFEC_PLATE_EXT,
    DFFIELD.DFSTYLE DFSTYLE,
    DFFIELD.DFVAR_STORE DFVAR_STORE,
    DFFIELD.DFVAR_DISPLAY DFVAR_DISPLAY,
    DFFIELD.DFVAR_HELP DFVAR_HELP,
    DFFIELD.DFMOD_NAME DFMOD_NAME,
    DFMODULE.DFMOD_DESC DFMOD_DESC,
    DFFIELD.DFMOD_INSTANCE DFMOD_INSTANCE
  FROM  DFSTUDY, DFPLATE, DFMODULE, DFFIELD
  WHERE DFFIELD.DFNUM = DFSTUDY.DFNUM
  AND   DFFIELD.DFPLT_NUM = DFPLATE.DFPLT_NUM
  AND   DFFIELD.DFMOD_NAME = DFMODULE.DFMOD_NAME
```

c. `DFNULLVALUE`: This is an optional table where all problem fields that are converted to `NULL` are recorded. The following SQL statements are used internally to create this table.

```
CREATE TABLE <schema>.dfnullvalue
(
  dfpid int4 NOT NULL,            -- study subject id
  dfplate int2 NOT NULL,          -- plate
  dfseq int4 NOT NULL,            -- sequence/visit number
  dftable varchar(30) NOT NULL,   -- name of sql table where substitution was made
  dffield varchar(30) NOT NULL,   -- name of sql field where substitution was made
  dfvalue varchar(###),           -- the original value exported from DFdiscover
  dfproblem varchar(###),         -- the reason the value was converted to NULL
  dfraster varchar(12),           -- the image id of the source CRF page
  CONSTRAINT dfnullvalue_pk PRIMARY KEY (dfpid, dfplate, dfseq, dftable, dffield)
) WITH OIDS;
```

The ### above represents the maximum length encountered in the data source.

d. `DFCODING`: This is an optional table where all value and label pairs for coded fields are stored. The following SQL statements are used internally to create this table.

```
CREATE TABLE <schema>.dfcoding
(
  dfplate int2 NOT NULL,          -- plate
  dffield varchar(30) NOT NULL,   -- sql table column name
  dfcode varchar(###) NOT NULL,   -- code value for this column
  dflabel varchar(###),           -- code label for this column
  CONSTRAINT dfcoding_pk PRIMARY KEY (dfplate, dffield, dfcode)
) WITH OIDS;
```

The ### above represents the maximum length encountered in the data source.

2. Verify any existing SQL tables. The following tasks are performed in the verification of existing SQL tables.

   a. All tables with the prefix `DF` are treated as **DFsqlload**-defined tables. For any given run of **DFsqlload**, only the tables relevant to the current job are used.

   b. Existing SQL table definitions are compared to the `DFschema` file. **DFsqlload** will truncate any unchanged tables and re-create changed tables. Changes that may cause **DFsqlload** to drop a table are as follows:

      - add, delete, reorder fields
      - rename field
      - change data type
      - any change to field size or format causing storage changes in the target database
      - missing code or label changes
      - code or label changes to coded fields
      - SQL tables that have been directly user-modified

   c. All privileges (if any) for tables create by **DFsqlload** are backed up and restored.

   d. If other tables reference any tables created by **DFsqlload**, the foreign keys will either be dropped (Postgresql, MS SQLServer) or disabled (MySQL, Oracle) and saved to the log file in the form of a database-specific SQL statement. The user can choose to execute these statements to restore the foreign keys manually, as **DFsqlload** does not do it automatically.

   e. Other database objects - triggers, views, procedures, etc., which depend upon **DFsqlload**-defined tables are ignored.

Files used by DFsqlload

All **DFsqlload** created files are in the `study/working_dir/DFsqlload_logs` directory by default. If this directory does not exist, **DFsqlload** will create it at the default location. The file names use time stamp in the format *`yymmdd_hhmiss`* as a prefix, where *`mm`* is two-digit month and *`mi`* is two-digit minute. The time stamp, which is also the value of `DFSQLLOAD.DFSTART`, is the unique identifier of this **DFsqlload** process.

1. **Log file: *`yymmdd_hhmiss.log`*.** This file records the detailed loading progress including schema setup, SQL table definitions, record count, and rejected records with error messages in the following formats:

   Regular plates: Record (id, seq, plate, image): error message

   QCs and REASONs: Record (id, seq, plate, image, field): error message

2. DFdiscover Retrieval File: If path is included, this file will be in the specified location. If the file already exists, the existing file will be removed. If the file cannot be created or written, **DFsqlload** will report an error and continue the loading process. The file is in standard DRF format. The first four fields are Id, Visit, Plate, and Image. The combination of id, visit, and plate is unique. The 5th field records the list of problems. The record level errors appear first, followed by the field level problems. The field level problems are derived from the `DFNULLVALUE` table, which is created by default if a `.drf` file is requested. Problem types are summarized below.

   a. Record level errors

      - error - incorrect number of fields: The number of fields of a record in *`plt###.dat`* does not match the `DFschema` definition.

- error - invalid DFdiscover field: The value of DFdiscover leading (1~7) or trailing (NF-2~NF) field is blank or invalid.
- error - duplicate primary record: Two or more records have the same id, seq, plate combination.
- error - rejected by database: Any field error that was not identified by **DFsqlload**, but rejected by the database.

b. Field level problems

- missing value
- too wide
- bad format
- invalid date
- partial date
- undefined code
- data/type conversion

The format used in the `.drf` file is `Table1Name: FieldName (problem), FieldName (problem),..., Table2Name: F ieldName (problem),...`

c. QC or REASON specific error

- error - primary record was rejected.

3. **Data file:** yymmdd_hhmiss_plt### (for regular plates)

   yymmdd_hhmiss_DFreason (for plate 510)

   yymmdd_hhmiss_DFqc (for plate 511)

   This is the data source of current loading plate created by **DFexport.rpc**, and is removed automatically after the data is loaded into the SQL database.

4. **Error files:** yymmdd_hhmiss_plt###.err (for untyped table)

   yymmdd_hhmiss_tbl###.err (for typed table)

   yymmdd_hhmiss_DFreason.err (for plate 510)

   yymmdd_hhmiss_DFqc.err (for plate 511)

   These files record the records rejected by the SQL database along with database generated error messages.

5. **Rejected keys: yymmdd_hhmiss.tmp.** This file records the keys (plate, seq, id) of primary records discarded by **DFsqlload** or rejected by the SQL database. If a REASON or QC record matches one of the key combinations in this file, that REASON or QC record will not be loaded into the SQL database and a message will be written to the log file:

   Record (id#,seq#,plate#,image,field#): discarded by **DFsqlload**.

   DFRECORD (error - primary record was rejected).

   This file is removed automatically.

Database login credentials files. The following database-specific files may be used to store login credentials.

- **Postgres: ~/.pgpass.** This is a Postgres standard file located in the user's home directory and the file permission must be 600; otherwise, Postgres will ignore it. This file specifies the database login credentials in the format:

```
host:port:database:username:password
```

  The username can be any valid database user, for example:

```
parkcity:5432:test_db_name:user_a_name:user_a_password
parkcity:5432:test_db_name:user_b_name:user_b_password
```

- **MySQL: ~/.my.cnf.** This is MySQL standard file located in user's home directory and the file permission should be 600. This file specifies the program groups and options for each group. A typical group is [client]. In this group the database password for OS user can be specified:

```
[client]
password=my_pass
...
```

  The global options can be specified in the global option file `/etc/my.cnf` or `DATADIR/my.cnf`.

- **Oracle: tnsnames.ora, ~/.orapass.** `tnsnames.ora` is the Oracle standard net services file located in *`ORACLE_HOME`*`/network/admin` directory by default. Oracle client will lookup net service names from this file. This file can also be in *`ANY_DIR`*`/network/admin` and the environment variable `ORACLE_HOME` is set to *`ANY_DIR`*.

  `~/.orapass` is NOT an Oracle standard file. It is provided for convenience for DFdiscover users to store their database password. This file should be in the user's home directory and file permission should be 600. The format is:

```
db_name:password
```

  for example,

```
test_db_name:test_db_password
production_db_name:production_db_password
```

- **MS SQLServer: ~/.mssqlpass.** This is not an MS SQLServer standard file. It is provided as a convenience to DFdiscover users for storing their database password. This file needs to be kept in the user's home directory and the file permission needs to be 600. The format of this file is:

```
server_name:password
```

  There are two types of entries that can be used. Both the server name and the password to use can be specified as follows:

```
my_server:my_server_password
```

  or a password can be specified for any server this user connects to as in the following example:

```
*:any_server_password
```

Tables

The following details apply to tables and fields created by **DFsqlload**.

- **Table Names.** Table names follow these rules. `DFSQLLOAD` is a log table and is used to store the details of a given **DFsqlload** for a particular schema. The table for plate 510 is named `DFREASON`. The table for plate 511 is named `DFQC`. All other plates are named `DFPLATE_nnn` (untyped) or `DFTABLE_nnn` (typed), where `nnn` is the plate number. Optional tables created are `DFNULLVALUE` for the storage of any problem field data conversions and `DFCODING` for the storage of value/value label pairs. All table names are in uppercase letters. Note that the table names are case sensitive for MySQL on UNIX platforms only.

- **Table Types.** Table types used for each of the supported database products are as follows: For PostgreSQL and Oracle, all tables are type `relational table`. For MySQL, all tables are type `InnoDB table`.

- **Field Names for study tables.** Field naming follows these rules. For fields 1 to 7 and the last three fields for a plate, generic variable names are used. For all fields in between, unique variable names are used. Any field names matching an SQL keyword get an _ (underscore) appended. This is target product dependent. Refer to the documentation for the product you are using for a complete list of the relevant keywords. Any non-alphanumeric characters are replaced with _ (underscore). If a field name starts with a digit, `DF_` is prepended. Field names are truncated to 30 chars. A sequence number is appended to each non-unique field name.

- **DFdiscover type to SQL type mapping:** **DFsqlload** will map DFdiscover types to SQL types according to Data typing when creating SQL tables for typed columns. Untyped columns are mapped to VARCHAR (PostgreSQL, MySQL) and VARCHAR2 (Oracle).

Table 3.13. Data typing

DFdiscover type	PostgreSQL	Oracle	MySQL	MS SQL Server
string	VARCHAR(n)	VARCHAR2(n)	VARCHAR(n)[a]	VARCHAR(n)
check	INT2	NUMBER(p)	INT2	SMALLINT
choice	INT2	NUMBER(p)	INT2	SMALLINT
integer	INT4	NUMBER(p)	INT4	INT
float	NUMERIC(p,s)	NUMBER(p,s)	DECIMAL(p,s)	DECIMAL(p,s)
vas	NUMERIC(p,s)	NUMBER(p,s)	DECIMAL(p,s)	DECIMAL(p,s)
number(nn:nn)	TIME	VARCHAR2(n)	TIME	VARCHAR(n)
date	DATE	DATE	DATE	DATETIME
timestamp	TIMESTAMP	DATE	DATETIME	DATETIME

[a] MySQL converts VARCHAR(n) to CHAR(n) (n < 4) or TEXT (n > 255).

- **SQL column naming convention:** **DFsqlload** will follow the rules defined in Fields for typed SQL tables and Fields for untyped SQL tables for DFdiscover field name to SQL column naming convention when creating SQL tables.

Table 3.14. Fields for typed SQL tables

Field	Field Number	Field Name	Field Type	Missing Code/ Label	Partial Date	Impute
Coded field: Code	1~7,NF-2~NF	Generic	True Type	No		
Coded field: Label	1~7,NF-2~NF	Generic	VARCHAR	No		
Coded field: Code [a]	1~7,NF-2~NF	Generic	True Type	No		
Coded field: Label [b]	1~7,NF-2~NF	U_Generic	VARCHAR	No		
Coded field: Code	8~NF-3	Unique	True Type	No		
Coded field: Label	8~NF-3	Unique	VARCHAR	Yes		

Field	Field Number	Field Name	Field Type	Missing Code/ Label	Partial Date	Impute
Coded field: Code[a]	8~NF-3	Unique	True Type	No		
Coded field: Label[b]	8~NF-3	U_Unique	VARCHAR	Yes		
Date field: Typed	8~NF-3	Unique	True Type	No	No	Yes
Date field: Untyped	8~NF-3	Unique	VARCHAR	Yes	Yes	No
Date field: Typed[a]	8~NF-3	Unique	True Type	No	No	Yes
Date field: Untyped[b]	8~NF-3	U_Unique	VARCHAR	Yes	Yes	No
Other fields	8~NF-3	Unique	True Type	No		
Other fields	1~7,NF-2~NF	Generic	True Type	No	No	No

[a] The first field, if `-coding both` or `-date both` is specified.

[b] The second field, if `-coding both` or `-date both` is specified.

Table 3.15. Fields for untyped SQL tables

Field	Field Number	Field Name	Field Type	Missing Code/ Label	Partial Date	Impute
Coded field: Code	1~7,NF-2~NF	Generic	True Type	No		
Coded field: Label	1~7,NF-2~NF	Generic	VARCHAR	No		
Coded field: Code[a]	1~7,NF-2~NF	Generic	True Type	No		
Coded field: Label[b]	1~7,NF-2~NF	U_Generic	VARCHAR	No		
Coded field: Code	8~NF-3	U_Unique	VARCHAR	Yes		
Coded field: Label	8~NF-3	U_Unique	VARCHAR	Yes		
Coded field: Code[a]	8~NF-3	Unique	VARCHAR	Yes		
Coded field: Label[b]	8~NF-3	U_Unique	VARCHAR	Yes		
Date field: Typed	8~NF-3	U_Unique	True Type	No	No	Yes
Date field: Untyped	8~NF-3	U_Unique	VARCHAR	Yes	Yes	No
Date field: Typed[a]	8~NF-3	Unique	True Type	No	No	Yes

Field	Field Number	Field Name	Field Type	Missing Code/ Label	Partial Date	Impute
Date field: Untyped[b]	8~NF-3	U_Unique	VARCHAR	Yes	Yes	No
Other fields	8~NF-3	U_Unique	VARCHAR	Yes		
Other fields	1~7,NF-2~NF	Generic	True Type	No	No	No

- **Locking:** **DFsqlload** uses the table `DFSQLLOAD` to prevent two processes from working on the same database schema. A NULL entry in `DFSQLLOAD.DFFINISH` indicates that another process is running or terminated abnormally. If `DFSQLLOAD` does not exist, **DFsqlload** will create it. Upon completion, **DFsqlload** updates `DFSQLLOAD.DFFINISH` to the finish time and the `DFSQLLOAD.DFSTATUS` to zero (normal exit process).
- **DFdiscover Retrieval File:** The first line in the DRF contains a two-field comment. The first field contains the username and creation timestamp. The second field identifies the creator of the DRF as **DFsqlload** and lists the parameters used to access the SQL database. The next line is a comment describing the format of the DRF records to follow. One DRF data record is created for each DFdiscover record with data import problems. Each DRF data record is identified by Id, Visit, Plate and Image. The 5th field records the SQL table name, followed by the field name and problem description for each problem encountered. Multiple field/problem descriptions are separated by commas.
- **Date fields:** **DFsqlload** converts two-digit years to four-digits based on the cut off year specified for each date field in DFschema, or the year the study began (%B) if not specified. **DFsqlload** imputes partial dates according to the imputation method specified for each date field.
- **Number of fields:** **DFsqlload** creates a minimum of 10 fields (1~7,NF-2~NF) for each SQL table. The maximum number of fields is limited by the database: PostgreSQL 1600, MySQL 1000, Oracle 1000, MS SQLServer 1024. **DFsqlload** will report errors for DFdiscover records that do not meet these field requirements and will continue the loading process.

Schema

Postgres. A schema is a namespace that contains DFdiscover study tables. Schema names are DFdiscover study names. If the schema name specified in the **DFsqlload** command line does not exist in the Postgres database, **DFsqlload** will create the schema as specified. **DFsqlload** will never drop existing schemas.

Oracle. A schema is a database user who is also the owner of DFdiscover tables that belong to one study. The schema specified in the command line must already exist in Oracle, unless the tablespace name (must exist in database) is also specified. If the schema does not exist, **DFsqlload** will create the schema and assign the specified tablespace as the schema's default tablespace. The DFdiscover study tables will be created, if specified, in the specified tablespace, otherwise in the schema's default tablespace. **DFsqlload** will check the schema's quota privilege on storage tablespace and grant unlimited quota privilege on that tablespace. **DFsqlload** will never drop existing schemas.

MySQL. There is no schema in MySQL. A MySQL database maps to a DFdiscover study database. In the command line, the schema name must be the same as the database name. Note that the database name is case sensitive whether MySQL is running on a UNIX or Windows platform. If the specified database does not exist in the MySQL database, **DFsqlload** will create the database as specified. **DFsqlload** will never drop existing MySQL databases.

MS SQLServer. There is no schema in MS SQLServer in version 2000 and older. A SQLServer database maps to a DFdiscover study database. In the command line, the schema name must be the same as the database name.

Examples

Example 3.72. Import study 254 into mySQL

Import the validation study val254 into mySQL on host `talisman`.

```
% DFsqlload -flavor mysql -q talisman:val254:val254:root:mysql 254
```

Name

DFstatus — Display database status information in plain text format

Synopsis

`DFstatus` [-l] [-m] [-h] [-c] [-n *#, #-#*] [-i *#, #-#*] [-v *#, #-#*] [-p *#, #-#*] [-s *#*]

Description

This command-line invocation of the **DFexplore** Status View generates a tabular representation of the database status in plain text format and writes the results to standard output.

Options

-c execute **DFstatus** in command-line mode. This option is retained for backward compatibility but is no longer necessary as **DFstatus** now runs only in command line mode.

-l displays a list of current user logins with the hostname of the system running their DFdiscover applicataion.

-h removes the title header when executed with the -l option.

-m displays current seat usage statistics for the current DFdiscover server.

-n *#, #-#* select only the requested site IDs for inclusion in the database status table. Default is all sites.

-i *#, #-#* select only the requested subject IDs for inclusion in the database status table. Default is all subject IDs.

-v *#, #-#* select only the requested visit numbers for inclusion in the database status table. Default is all visit numbers.

-p *#, #-#* select only the requested plate numbers for inclusion in the database status table. Default is all plate numbers in the range 1 to 500, inclusive.

-s *#* the study number (required unless -l or -m option is used).

Exit Status

DFstatus exits with one of the following statuses:

0 The command was successful.

36 The required command-line arguments were not present or were incorrectly specified.

> 0 The command failed because the database server could not be contacted, or communication with the database server failed.

Examples

Example 3.73. Display record status and current user connections for study 253

```
%  DFstatus -s 253
#Database Status of Study 253
#Date           Mon Mar 14 09:45:34 2011
#Sites
```

```
#Subjects
#Visits
#Plates
 Level       Pending        Missed    Incomplete         Final         Total
     0             7             0             0             0             7
     1             0             2            32            43            77
     2             0             0             4             2             6
     3             0             0             3             1             4
     4             0             0             1             7             8
     5             0             0             0             1             1
     6             0             0             0             0             0
     7             0             0             0             0             0
 Total             7             2            40            54           103

#Records awaiting validation: 18
#Records being validated: 0

#Connected Users
User             Program          Host
---------------- ---------------- ------------------------------
datafax          DFexplore        vncdemo.datafax.com
datafax          Status Tool      dhcp214.datafax.com
```

Example 3.74. Display current seat usage on the server

```
%  DFstatus -m
Seats in Use:
 Admin   2 of 10
 General 122 of 150
 Total   124 of 160
```

Name

DFtextps — Convert one or more input files into PDF

Synopsis

`DFtextps` [-PDF] [-A4] [-h] [-n *#*] [-d] [[-1] | [-2] | [-4]] [-p *#*] {file...}

Description

DFtextps is a utility program that converts plain text input files to PDF. If no input files are named, the input is taken from standard input.

The resulting PDF is sent to standard output where it can be re-directed to a file.

Options

-PDF create a PDF output file. This is the default behavior. The option is present for backwards compatibility only.

-A4 format for A4 size paper. The default is US letter.

-h apply a standard header to each page.

-n *#* start the page numbering at *#* instead of 1.

-d double-space the output.

-1-2-4 format the output in 1-up, 2-up, or 4-up mode

-p *#* use *#* as the default point size.

file one or more input files.

Exit Status

DFtextps exits with one of the following statuses:

0 The command was successful.

1 One or more errors were encountered.

36 The required command-line arguments were not present or were incorrectly specified.

Examples

Example 3.75. Print output from DF_SSvisitmap report

Run the DFdiscover report **DF_SSvisitmap** for study 1, saving the output as a PDF document.

```
% /opt/dfdiscover/reports/DF_SSvisitmap 1 | /opt/dfdiscover/bin/DFtextps > visitmap.pdf
```

Name

DFuserdb — Perform maintenance operations on the user database

Synopsis

`DFuserdb` [-help] [-fsck] [-reset] [-reset2fa] [-dump2fa] [-stats] [-unlock] [-export *`filename`*] [-import *`filename`*]

Description

DFuserdb is used to perform maintenance operations such as import/export on the user and role database.

Invoked without arguments **DFuserdb** works in interactive mode. Allowable commands match the options listed here, but without the leading dash.

Options

-help print a list of the commands available.

-fsck perform a consistency check on the database. If there are no consistency errors in the database structure only the message `FSCK done` will be output. If errors do exist, the database will need to be rebuilt by using the `-import` option along with a copy of the `DFuserdb.log` as input.

-reset used to reset the `datafax` password and administrator status in cases where it has been accidentally altered.

-reset2fa clear all of the devices that have been verified with two-factor authentication security codes. This will force all logins that require two-factor authentication to re-acquire and enter security codes during next login.

-dump2fa list all of the devices that have been recently verified with two-factor authentication security codes.

-stats display information about the database version and the number of records in the database for each of the indices.

-unlock reset the database synchronization locks in cases where they may be stuck after system failures.

-export outfile export (write) the user and role database information to the argument filename.

-import infile import (read) user and role database information from the argument filename. The file is expected to be in the `DFuserdb.log` format. If the entire database is to be rebuilt, the old `DFuserdb.log` and `DFuserdb.idx` files should first be removed. In this case, **DFuserdb** will create a new database and import the file.

Exit Status

DFuserdb exits with one of the following statuses:

0 The command was successful.

2 An error occurred.

Name

DFversion — Display version information for all DFdiscover executables (programs), reports, and utilities

Synopsis

```
DFversion
```

Description

DFversion invokes the **DFwhich** command for every DFdiscover executable, DFdiscover report and DFdiscover utility included in a standard installation.

Output is grouped by executables, reports and utilities. Within each group, output is sorted alphabetically by name.

DFversion is the most efficient and accurate way to determine the current state of an installation.

Options

None.

Exit Status

DFversion exits with one of the following statuses:

0 The command was successful.

See Also

DFwhich

Name

DFwhich — Display version information for one or more DFdiscover programs, reports and/or utilities

Synopsis

`DFwhich` {*name*...}

Description

DFwhich examines and displays the RCS (revision control system) string of the specified filename(s), in a manner similar to the UNIX **what** command.

The output from the **DFwhich** command can be useful in determining exactly what version of the DFdiscover software is currently being used.

Options

name one or more names of DFdiscover programs, reports, or utilities

Exit Status

DFwhich exits with one of the following statuses:

0 The command was successful.

Examples

Example 3.76. Show the version information for DFedcservice

```
% DFwhich DFedcservice
DFedcservice: Version: 2016.0.0, Date: Apr 29 2016 DF/Net
```

Limitations

DFwhich uses standard UNIX commands to locate version information. The content of the output produced will be essentially the same but may differ in appearance due to different implementations of these commands in flavors of the Linux operating systems.

See Also

DFversion

Chapter 4. Utility Programs

4.1. Introduction

DFdiscover includes several utility programs that can be executed from a command line. Most of these programs are useful in situations where repairs or corrections within your DFdiscover environment are needed. They are located in the DFdiscover utilities directory, `/opt/dfdiscover/utils`.

4.2. Alphabetical Listing

Name

DFaddHylaClient — Create the symbolic links necessary for accessing HylaFAX on a DFdiscover server

Synopsis

```
DFaddHylaClient
```

Description

DFdiscover uses HylaFAX to send and receive faxes. However, as installed by the DFdiscover **INSTALL** program, HylaFAX is not fully configured to run on a fax server workstation. **DFaddHylaClient** makes the links necessary to allow HylaFAX to operate.

Each workstation that will be used for receiving incoming faxes or sending faxes, must have this utility command run on it. The command must be run by someone with super-user privileges and needs to be run only once per workstation (unless the location of the DFdiscover software is subsequently changed).

As distributed, HylaFAX expects to find all of the fax resources it needs in the `/opt/hylafax` directory. However, those resources are actually in /opt/dfdiscover/`$MACHINE/hylafax`. **DFaddHylaClient** makes symbolic links to resolve this inconsistency. Additionally, **DFaddHylaClient** creates a HylaFAX work directory in `/var/spool/fax`. If the directory already exists, the necessary HylaFAX files are copied into the directory.

Note

This program is generally executed as part of the HylaFAX configuration in a new DFdiscover install, and subsequently never needs to be executed again.

Options

None.

Exit Status

DFaddHylaClient exits with one of the following statuses:

0 The command was successful.

Name

DFauditdb — Add or reload journal files to DFaudit.db sqlite database.

Synopsis

`DFauditdb` [-reload] {-study #~#|all}

Description

A new audit trail sqlite database was introduced in release 5.5.0 that greatly improves the performance of retrieving and displaying page or field history in **DFexplore** or **DF_SBhistory**. Existing journal files for any ongoing studies created in a release previous to 5.5.0 must be loaded into the new audit database for each study. **DFauditdb** is provided for this purpose. Until study journal files are loaded, it is not possible to view page or field history, or run **DF_SBhistory**.

Studies that have been created in release 5.5.0, or newer, do not need to be reloaded.

The **DFauditdb** utility must be run by either user `datafax` or `root` when reloading journal files using the -reload option. The reload option empties existing entries and reloads journal files to the DFaudit table in DFaudit.db. If DFdiscover is running, the study to be loaded must not be writing to the study database. **DFauditdb** can be used to load all studies at once using the `-study all` option provided the study servers can be started. Running **DFauditdb** with just the -study studynum option counts entries in the DFaudit table in DFaudit.db.

DFauditdb can be part of the server upgrade process like **DFmigrate**. **DFauditdb** is installed in the utils directory.

Name

DFcertReq — Request an SSL certificate signing for **DFedcservice**.

Synopsis

`DFcertReq`

Description

DFcertReq is used to generate an SSL key and a signing request for use with **DFedcservice**. It must be run by `root` or `datafax`. **DFserveradmin** also provides this functionality in a point-and-click visual interface. Most administrators will find **DFserveradmin** to be the preferred interface for this task.

Note

There is no requirement to use **DFcertReq** and DF/Net Research, Inc. as the SSL certificate signing authority. There are many standard, commercial certificate signing authorities (known as CAs) that are internationally recognized. For a small annual fee paid to the CA, they will sign your certificate. Their signed certificate can be used in your DFdiscover installation. Some clients prefer this approach of using an independent CA.

DFexplore, **DFsetup**, **DFadmin** and **DFsend** communicate with **DFedcservice** using TLS (Transport Layer Security) [1] in the same way that Internet banking sites do. TLS provides an encrypted path through the internet that prevents eavesdropping and modification of your data by third parties. The client applications check that they are communicating with the correct DFdiscover server by means of a certificate that encodes the DFdiscover server's name and ownership. This certificate is generated by choosing a very large random number (specifically a 4096-bit RSA key), adding organizational ownership information to it and then requesting that DF/Net Research, Inc. certify this key as authentic. Subsequently when an **DFexplore**, **DFsetup DFadmin** or **DFsend** client connects to **DFedcservice**, it asks for this certificate and can then determine whether it is communicating in an encrypted manner with the correct server.

The process of generating a certificate starts with the execution of the **DFcertReq** script. This script generates a large random number and then prompts for organizational information, including the country, state, organization name and server name.

Important

It is extremely important that the organizational information is up-to-date and accurate. Client applications may view this information to confirm the server's identity and certificate status.

The organizational information is combined with the large random number to create a unique certificate signing request text file. An email is created for <`certreq@dfnetresearch.com`> containing a request to certify that this is an authentic DFdiscover server. DF/Net Research, Inc. processes this request and emails back a small file containing the certificate, which is then installed in the DFdiscover system. At the end of these steps, communication between the **DFexplore**, **DFsetup**, **DFadmin** and **DFsend** client applications is encypted and secure.

DFcertReq will fail to email the signing request if the computer from which it is run is unable to send email via the internet. In this case, it is possible to manually generate the request by:

1. Transferring the files `/tmp/cert.csr.text` and `/tmp/cert.csr`, that are generated by **DFcertReq**, to an email enabled computer. Remember to perform the transfer in binary mode if using an application like **ftp**.

2. Attach the two transferred files to a new email message and send it to <`certreq@dfnetresearch.com`>.

[1] Specifically, TLS v1.2 or v1.3 is used.

Impact on Login Dialog Banner

At the time of executing **DFcertReq**, if there is no /opt/dfdiscover/`lib/DFlogin.html` file present, **DFcertReq** will also create the file, adding the organizational information collected from the user's responses. Subsequently, this information appears in the banner of each DFdiscover login dialog. To override this behaviour, before executing **DFcertReq**, create your own login banner message in /opt/dfdiscover/`lib/DFlogin.html`.

Options

None.

Exit Status

DFcertReq exits with one of the following statuses:

0 Always.

Examples

Example 4.1. Creating a DFedcservice SSL certificate and signing request

```
# DFcertReq
*****************************************************************
* When asked for 'DFdiscover Server Name (fully qualified domain name)'
* type the full name of the machine (e.g. dfdiscover.mycompany.com)
* as it is called from the Internet.
*****************************************************************
----------------- Generating Server Key ----------------
Generating RSA private key, 4096 bit long modulus (2 primes)
.....................................................++++++
..................++++++
e is 65537 (0x10001)
----------------- Decrypting Server Key ----------------
writing RSA key
----------------- Generating Server Signing Request ----------------

You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [US]:
State or Province Name (full name) []:California
Locality Name (eg, city) []:San Diego
Organization Name (eg, company) []:Pharmadrug Biotech Inc.
Organizational Unit Name (eg, section) [Research]:
DFdiscover Server Name (fully qualified domain name) [dfdiscover.your-
company.com]:dfdiscover.pharmadrug.com
Email Address [support@your-company.com]:support@pharmadrug.com

Emailing certificate signing request to DF/Net Research, Inc...
```

```
Once the certificate has been signed it will be emailed back to you.
```

Name

DFclearIncoming — Clean out the fax receiving directory, processing all newly arrived faxes

Synopsis

```
DFclearIncoming
```

Description

DFclearIncoming uses **DFinnotify.rpc** to submit all unprocessed faxes in the DFdiscover received fax (incoming) directory to the defined incoming DFdiscover daemons.

Under normal circumstances, this command is not needed as DFdiscover automatically processes each incoming fax as receipt completes.

This command is also automatically invoked by the DFdiscover bootstrap procedure when the software is restarted to process any faxes that were received while DFdiscover was not operational.

If one or more incoming daemons are processing when **DFclearIncoming** is started, **DFclearIncoming** will wait until all of the daemons have exited. Then it will empty out the /opt/dfdiscover/`work/.dfincoming_work` file and submit for processing all of the faxes that appear in the DFdiscover incoming directory.

Options

None.

Exit Status

DFclearIncoming exits with one of the following statuses:

0 The command was successful.

Examples

Example 4.2. Clean out the incoming fax directory

```
# DFclearIncoming
1. Checking state of incoming daemons...
2. Checking /opt/dfdiscover/work/.dfincoming_work...
  2 stale incoming entries obsoleted
3. Checking /opt/dfdiscover/incoming...
  1 faxes awaiting processing.
  Processing fax00010.tif
```

Name

DFcmpSchema — Apply the data dictionary rules against the study database

Synopsis

`DFcmpSchema` [-a] [-v] [-p *#*] [-d *DRF_filename*] {-s *#*}

Description

DFcmpSchema performs a consistency check of the database against the data dictionary for the study. It reports:

- records that have an incorrect number of fields
- records that have illegal status, validation levels, or time stamps
- records that have an impossible CRF image reference
- key fields that are illegal or inconsistent with the current study or plate
- values that occupy more columns than the maximum defined for the field
- values that have an incorrect format
- fields that have impossible values
- choice and check fields whose data value does not match the coding defined in the study schema
- missing delimiter at the end of data records for user defined CRF plates
- missing or empty required fields on clean primary or secondary data records
- date values that contain digits, characters, or ?? on clean primary and secondary records, and do not conform to the field imputation or partial rounding variable format

When the data dictionary for an existing study is changed via **DFsetup**, DFdiscover does not retroactively modify the database to match the new dictionary. **DFcmpSchema** is useful in this circumstance to identify and locate existing data that now violates the data dictionary.

DFcmpSchema applies two types of checking: basic and exhaustive checking. Basic checking is the default and includes all but the last two bulleted items described above. Exhaustive checking includes everything verified in basic checking plus the last two items for missing/empty required fields and inconsistent date values. Exhaustive checking can be performed by running **DFcmpSchema** with the `-v` option.

By default, **DFcmpSchema** applies basic checks to all primary records in the database, excluding any records in the new record queue. New records are only checked if plate zero is explicitly specified. Because the data fields in new records have not yet been verified, **DFcmpSchema** only checks fields 1-7, i.e. checking stops at the subject ID field.

For each inconsistency, the report includes the record, plate number, the line number in the exported data file, a synopsis of the inconsistency, the key fields of the record (so it can be retrieved with **DFexplore**), the data dictionary definition, and the current data value.

Options

-a Check all primary and secondary records. The default is to check only primary records. [1]

[1] Missed records are never checked.

-v Apply exhaustive checking. Exhaustive checking includes all basic checking plus additional checks *on clean records only* for

- missing or empty required fields
- date values that do not conform to the field's imputation or partial rounding specifications

-p # Check only the requested plate number. The plate number can be one of the user-specified plates, plate 0 (new record queue), plate 510 (reason for data change), or plate 511 (query).

-d DRF_filename Create a DFdiscover retrieval file for all problems identified.

-s # Study number (required).

Exit Status

DFcmpSchema exits with one of the following statuses:

0 The command was successful.

36 The required command-line arguments were not present or were incorrectly specified.

2 The command failed because the study number was not defined, the study schema could not be read, the requested plate number was not defined, or communication with the database server failed.

Examples

Example 4.3. Report on all inconsistencies for study 240

```
% DFcmpSchema -s 240
2|1|0245R0032001|240|1||1||0|0||||||||2|02/11/11 13:26:52|02/11/11 13:26:52|
E** Plate 1 (Screening Form), line 1: Incorrect field count: 20 should be 21.
```

Example 4.4. Perform exhaustive checking for inconsistencies on plate 2 for study 254

```
% DFcmpSchema -v -p 2 -s 254

1|7|0436R0008002|254|2|1|10052|KKL|23/06/04||09/09/24|||180||080|1|1|23/07/04|1|04/09/08
 11:08:15|04/11/11 09:33:48|
E** Plate 2 (Patient Entry Form), line 2: Required data field.
        Subject ID='10052', Visit='1'
        Field#10  (status=1, validation=7)
        Name='MEDCODE'
        Desc='Medication Code 1'
        Type=INT      Required  Width=4
        DATA LEN=0 ''

1|7|0436R0006002|254|2|1|10056|POL|00/04/03|1112|07/08/24||111.1|166||070|1|1|05/06/04|1|
04/09/08 10:03:14|04/11/11 09:45:32|
E** Plate 2 (Patient Entry Form), line 3: Bad data.
        Subject ID='10056', Visit='1'
        Field#9  (status=1, validation=7)
        Name='EDATE'
        Desc='Entry Date'
        Type=DATE     Required  Width=8   Format='dd/mm/yy'
```

```
        Imputation='never'  Range='1940 - 2039'
        DATA LEN=8 '00/04/03'
```

Name

DFcmpSeq — Determine the appropriate values for each `.seqYYWW` file

Synopsis

`DFcmpSeq`

Description

This command must be run by user `datafax` or `root`.

DFcmpSeq verifies the contents of the sequence files maintained by DFdiscover in the /opt/dfdiscover/`work` directory. It verifies for each file that the number stored in the file is:

- greater than the highest sequence number assigned to a file in the TIFF archive directory (by any daemon)
- greater than the highest sequence number referenced in the DFdiscover maintained `fax_log` file

In unusual circumstances it may be that a sequence file cannot be updated by DFdiscover when it should be. This can subsequently lead to problems processing incoming faxes because new sequence numbers assigned by **DFmaster.rpcd** overlap with previously used sequence numbers. Incoming fax processing will fail and messages will be logged while this condition persists. **DFcmpSeq** must be used in this case to determine what the correct values are for the sequence files.

Typically this command is required only in circumstances where a sequence file has been accidentally deleted and its contents need to be re-created.

Options

None.

Exit Status

DFcmpSeq exits with one of the following statuses:

0 The command was successful.

2 The command failed because the configuration of the incoming daemon could not be read.

Examples

Example 4.5. Report on the current status of the sequence files

In this example, **DFcmpSeq** finds two problems. The solutions are to insert `286` in /opt/dfdiscover/`work/.seq9245` to fix the first problem and 3 in /opt/dfdiscover/`work/.seq9401` to fix the second problem.

```
# DFcmpSeq
checking daemon 1, configuration file /df/lib/DFinbound.1...
Checking archive directory /archive/g3...
checking YYWW 9618...
checking YYWW 9621...
checking YYWW 9622...
checking YYWW 9604...
checking YYWW 9605...
```

```
checking YYWW 9606...
checking YYWW 9607...
checking daemon 2, configuration file /df/lib/DFinbound.1...
Checking .seq files...
Checking fax_log...
YYYY/WW   Archive   Faxlog  SeqFile  Error
1992/45         0      285      279  FAXLOG > SEQFILE
1994/01         2        0        0  ARCHIVE > SEQFILE
```

Name

DFisRunning — Determine if the DFdiscover master program is currently running on the licensed DFdiscover machine

Synopsis

`DFisRunning` [-q]

Description

DFisRunning is a utility program that determines whether or not **DFmaster.rpcd** is currently running on the licensed DFdiscover machine. It is most useful in shell scripts and cron jobs that need to determine if DFdiscover is operational before proceeding.

Options

-q execute in quiet mode. Do not echo any messages to standard output. The result of the command can be determined from the command status, where 0 indicates that the master is not running, and 1 indicates that it is.

Exit Status

DFisRunning exits with one of the following statuses:

0 The DFdiscover master is not running.

1 The DFdiscover master is running.

2 There is an error in the command-line arguments or the hostname executing the DFdiscover master cannot be determined/located.

Examples

Example 4.6. Report on the current status of the DFdiscover master, first in quiet mode and then in non-quiet mode

```
% DFisRunning -q
% echo $status
1
% DFisRunning
DFmaster is running on 'oberon'.
% echo $status
1
```

Name

DFmigrate — Upgrade study setup and configuration files from an old DFdiscover version to the current version.

Synopsis

`DFmigrate` [-f] [-a] [-s *#, #-#*] [# *study_directory*]

Description

Several changes were introduced in release 2014.0.0 that are incompatible with earlier releases of DFdiscover. As a result any ongoing studies created in a release previous to 2014.0.0 must be migrated in order to make them compatible. **DFmigrate** is provided for this purpose. Until a study is migrated, it is not possible to use it in the current release of the software.

Studies that have been created in release 2014.0.0, or newer, do not need to be migrated. Similarly, studies that were previously migrated to be compatible with 2014.0.0, do not require (re-)migration.

Important

It is strongly recommended that you create a backup of your original study directories prior to migration. If you have not already backed up all studies prior to the new installation you should do it now. The migration process does not touch study data or faxed images, only study setup files including plate backgrounds are migrated.

The **DFmigrate** utility must be run by either user `datafax` or `root`. DFdiscover does not need to be running to run **DFmigrate**. If DFdiscover is running at the time of migration, the study to be migrated must not be in use. **DFmigrate** can be used to migrate all studies at once or one study at a time. The migration process follows the same steps regardless of the number of studies being migrated. The steps of the migration process are documented in the **DFmigrate** output as follows:

1. **Sanity Checks.** Before migrating any studies **DFmigrate** checks to ensure that:

    1. no study directory is nested within another study directory,

    2. each study directory and configuration file belongs to exactly one study [1]

    If a failure is detected in either of these requirements, **DFmigrate** terminates with an error message and no studies are migrated.

2. **Updating DFserver.cf.** This step updates the existing DFserver.cf file found in `STUDY_DIR`/lib to include new Minimum Version parameters. A copy of the original DFserver.cf file is created as DFserver.cf_oldversion and stored in `STUDY_DIR`/lib prior to the conversion. The study's minimum version restriction for **DFexplore** and **DFsetup** are set to the same version as **DFmigrate** (i.e. the current DFdiscover version).

3. **Converting DFsetup.** This step converts the existing DFsetup, DFschema, DFschema.stl, DFtips and DFcterm_map files found in `STUDY_DIR`/lib to the format expected by the current version. Copies of the original files (called DFsetup_oldversion, DFschema_oldversion, DFschema.stl_oldversion, DFtips_oldversion, DFcterm_map_oldversion) are created and stored in `STUDY_DIR`/lib prior to the conversion. The `QC_Report_ID` style is converted from type string to type number. If user-defined string styles also exist with the "Treat As Pre-printed Numerals" attribute, these too will be converted to type number during migration. If plate triggered procedures (Pre- and Post-processes) have been defined for any of the plates in **DFsetup**, a new plate arrival trigger file is created for each Pre- and Post-process. The plate arrival trigger files are named `DFPrePost###.sh`, where ### represents the plate number on which the

[1] Study directory paths are evaluated without regard to case, e.g. `/opt/studies/study1` and `/opt/studies/Study1` are considered identical, and not allowed as each study path must be unique.

process is defined. These files are saved to the study directory STUDY_DIR/ecbin. If a plate contains both a Pre- and Post-process, both processes will be merged into a single plate arrival trigger file.

This step is also responsible for creating the following directories in the STUDY_DIR parent directory: ecbin, dfsas, drf and dfschema, which did not exist in earlier releases.

Where they are not already defined, custom level labels are set to the default label values Level 0, Level 1,... , Level 7.

4. **Moving Lookup Tables to lut directory.** All lookup tables must reside in either a study lookup table directory, specifically STUDY_DIR/lut, or in a DFdiscover level lookup table directory, named /opt/dfdiscover/lut. DFdiscover looks for referenced lookup tables first at the study level and then if they cannot be found there at the DFdiscover level. STUDY_DIR/lut is created and lookup tables defined in the study lookup table map file, STUDY_DIR/lib/DFlut_map, which can be found in STUDY_DIR/lib are moved to STUDY_DIR/lut. DFlut_map itself continues to reside in STUDY_DIR/lib/DFlut_map.

   > **Note**
   >
   > Lookup tables which do not reside in $STUDY_DUR/lib, and were instead defined in STUDY_DIR/lib/DFlut_map with an absolute path location, will not be moved by **DFmigrate** and must be moved manually to either STUDY_DIR/lut or /opt/dfdiscover/lut. Also STUDY_DIR/lib/DFlut_map must be updated to remove any absolute pathnames to lookup tables.

5. **Moving Edit checks code to the ecsrc directory.** Edit checks are stored in the STUDY_DIR/ecsrc directory. If necessary this directory is created and the pre-migration edit check file DFedits is moved to this directory. Published edit check file DFedits.bin, which is used by **DFexplore**, is not moved and continues to reside in STUDY_DIR/lib.

   > **Note**
   >
   > Other edit check source files (i.e. any include files specified in DFedits) are not moved by **DFmigrate** and must be moved manually to the ecsrc directory in either STUDY_DIR or /opt/dfdiscover. Like lookup tables, DFdiscover now looks for edit check include files first in the study directory STUDY_DIR/ecsrc and if not found, then in the system location /opt/dfdiscover/ecsrc. All include files must be referenced by their file name alone, and an absolute path name is not allowed.

6. **Converting postscript and old TIFF files to PNG.** A DFbkgdXXX.png file is created for each plate background image found in the study STUDY_DIR/bkgd directory. These PNG files are necessary if you use the DFdiscover DFprintdb program to print CRF backgrounds merged with data records from the study database. These high-resolution PNG files are also used by **DFexplore** to print CRF backgrounds. The PNG files are created by converting existing high-resolution tiff files. If tiff files do not exist then the PNG files are generated by amalgamating the DFbkgd-prologue.ps file and the individual DFbkgdXXX.ps files for each plate and using Ghostscript (DFgs) to convert the merged PostScript files into high resolution PNG files.

   > **Note**
   >
   > If the PostScript conversion performed in this step fails, the PNG files can be created by re-importing and saving the CRF backgrounds in the **DFsetup** tool.

If during execution of **DFmigrate** any of the above steps fail, **DFmigrate** can be re-run for the same study after the outstanding issues have been resolved.

DFmigrate appends a title (which includes: study number, study directory, date and time) followed by any error or warning messages for each migrated study to a log file named dfmigrate_errors which is created in the directory from which **DFmigrate** is run if it does not already exist. This file should be checked when **DFmigrate** ends. It may contain messages describing manual steps that need to be taken to complete the migration of one or more studies.

When migrating pre 4.1 studies, if the -a (migrate all studies) option is used an entry is added to DFstudyspaces.db for each unique study parent directory found in DFstudies.db; and if the -s option is used to migrate a single study an entry is added for that study alone, unless it's study space is already defined.

Once migration has been successfully completed for a study the DFdiscover utility program **DFstudyPerms** should be run to verify and, if necessary, correct any permission problems that may exist for the study directories and files.

Options

-f force the conversion of all plate backgrounds if there are no PNG backgrounds already existing in `STUDY_DIR`/bkgd.

-a migrate all studies found in /opt/dfdiscover/lib/DFstudies.db

-s #, #-# migrate the specified study numbers (required). /opt/dfdiscover/lib/DFstudies.db is read to determine the study directory corresponding to each study number.

 # study_directory migrate the specified study number (required) that is located in the specified study directory

Exit Status

DFmigrate exits with one of the following statuses:

0 **DFmigrate** ran successfully

> 0 **DFmigrate** failed, Any output error messages are written to the `dfmigrate_errors` file in the working directory.

Examples

Example 4.7. Migrate study 100 to the current version

DFmigrate gets the correct path for study 100 from its entry in /opt/dfdiscover/lib/DFstudies.db.

```
% DFmigrate -s 100

**********************************************************
DFmigrate: Study 100 - /opt/studies/test100 - Thu Apr 15 12:58:40 2010
**********************************************************
Step 1: Updating DFserver.cf
------------------------------------------------------------
File Converted: /opt/studies/test100/lib/DFserver.cf
Step 2: Converting DFsetup
------------------------------------------------------------
OLD SETUP FILE <DFsetup v3.7.0>

File Created: /opt/studies/test100/ecbin/DFPrePost001.sh.
File Created: /opt/studies/test100/ecbin/DFPrePost002.sh.
File Created: /opt/studies/test100/ecbin/DFPrePost003.sh.

NOTE: Style type for the following styles has been been changed to
Number as it was previously set to treat data as pre-printed numerals:
        STYLE
        --------------
        QC_Report_ID
```

```
File Converted: /opt/studies/test100/lib/DFsetup
File Converted: /opt/studies/test100/lib/DFschema
File Converted: /opt/studies/test100/lib/DFschema.stl
File Converted: /opt/studies/test100/lib/DFtips
File Converted: /opt/studies/test100/lib/DFcterm_map

Step 3: Moving Lookup Tables to lut directory
-------------------------------------------------------------
ERROR: Absolute file path found! lookup table file
/opt/studies/test100/lib/DF_QClut not moved.

Step 4: Moving Edit Checks code to ecsrc directory
-------------------------------------------------------------
File Moved: from lib/DFedits to ecsrc/DFedits.
WARNING: DFedits contains #include files which must be moved to ecsrc
manually.

Step 5: Converting postscript to png and old tiffs to png
-------------------------------------------------------------
All background files converted from DFbkgd###.ps to DFbkgd###.png

Study migration was successful.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
DONE:
Migration has been performed on the following study: 100
Please review dfmigrate_errors for any migration errors
or warnings and/or manual steps that may be required.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

%
```

Example 4.8. Migrate a non-active study to current version

Study 207 is not active. It does not appear in the **DFadmin** study list and is not defined in /opt/dfdiscover/lib/DFstudies.db. The study directory is located at /tmp/studies/study207. It might be an old study copied from a backup medium, or a copy of an active study (e.g. cp -pr /opt/studies/study107 /tmp/studies/study207)

```
%  DFmigrate 207 /tmp/studies/study207
```

Example 4.9. Migrate all studies found in /opt/dfdiscover/lib/DFstudies.db to current version

```
%  DFmigrate -a
```

Name

DFras2png — Convert Sun raster files in the study pages directory into PNG files

Synopsis

`DFras2png` {-s *`study_dir`*}

Description

DFras2png is used to convert Sun raster files in the study pages directory into PNG files. File names remain the same.

All recent versions of DFdiscover store images in PNG format rather than the Sun raster image format used in older versions. Converting the images to PNG format brings several advantages: smaller file sizes, color capability and better interoperability with other software. Very few packages can deal with the Sun raster file format.

Only files in the pages directory are converted. Any Sun raster image files in any of the other study directories are not touched. Any PNG files that exist in the pages directory are reported but are not re-converted. Any other files that are not Sun raster files are ignored. Study directories that are incorrectly specified or don't exist are reported. All reporting is written to stderr.

Options

-s study_dir This is a required option. The study_dir is the full pathname to a study directory.

Exit Status

exits with one status:

0 The command was successful.

Examples

Example 4.10. Convert all Sun raster files in the pages directory found in the study directory `/opt/studies/demo253` into PNG files

```
% DFras2png -s /opt/studies/demo253
```

Name

DFshowIdx — Show the per plate index file(s) for a specific study

Synopsis

`DFshowIdx` [-F] [-q] [-l #] [-p #] {-s #}

Description

DFshowIdx displays the per plate index files as described in plt###.ndx - per plate index files.

Options

-F Update the count of total entries (if needed), sort the index (so that the sorted count now matches the total count), and reset the unsorted count to 0.

-q Display header only.

-l Maximum length of data record.

-p # Display the index file for a specific plate. The plate number can be one of the user-specified plates, plate 0 (new record queue), plate 510 (reasons for data), or plate 511 (queries). If not specified, index files for all plates are checked.

-s # Study number (required).

Exit Status

DFshowIdx exits with one of the following statuses:

0 The command was successful.

1 The command failed because of one or more errors with command-line flags.

Name

DFstudyDiag — Report (diagnose) the current status of a study database server

Synopsis

`DFstudyDiag` {-s #}

Description

There are a variety of consistency checks that must be in place for a study server to operate correctly. If one or more of these consistency checks fails, it may be difficult for a user to determine the failure condition so that it can be remedied. **DFstudyDiag** is the utility to use in situations like this.

DFstudyDiag checks a variety of places while diagnosing a study server. It consults with the DFdiscover master, reviews the DFdiscover studies database, communicates with the operating system's portmapper, and also interacts with one or more DFdiscover slaves. **DFstudyDiag** displays its progress which each of these interactions as these proceed.

Options

-s # the DFdiscover study number to diagnose (required).

Exit Status

DFstudyDiag exits with one of the following statuses:

0 The command was successful and the study server is operational and responding correctly, or the study server has been disabled.

1 The command was successful and the study server is not responding, or the command failed because there was an error in the command-line arguments.

Examples

Example 4.11. What is the status of study 7's database server?

```
% DFstudyDiag -s 7
Diagnosing study server 7 starting Fri Apr 25 14:57:16 1997...
>> Trying to contact study server directly...
<< Study server is currently operational and responding.
```

Example 4.12. DFstudyDiag detects a problem with study 8

```
% DFstudyDiag -s 8
Diagnosing study server 8 starting Fri Apr 25 15:00:52 1997...
>> Trying to contact study server directly...
<< Failed.
>> Trying to load studies database from master...
<< OK.
>> Contacting portmapper on candidate hosts...
<< OK.
>> Contacting slaves on candidate hosts...
<< OK.
```

```
>> Checking portmapper entries on candidate hosts...
<< OK.
>> Looking for existing serverstatus file...
<< The file '/opt/dfdiscover/work/.serverstatus8' exists although no study
<< appears to be running.  The file should be removed.
Please show this output to your DFdiscover administrator.
```

Name

DFstudyPerms — Report, and correct, the permissions on all required DFdiscover sub-directories and files for a study

Synopsis

`DFstudyPerms` [-v] [-f] [-g *`string`*] {*#*}

Description

Incorrect permissions or file ownerships are the most common causes of problems in UNIX applications, and DFdiscover, being a UNIX application, is no exception.

DFstudyPerms is a useful utility for detecting permission and ownership problems on all required DFdiscover sub-directories and files for a study. It is not able to detect errors in files that are not required by DFdiscover.

DFstudyPerms exits with a status of 0 if no errors are detected and a non-zero status if errors are detected.

DFstudyPerms does not detect problems with ownership or permissions in the DFdiscover software files themselves. To reset ownerships and permissions with the DFdiscover software, use the **SETPERMS** script that can be found in /opt/dfdiscover.

Options

-v verbose mode. Choosing this option causes **DFstudyPerms** to echo the name of each file and sub-directory it examines. The default behavior is to examine directories and files quietly unless an error is detected.

-f fix mode. Choosing this option causes **DFstudyPerms** to attempt to fix each permission problem that is detected. In most environments, the user executing **DFstudyPerms** will need to be `root` for fix mode to work.

-g string check group ownership and permissions for the named group instead of the default `studies` group.

the DFdiscover study number (required).

Exit Status

DFstudyPerms exits with one of the following statuses:

0 The command was successful and no permission problems were detected.

1 The command was executed with the `-u` (usage) option.

2 The command was successful and permission problems were detected, or the command failed because user `datafax` or group `studies` was not defined.

Examples

Example 4.13. Check, in verbose mode, the permissions for study 251

```
% DFstudyPerms -v 251
checking study 251, group studies
...checking '/opt/studies/exemplar251'
...checking '/opt/studies/exemplar251/lib'
...checking '/opt/studies/exemplar251/bkgd'
```

```
...checking '/opt/studies/exemplar251/data'
...checking '/opt/studies/exemplar251/data/1602.jnl'
...checking '/opt/studies/exemplar251/data/1603.jnl'
...checking '/opt/studies/exemplar251/data/1604.jnl'
...checking '/opt/studies/exemplar251/pages'
...checking '/opt/studies/exemplar251/pages_hd'
...checking '/opt/studies/exemplar251/reports'
...checking '/opt/studies/exemplar251/work'
...checking '/opt/studies/exemplar251/lib/DFcenters'
...checking '/opt/studies/exemplar251/lib/DFfile_map'
...checking '/opt/studies/exemplar251/lib/DFschema'
...checking '/opt/studies/exemplar251/lib/DFsetup'
...checking '/opt/studies/exemplar251/lib/DFtips'
...checking '/opt/studies/exemplar251/lib/DFvisit_map'
...checking '/opt/studies/exemplar251/lib/DFlut_map'
...checking '/opt/studies/exemplar251/lib/DFmissing_map'
...checking '/opt/studies/exemplar251/lib/DFpage_map'
...checking '/opt/studies/exemplar251/lib/DFqcproblem_map'
% echo $status
0
```

Name

DFtiff2ras — Convert a TIFF file into individual PNG files

Synopsis

{*infile*} {*outfile*}

Description

is used to convert TIFF files into individual PNG files whose names are comprised of the output stem followed by a 3-digit page number. The raster files are converted to 100DPI images but are not image processed in any other way.

Options

infile the name of the input TIFF file to be split

outfile the name of the output PNG file

Exit Status

exits with one of the following statuses:

0 The command was successful.

2 The command failed because there was an error in the command-line arguments, or the required input file could not be read.

> 0 The command was successful but one or more output files could not be created. The exit status is the number of output files that could not be created.

Examples

Example 4.14. Convert the file `fax12345.tif` into PNG files `rast001`, etc

```
% DFtiff2ras fax12345.tif rast
```

Name

DFuserPerms — Import and update users and passwords, and optionally import roles, role permissions, and user roles

Synopsis

`DFuserPerms` [-S *`server`*] [-U *`username`*] [-C *`password`*] [-a] [-f] [-e *`errorlog`*] {-i *`inputfile`*}

Description

Normally, creating and modifying users, passwords, roles, role permissions, and user roles is done with **DFadmin**. However, there may be cases where it would be useful to perform these operations from the command line. **DFuserPerms** is a tool that grants the ability to import these records from the command line. The records must be stored in an input file which conforms to the format used in the `DFuserdb.log` file (see *System Administrator Guide, DFuserdb.logDFuserdb.log*), although with the following exceptions:

- Record Time Stamp and Record Modifier must not be included for any record type.
- Instead of a Password Hash field for PASS records, the actual password to be imported must be specified.

Important

The following behaviors of **DFuserPerms** should be noted:

- USRL and RLPM records require the corresponding ROLE record to be present in the same import file. However, PASS and USRL records do not require the corresponding USER to be present in the same file.
- For ROLE records, the role ID specified in the import file does not affect which ID it is actually assigned. If the role's name and study number matches an existing role, the existing role is edited to match the record being imported. If the role's combination of name and study number is new and unique, it is imported as a new role with the next available ID. As a result, role names cannot be edited with **DFuserPerms**.
- Though it does not matter to the ROLE record which ID it is given, if a USRL or RLPM record is being imported, the Role ID field is used to match it to a role imported in the same file. So if a user wishes to import USRL or RLPM records for a certain role, they must give the ROLE, RLPM, and USRL records the same role ID in their import file. See the second example.
- The Expiry field for PASS records is required but irrelevant. **DFuserPerms** sets the password expiry according to the settings in **DFadmin**.
- When there is an error in the record formatting or data, **DFuserPerms** does not import that specific record, but does import all other valid records in the file. As such, **DFuserPerms** is considered to have run successfully even if there are invalid records. Thus errors in the record formatting or data are not written to stderr, but rather stdout. Only errors which prevent **DFuserPerms** from running, such as authentication errors, are written to stderr.
- If there is an error when reading a PASS record, the password characters are replaced with X's when the error is written to stdout.

Options

-S server the DFdiscover server name. Must be specified unless the user has the DFSERVER shell variable set appropriately.

-U username login username. Must be specified unless the user has the DFUSER shell variable set appropriately.

-C password login password. Must be specified unless the user has the DFPASSWD shell variable set appropriately, or has previously set up authentication using DFpass.

-a allow ROLE, USRL, and RLPM records to be imported.

-f check data format only. Does not import records. This option only looks for record formatting errors. Problems in the records that would need to be caught by the study server, such as passwords that do not meet the requirements or importing passwords for non-existent users, are not recognized by this option.

-e errorlog output critical errors to specified file. Formatting errors are not written to the error log, only errors that prevent **DFuserPerms** from running. If this option is not specified, errors are written to stderr.

-i inputfile specify the input file for **DFuserPerms** to import (required).

Exit Status

DFuserPerms exits with one of the following statuses:

0 The command was executed, **DFuserPerms** has run and imported all valid records. If there are invalid records but **DFuserPerms** has still run, the exit status is still 0.

1 **DFuserPerms** encountered a critical error such as failed authentication or permission errors. Invalid records in the import file are not critical errors since **DFuserPerms** still runs, and do not cause an exit status of 1.

Examples

Example 4.15. Importing USER and PASS records

In this example, a new user named Jason is imported and a password is assigned to them. The input file contains:

```
USER|Jason|2|Jason Johnson|A Company Incorporated|||||||||0|2|1|
PASS|Jason|apassword1234|1464208516
```

Importing the file:

```
% DFuserPerms -S servername -U username -C password -i inputfile

*****************************************************************
DFuserPerms: Server [servername] User [username] Fri Jun 10 09:40:37 2016
*****************************************************************
Input file: inputfile
Reading file
==============================
Imported Records = 2
Total Rows = 2
==============================

DONE: Importing user-perms complete. Errors (if any) are logged above.
*****************************************************************
```

Example 4.16. Importing ROLE, RLPM, and USRL records

In this example a new role called Company Permissions is imported, role permissions for this role are specified, and user Jason is assigned to have this user role. The input file contains:

```
ROLE|20|254|2|Company Permissions||*|*|*||*|0|0
RLPM|20|2|2|*|*|1,2,3,4,5|1,2,3,4,5|1,2,3,4|*|*|*|0|0
USRL|Jason|20|1|2|*|*
```

Importing the file:

```
% DFuserPerms -S servername -U username -C password -a -i inputfile

*********************************************************************
DFuserPerms: Server [servername] User [username] Fri Jun 10 09:51:27 2016
*********************************************************************
Input file: inputfile
Reading file
==============================
Imported Records = 3
Total Rows = 3
==============================

DONE: Importing user-perms complete. Errors (if any) are logged above.
*********************************************************************
```

Note that the ROLE, RLPM, and USRL records all used the same Role ID value (20). The `DFuserdb.log` file shows the the IDs have changed when they were imported, but **DFuserPerms** ensures that since they were imported with the same ID value, they are assigned to the same role ID (105):

```
20160610095127|ROLE|datafax|105|254|2|Company Permissions||*|*|*||*|0|0
20160610095127|RLPM|datafax|105|2|2|*|*|1,2,3,4,5|1,2,3,4,5|1,2,3,4|*|*|*|0|0
20160610095127|USRL|datafax|Jason|105|1|2|*|*
```

Chapter 5. Edit checks

5.1. Introduction

The DFdiscover edit check language provides a general-purpose programming environment in which to create procedures that can be used to perform logic checks on data fields, generate quality control notes, and calculate and insert values into data fields. Edit checks may reference one or more data fields from any available record in the database, and may include arithmetic, logical and comparison operators. Looping and conditional execution constructs are also provided. The language structure is based on the C programming language and is a loose subset of C.

Edit checks are defined, named and stored in a study edit check file (named `DFedits` and located in the study `lib` directory). This file is accessed and edited by selecting **View** > **Edit checks** in **DFsetup**. Once defined, an edit check can be applied to the desired data field(s) using the style or variable definition dialogs, where the edit check can be set to execute on: field entry, field exit, page entry, or page exit.

When choosing among the options of field entry, field exit, plate entry and plate exit, note the following:

- most edit checks should execute on exit from the last field used in the edit check to ensure that the user has finished all relevant data entry and corrections.
- if you do not trust users to tab through all data fields you may want to execute edit checks on both field and plate exit to ensure that a data record can not be saved without executing the edit checks.
- do not attach edit checks to hidden fields if you want them to be executed by users who do not have access to hidden fields.
- in Image view most edit checks should not be executed until after the duplicate resolution step has completed (which occurs on entry to the first non-key field), because the initial ICR values may be replaced by existing database values during duplicate resolution. In particular note that any edit checks triggered on exit from the key fields (visit and ID) will run to completion before duplicate resolution has a chance to occur, and thus might produce incorrect results.
- any plate entry edit checks executed in Image view will be re-executed after the existing data record is brought forward by duplicate resolution.

Edit checks are most often executed interactively when entering and reviewing data records in DFexplore, DFcollect and DFweb but can also be executed in batch mode (see Batch Edit checks).

The process used to define edit checks in **DFsetup** is detailed in *Study Setup User Guide, Edit checks*.

5.1.1. `DFopen_study` and `DFopen_patient_binder`

In addition to user-defined field and plate entry and exit edit checks, there are 2 reserved edit check names:

- `DFopen_study` - executed when the study is selected in the login dialog, and
- `DFopen_patient_binder` - executed when a subject binder is opened in **DFweb**, **DFcollect** or in DFexplore Data View, including when a user switches to Data View from any of the other views, and when a task record is selected for a different subject.

These two reserved edit checks are optional; if they are defined by an edit check programmer they will execute in DFexplore, DFweb and DFcollect. Additionally, `DFopen_study` executes for the first batch in a batchlist when run in batch mode. They are typically used to set user preferences (using function `dfpref`), change visit and plate requirements from the default visit map specifications (using function `dfneed`), and to display messages (using function `dfwarning` or `dferror`). Since no data record has the focus when these edit checks run, the edit checks cannot refer to data fields unless the fields are

fully qualified. For example, `@[1001,0,1,15]` references field 15 and `VDATE[1001,0,1]` references variable `VDATE`, both of plate 1 at visit 0 for subject 1001. In `DFopen_patient_binder`, `@PID` can be used to refer to the subject ID; thus `VDATE[@PID,0,1]` contains the value of the `VDATE` field for the subject whose binder is being opened. In `DFopen_study`, `@PID` equals 0 since no subject has yet been selected.

5.2. Language Features

The edit check language provides the following features:

- Support for all DFdiscover data types
- Read/Write access to variables on the current plate
- Read access to variables on other plates
- Local variables
- Arithmetic, logical, comparison operators
- Query functions
- Lookup table support
- Legal range check functions
- Message output functions
- String matching and manipulation functions
- Information functions
- User-defined functions

5.3. Database Permissions

In DFexplore the data fields available to edit checks are restricted by user's site, subject, visit, plate and read level access permissions, as specified in the roles the user plays within each study. This helps to ensure that users will not be shown database values in edit checks to which they would normally not have access, but it also means that data records unavailable to the DFexplore user can not be used in edit checks. This restriction does not apply to hidden fields. Thus data values that are needed in an edit check, but should not normally be seen by users with a certain role, can be made available by defining them as hidden fields on plates to which the user has read access permissions.

5.4. Language Structure

As each edit check is defined, it must be given a name. This name can be any sequence of letters, but it is a good idea to use names that are descriptive of what the edit check is to accomplish. Names must start with a letter and may contain letters, numbers and underscores, _. There is no length limit on edit check names. Edit check names are case sensitive, so `myeditcheck()` and `MyEditCheck()` refer to different edit checks.

Comments can be placed anywhere an edit check by preceding it with an octothorpe, #.

Edit checks begin with the line containing the keyword `edit`, the name of the edit check, a `(`, an optional parameter declaration list and a `)`. The optional parameter declaration allows arguments to be passed into the edit check. It is important to note that if parameters are declared, they must be supplied when the edit check is invoked. Following this is the body

of the edit check, enclosed in a pair of braces, `{` and `}`. The body of the edit check contains zero or more statements that perform the desired operations.

Execution of the edit check begins with the first statement in the edit check and proceeds to the next in sequence until the logic flow changes because of an `if` or `while` statement. Execution is terminated via an `exit` or `return` statement or when control reaches the end of the edit check.

Braces, `{` and `}`, are used throughout the edit check language to group two or more statements together to operate as one statement. They become especially important when used with the `if` and `while` statements that require a single action statement.

Each statement in the edit check language is terminated by a semicolon, `;`. A simple edit check to convert pounds to kilograms could be written as follows:

```
# This is a comment
edit lbs2kgs()
{
        kgs = lbs / 2.205;
}
```

Edit checks are placed one after the other in the `DFedits` file, so the addition of a similar function to convert kilograms to pounds would result in the following `DFedits` file:

```
edit lbs2kgs()
{
        kgs = lbs / 2.205;
}
edit kgs2lbs()
{
        lbs = kgs * 2.205;
}
```

An example of an edit check with parameters would look like this:

```
edit isbetween(number low, number high)
{
        if ((lbs < low) || (lbs > high)) {
                dferror("Weight is not between ", low, " and ", high, " pounds.");
        }
}
```

To verify that the weight is in the range of 100-250 pounds we would attach the edit check `isbetween(100, 250)` on field exit on the variable `lbs`.

5.4.1. `return` and `exit` statements

Statements in the body of an edit check are executed in order. The logic of an edit check typically terminates after the last statement is executed, however, an edit check can be forced to terminate earlier by use of the `return` or `exit` statements. These two statements are very similar in purpose; they terminate the logic of an edit check at the point where the statement is executed - no following statements are executed.

The difference in the `return` and `exit` statements is in their behavior with respect to a sequence of edit checks that are to be executed at the same location on the current variable. The `exit` statement terminates the current edit check and does not execute any of the following edit checks on the variable, whereas `return` terminates the current edit check but then resumes processing with the next edit check defined on the variable, if any.

Example 5.1. Difference between `exit` and `return`

In this example, a variable has the following definition for the field enter edit checks:

```
ageCheck, demog, conmed
```

The three edit checks are to be executed in the listed order. If an `exit` statement is executed in the body of `ageCheck` then edit checks `demog` and `conmed` are not executed. However, if a `return` statement is executed in the body of `ageCheck`, edit checks `demog` and `conmed` would still be executed.

The same would be true for an `exit` or `return` statement inside the body of edit check `demog`, `conmed` would be skipped if `exit` executed, while it would not be skipped if `return` was executed.

Now that you have some idea of what edit checks are about and have seen an example, we will turn to a description of the elements of the edit check language.

5.5. Variables

5.5.1. Variables and Types

Variables are storage spaces that can hold values. Each variable has a data type associated with it, where the data type is from the list:

- number
- date
- string
- time

The data types have the following properties:

- **number.** an optional leading plus/minus sign, a sequence of one or more digits (whole part of the number), an optional decimal point, and, optionally, one or more digits (fractional part). The range of numbers (10 digits at maximum, except for subject ID which allows 15 digits at maximum) that can be represented is `-2147483647` to `2147483647`, inclusive.
- **date.** 2 or 4 digits for the year, 2 digits or 3 characters for the month, 2 digits for the day, and optional delimiters. The format of the date is taken from the field definition for database variables, or from the `format date` declaration (see Section 5.5.7, “Date Variables”) for constant dates.
- **string.** a sequence of zero or more alphanumeric characters, plus a small set of two character sequences (see Section 5.19.2, “String Constants”), enclosed in double quotes. The maximum length of a string is taken from the field definition for database variables, or is 16383 bytes for constant strings (4095 UNICODE characters).
- **time.** 2 digits for hours, a colon delimiter, two digits for minutes or 2 digits for hours, a colon delimiter, two digits for minutes, another colon delimiter and two digits for seconds. The minimum and maximum values are based on a 24 hour clock with a minimum value of 00:00:00 and a maximum value of 23:59:59.

Field types map to data types in the following way:

Field type	Data type
Number	number

Field type	Data type
Date	date
String	string
Time	time
Choice	number
Check	number
VAS	number

Different types can have different operations performed on them. For example, it makes sense to multiply two numbers together, but not two dates. The edit check language uses type information to decide what operations are permitted and what the results are. Subtracting two dates returns the number of days between them. Adding dates doesn't make sense, so this operation is not permitted and will result in an error message. Adding a number (of days) to a date is permitted and is used to calculate a date in the future.

5.5.2. Database Variables

Variables allow read/write access to data fields on the current plate, read-only access to data fields on another plate in the database, or read/write access to local temporary storage areas. A database field is referenced by its name as defined in the setup tool.

For example, if you have a database field called `DOB` in your study setup, you would reference the first instance of that field on the current page using:

```
DOB
```

References can be refined by specifying which module the variable is in. To reference the `DOB` field in the current module that the edit check is running in, use:

```
.DOB
```

To reference the `DOB` variable in the first instance of the `DEMOGRAPHICS` module, use the construct:

```
DEMOGRAPHICS.DOB
```

To reference the `DOB` variable in the module `DEMOGRAPHICS` with instance ID of 5, use the construct:

```
DEMOGRAPHICS[5].DOB
```

The above constructs operate on the current page. It is also possible to reference variables in a read-only context on other pages by including the keys to those pages by adding the id, visit and plate parameters to the variable name using the form `variable[id, visit, plate]`.

To reference the first instance of the `DOB` variable for subject ID 12345 at visit 1 on plate 2, you would use:

```
DOB[12345, 1, 2]
```

The `id`, `visit`, and `plate` fields can each be arithmetic expressions, or may be left blank in which case they default to the current id, visit, and plate. Thus:

```
DOB[,,]
```

means, the variable `DOB` for the current id, on the current visit and plate which is the same as writing `DOB` by itself. Writing:

```
DOB[,1,2]
```

means the first instance of variable DOB for the current subject ID, on visit 1, plate 2.

Similarly, module names can be added to more precisely specify which instance of the DOB variable you wish to reference. To reference the DOB field in the first instance of the DEMOGRAPHICS module for subject ID 12345 at visit 1 and plate 2, use:

```
DEMOGRAPHICS.DOB[12345, 1, 2]
```

To reference the DOB field in instance 5 of the DEMOGRAPHICS module for subject ID 12345 at visit 1 and plate 2 use:

```
DEMOGRAPHICS[5].DOB[12345, 1, 2]
```

Any string values written to database variables are sanitized (i.e., any '|' characters or control characters are converted to blank) before the data is written out to the database.

The first 6, and last 3, fields in all data records in a DFdiscover database are used for database management by DFdiscover, and are referred to by the same variable names in all DFdiscover studies. They are: DFSTATUS (data record status: final, incomplete, etc.), DFVALID (data record validation level: 1-7), DFRASTER (the name of the file holding the fax image of the CRF page corresponding to the data record), DFSTUDY (the DFdiscover study number), DFPLATE (the data record plate number), DFSEQ (the data record sequence or visit number), DFSCREEN (data record status without consideration for primary/secondary), DFCREATE (the record creation date and time) and DFMODIFY (the record's last modification date and time). Note that DFSEQ is assigned only if the sequence/visit number is in the barcode; otherwise the name is user-defined. A detailed description of these 6 fields can be found in plt###.dat field descriptions.

5.5.3. Positional Variables

In addition to named references to database variables, the edit check language allows access to data via positional notation. We may want to reference the variable we're presently on, without knowing its name. Similarly, we may want to reference the previous variable or the next variable in a record. This is accomplished with the @[expression], @[id,visit,plate,field], @T, @(T-expression), and @(T+expression) constructs.

Except for @[id,visit,plate,field] these positional variables may only reference data on the current record.

The @[expression] form refers to the field number represented by expression. For example, if expression evaluates to 7, then it would refer to the ID field (always the 7th field on a plate). To refer to the current field, the expression @[.] can be used. @[.+1] would indicate the next field on the plate.

A second, older construct also exists which does the same job. This is the @T construct (current field), @(T+1) which refers to the next field, and @(T-1) which refers to the previous field.

> **Important**
>
> Note that @(T-1) means the previous field, while (@T-1) means one less than the current field. Watch those brackets!

The @[id,visit,plate,field] form can be used to refer to any field on any record in the study database, by it's numeric keys. Those keys which will always be the same as the plate on which the edit check is triggered can be omitted. For example, @[,,55,10] refers to field 10 on plate 55 of the same visit for the same subject, and @[,,,10] is equivalent to @[10], both referring to field 10 on the current plate. While this form can be used to read and test the value of any field in the study database it cannot be used to change the value of fields on other records in the database. The edit check language does not allow changes to be made to records other than the one on which the edit check is triggered.

The use of positional variables is both convenient and necessary when writing reusable generic edit checks. However they depend on field positions remaining constant. Problems can arise if a plate is modified by adding, deleting or renumbering fields. Thus edit checks must be reviewed as part of any such modifications.

5.5.4. Local Variables

Local variables are temporary storage locations that can be used to hold intermediate results of calculations. Local variables are only valid inside the edit check or function in which they are defined. They do not retain their values across invocations of that edit check or function.

Local variables are declared at the beginning of the edit check or function where they will be used. The declaration includes the data type of the variable and it's name. It must precede any other statements inside that function or edit check. Local variables are automatically initialized to a blank value.

Example 5.2. Local variable declaration

```
edit testdecl()
{
        number average;
        average = (bp1 + bp2) / 2;
}
```

In this simple edit check, the average of two variables is calculated and stored in the local variable `average`. Since this variable is local to this edit check, its value is no longer available as soon as the edit check completes.

5.5.5. Global Variables

Global variables are storage locations just like local variables but differ in that they maintain their values across edit checks. Global variables are initialized when the edit checks file is first loaded and maintain their values until an edit check changes it. That new value is then used in any subsequent references until it is changed again.

> **Important**
>
> It is important to remember that edit checks can be executed in an arbitrary order as the user traverses fields. It is therefore important to consider where the values in global variables really came from when executing in interactive tools such as DFexplore.

Global variables are declared in the same way that local variables are, except that they are declared outside of edit checks.

Example 5.3. Global variable declaration

```
number pages_traversed = 0;
edit another_page()
{
        pages_traversed = pages_traversed+1;
        dfmessage("Page ", pages_traversed, " PID=",
                PID, " Plate=", DFPLATE, " Visit=", DFSEQ);
}
```

If this edit check is attached as a plate exit check, it will count how many pages were traversed by a user in the course of a session and record the subject, plate and visit numbers in the edit checks log file.

5.5.6. Variable Groups

There are often cases where it is useful to group variables that are related to each other. The `group` declaration can be used to build one-dimensional arrays of variables. The `group` declaration syntax is as follows:

Figure 5.1. Group declaration syntax

```
group groupname variable1, variable2, ... ;
```

Once a group has been defined it is referenced by `groupname[index]`.

Example 5.4. Compute the total dose from the individual dosages

```
edit compute_dose()
{
        number total=0, i=1, blank=0;
        group dgrp dosage1, dosage2, dosage3, dosage4, dosage5;
        while (i<=5) {
                if (dfblank(dgrp[i])) blank = blank+1;
                else total = total + dgrp[i];
                i = i+1;
        }
}
```

The individual dosages are in the database variables `dosage1` through `dosage5`. The group variable `dgrp` allows the individual dosages to be referenced through an index.

Group variables can be used anywhere other variables can be used but must be declared *after* any local variables in that edit check or function have been declared and *before* the first statement of the edit check's body.

Missing group variables

If a variable is missing from a group, the missing variable is treated as a missing value. If a variable defined in a group is on a plate that is missing from the database, the variable will also evaluate to a missing value.

5.5.7. Date Variables

Each date variable in a DFdiscover study setup has a date format associated with it. This date format is used to determine which part of the date string contains the year, month and day portions of a date.

Internally, the edit check language uses julian dates and converts them to printable representations as required. Dates that are stored back into the database are stored using the date format associated with that variable. Dates displayed in messages are output using the default date format, `YY/MM/DD`, which can be overridden via the `date format` instruction at the beginning of a `DFedits` file.

Example 5.5. Set the default date output format to `MM/DD/YY`

```
date format "MM/DD/YY"
```

This statement must be added to the `DFedits` file.

Date Format

All date constants used throughout the `DFedits` file are assumed to be in this format. The date format statement may only appear once in each edit check file, but it may appear anywhere within the file.

Example 5.6. Incrementing a date value

```
date format "yy/mm/dd"
```

```
edit main()
{
        date d;
        d = "90/04/07";
        d = d + 14;
}
```

This example assigns the julian date for April 7th, 1990 to the local variable d, and then add two weeks (14 days) to this date. The two assignment lines cannot be combined into one line because the conversion of the string to a julian date must be completed before the subsequent addition of 14 to this value. Combining them into one line would indicate that the string "90/04/07" and the number 14 were to be added which is clearly meaningless.

5.6. Missing/Blank Data

The DFdiscover edit check language allows the use of missing values in data fields.

Data may be unavailable for one of four reasons:

- the data field has been left blank,
- the data field contains a missing value code
- the CRF page has not yet arrived and thus the data record does not exist in the database, or
- the CRF page exists as a missed record.

The edit check language provides five functions for dealing with missing values:

- `dfblank`,
- `dfmissing`,
- `dfmissval`,
- `dfmisscode`, and
- `dfmissingrecord`.

In addition, two functions exist that return information about missed data:

- `dflostcode`
- `dflosttext`

Table 5.1. Return values for `dfblank`, `dfmissing`, `dfmissval`, `dfmisscode`, and `dfmissingrecord`

	dfblank	**dfmissing**	**dfmissval**	**dfmisscode**	**dfmissingrecord**
Data Record does not exist	FALSE	TRUE	""	""	2
Data Record is a missed record	FALSE	TRUE	""	""	1

	dfblank	dfmissing	dfmissval	dfmisscode	dfmissingrecord
Field = missing value code	FALSE	TRUE	*missing value label*	*missing value code*	0
Field = blank	TRUE	TRUE	""	""	0
Field = value	FALSE	FALSE	""	""	0

5.6.1. dfblank

The dfblank function is used to determine if a data record exists and the field is blank.

Table 5.2. dfblank usage

Syntax:	dfblank(var)
Input Parameters:	var is any variable
Return Value:	TRUE if variable is blank. A blank string/number/date is one containing no characters or digits, not even a space. Also TRUE for check and choice fields having a code for "no choice". FALSE in all other cases.
Example:	`if (dfblank(DOB)) dfmessage("DOB is missing");`

Notes:	The record containing var must exist for dfblank to return TRUE.
	
	Previous to 3.8, it was necessary to use, as a work-around, the construct
	
	`if ( @T == 99 )...`
	
	for check fields that coded "not checked" using a code other than 0, (e.g. 99 in this example). This work-around is no longer correct or supported. For check and choice fields any test for the code used for no choice, or unchecked, will always fail (i.e. evaluate to FALSE). The correct way to test for this condition is by using,
	
	`if ( dfblank( @T ) )...`

5.6.2. dfmissing

The dfmissing function is used to determine if a variable is missing, either because the data record containing it does not exist, the data record containing it is missed, the value is blank, or the field contains a missing value code.

Table 5.3. dfmissing usage

Syntax:	dfmissing(var)
Input Parameters:	var is any variable
Return Value:	TRUE if variable is missing. TRUE if variable references keys belonging to a missed record. TRUE if the variable type is date, and the value is a nonsensical date. FALSE in all other cases.

Example:	`if (dfmissing(DOB))`
	`  dfmessage("DOB is missing");`
	
	`# returns TRUE if keys match an entry identified as missed`

```
if (dfmissing(DFSTUDY[,0,1]))
    dfmessage("Plate 1, visit 0 is a missed record");
```

Notes: Testing for a missing record can also be performed with the `dfmissingrecord()` function.

5.6.3. `dfmissval`

The `dfmissval` function returns the missing value label equivalent to the variable's value.

Table 5.4. `dfmissval` usage

Syntax:	dfmissval(var)
Input Parameters:	var is any variable
Return Value:	The missing value label equivalent to the variable's value. A Blank string in all other cases.
Example:	`label = dfmissval(DOB);`

5.6.4. `dfmisscode`

The `dfmisscode` function returns the missing value code equivalent to the variable's value.

Table 5.5. `dfmisscode` usage

Syntax:	dfmisscode(var)
Input Parameters:	var is any variable
Return Value:	The missing value code equivalent to the variable's value. A blank string in all other cases.
Example:	`code = dfmisscode(DOB);`

5.6.5. `dfmissingrecord`

The `dfmissingrecord` function returns information about a missing record.

Table 5.6. `dfmissingrecord` usage

Syntax:	dfmissingrecord(id, visit, plate)
Input Parameters:	id is the subject ID of the missing record visit is the visit number of the missing record plate is the plate number of the missing record
Return Value:	Information about a missing record for the specified keys. Return values are as follows: • `0` if the data record is in the database, that is, not missing. • `1` if a missed record matching the specified keys is in the database. • `2` if there is no record in the database matching the specified keys.

	• 3 if the record in the database matching the specified keys has a pending status.
Example:	`if( dfmissingrecord(99001,0,1) == 1 )` `  dfmessage( "Plate 1 at visit 0 is missed for this subject." );`

5.6.6. `dflostcode`

`dflostcode` returns information about a missed record entered in DFexplore, specifically the actual reason code assigned to the missed record.

Table 5.7. `dflostcode` usage

Syntax:	dflostcode(id, visit, plate)
Input Parameters:	id is the subject ID belonging to the missed record
	visit is the visit number belonging to the missed record
	plate is the plate number belonging to the missed record
Return Value:	The numeric reason code that has been assigned to the missed record having the specified keys.
Example:	`code = dflostcode(99001,0,1);`

5.6.7. `dflosttext`

`dflosttext` returns the actual text reason assigned to a missed record in DFexplore.

Table 5.8. `dflosttext` usage

Syntax:	dflosttext(id, visit, plate)
Input Parameters:	id is the subject ID belonging to the missed record
	visit is the visit number belonging to the missed record
	plate is the plate number belonging to the missed record
Return Value:	The reason text (explanation) that has been assigned to the missed record having the specified keys.
Example:	`dfmessage( "The missed reason is ", dflosttext(99001,0,1) );`

5.6.8. Missing Records

The edit check language supports two functions that can be used to identify data records that do not exist in the database - `dfmissing` and `dfmissingrecord`.

Using `dfmissing` requires testing for the existence of any one of the required fields on the data record of interest. For example, we could determine whether plate 1 at visit 0 is missing for the current subject by testing to see if the DFdiscover study number is blank for this record using `dfmissing`.

Example 5.7. Testing for a missing record with `dfmissing`

```
if( dfmissing( DFSTUDY[,0,1] )
```

```
    dferror("Plate 1 at Visit 0 is missing");
```

DFSTUDY is the name for the DFdiscover study number field that is present on all plates in the database. This field can never be left blank or contain a missing value code because it is maintained by the system and users cannot edit it. Thus the above test will only return true when the data record is missing or if the specified keys match an entry marked as missed.

`dfmissingrecord` removes the need for the 'trick' of testing for a missing record by evaluating the value of a known, fixed variable. `dfmissingrecord` takes as arguments the subject ID, visit and plate keys of the data record of interest and returns the following:

- `0` if the data record is in the database
- `1` if a missed record matching the keys is in the database
- `2` if there is no record in the database matching the keys

Example 5.8. Testing for a missing record with `dfmissingrecord`

```
if( dfmissingrecord(,0,1) == 2 )
    dfmessage( "Plate 1 visit 0 is not in the database" );
```

5.6.9. Examples

Example 5.9. Calculate the subject's age provided both birth date (`bdate`) and the study entry date (`edate`) are available.

```
if( !dfmissing( bdate ) && !dfmissing( edate ) )
    age = ( edate - bdate ) / 365.25;
```

Example 5.10. Complain if the subject was hospitalized (hospital has the value 2) but the hospitalization date has been left blank

```
if( hospital==2 && dfblank(hospdate) )
    dferror("Hospitalization date is required.");
```

Example 5.11. Check for a specific missing value label

```
if(dfmissval(hosp)=="not hospitalized" && !dfmissing(hospdate))
    dferror("Reason for hospitalization has missing value
    code = \"not hospitalized\", but a hospitalization date
    has been entered");
```

This example shows an edit check that might be placed on a field used to record hospitalization date. It checks the reason for hospitalization field (`hosp`) for the existence of the missing value reason "not hospitalized" and if it finds this reason pops up an error message.

Example 5.12. Check for a specific missing value code

If "N" was the missing value code for the above missing value reason, the same edit check could be written using `dfmisscode`.

```
if(dfmisscode(hosp)=="N" && !dfmissing(hospdate))
```

```
    dferror("Reason for hospitalization has missing value " +
    "code = \"not hospitalized\", but a hospitalization " +
    "date has been entered");
```

5.7. Arithmetic Operators

This section summarizes the operators available and their results. In these tables a blank box indicates that the operation is not permitted and an error message will be produced.

The order of operations (highest to lowest precedence) is as follows:

- unary minus
- exponentiation
- multiplication, division, modulus
- addition, subtraction

You can override the default order of operations by using the grouping operators, `(` and `)`. Expressions within parentheses are always evaluated first, and nested parenthetical expressions are always evaluated from the lowest nesting point to the highest. For example,

```
2 + 3 * 5
```

evaluates to 17, because normal precedence evaluates the `*` before the +, whereas

```
( 2 + 3 ) * 5
```

evaluates to 25, and

```
( ( 2 + 3 ) * 5 - 2 ) * 2
```

evaluates to 46. In this latter case, `( 2 + 3 )` is evaluated first (5), followed by `( 2 + 3 ) * 5` (25), and then `( ( 2 + 3 ) * 5 - 2 )` (23), and finally `( ( 2 + 3 ) * 5 - 2 ) * 2`.

5.7.1. Addition

The addition operator, +, adds two operands and returns the result as summarized by this table. A missing variable may be a blank field, a missing value code or a missing data record. Returned missing values evaluate TRUE with `dfblank` and `dfmissing`

Table 5.9. Result table for Addition operator

	Missing	**Number**	**Choice**	**Check**	**String**	**Date**	**Time**	**VAS**
Missing	Missing	Missing	Missing	Missing	String [a]	Missing	Missing	Missing
Number	Missing	Number	Number	Number		Date [b]	Time [c]	Number
Choice	Missing	Number	Number	Number		Date	Time	Number
Check	Missing	Number	Number	Number		Date	Time	Number
String	String				String [d]			

	Missing	Number	Choice	Check	String	Date	Time	VAS
Date	Missing	Date	Date	Date				Date
Time	Missing	Time	Time	Time				Time
VAS	Missing	Number	Number	Number		Date	Time	Number

[a] Unlike other data types, string concatenation makes a distinction between blank fields which are concatenated as an empty string, and fields that contain missing value codes or where the data record is missing, which abort the concatenation and return a null string.

[b] Date/Number addition returns the date *`number`* days in the future for a positive number or days in the past for a negative number.

[c] Time/Number addition returns the time *`number`* seconds in the future for a positive number or seconds in the past for a negative number.

[d] String/String addition returns the concatenated string, unless one of the strings is missing, in which case the result for Missing/String applies.

5.7.2. Subtraction

The subtraction operator, `-`, subtracts two operands and returns the result as summarized by the table. A missing variable may be a blank field, a missing value code or a missing data record. Returned missing values evaluate TRUE with `dfblank` and `dfmissing`.

Table 5.10. Result table for Subtraction operator

	Missing	Number	Choice	Check	String	Date	Time	VAS
Missing	Missing	Missing	Missing	Missing		Missing	Missing	Missing
Number	Missing	Number	Number	Number		Date [a]	Time [b]	Number
Choice	Missing	Number	Number	Number		Date	Time	Number
Check	Missing	Number	Number	Number		Date	Time	Number
String	String							
Date	Missing	Date [a]	Date	Date		Number [c]		Date
Time	Missing	Time [d]	Time	Time			Number [e]	Time
VAS	Missing	Number	Number	Number		Date	Time	Number

[a] Subtracting a number from a date returns the date *`number`* days in the past for a positive number of days or in the future for a negative number of days.

[b] Subtracting a number from a time returns the time *`number`* seconds in the past for a positive number of seconds or in the future for a negative number of seconds.

[c] Date/Date subtraction returns the number of days between the dates.

[d] Subtracting a number from a time returns the time *`number`* seconds in the past for a positive number of seconds or in the future for a negative number of seconds.

[e] Time/Time subtraction returns the number of seconds between the times.

5.7.3. Multiplication/Division/Modulus

The multiplication, `*`, division, `/`, and modulus, `%`, operators return the results as summarized by the table. A missing variable may be a blank field, a missing value code or a missing data record. Returned missing values evaluate TRUE with `dfblank` and `dfmissing`.

Table 5.11. Result table for Multiplication/Division/Modulus operators

	Missing	Number	Choice	Check	String	Date	Time	VAS
Missing	Missing	Missing	Missing	Missing				Missing
Number	Missing	Number[a]	Number	Number			Time	Number
Choice	Missing	Number	Number	Number			Time	Number
Check	Missing	Number	Number	Number			Time	Number
String								

	Missing	Number	Choice	Check	String	Date	Time	VAS
Date								
Time		Time	Time	Time				Time
VAS	Missing	Number	Number	Number			Time	Number

[a]For division in which both operands are integers (no decimal or decimal places), the returned value will be truncated to an integer, e.g., 100/60 will return 1. To obtain a floating point result at least one of the operands must be a floating-point number, e.g., 100/60.0 returns 1.666667.

Local and database fields may be cast to a floating-point number before the operation is performed by adding 0.0. For example, if A and B are 2 numeric fields which contain the integers 100 and 60 respectively, any of the following expressions: (A+0.0)/B, A/(B+0.0), (A+0.0)/(B+0.0) will return 1.666667.

Division or modulus by zero results in an error message.

5.7.4. Exponentiation

The exponentiation operator, ^, raises a number (the base) to the power of an exponent, and is written as:

```
base ^ exponent
```

where both the *base* and the *exponent* are numbers (integer, fixed point, or floating point). For example,

```
4 ^ 3 = 4 * 4 * 4 = 64
4 ^ 0.5 = sqrt( 4 ) = 2
```

The result of raising any number (including 0) to the exponent 0 (or 0.0) is 1. The result of raising 0 (or 0.0) to any positive exponent is 0. The result of raising 0 (or 0.0) to any negative exponent is illegal. The base can be negative only if the exponent is an integer value; that is, it is illegal to raise a negative number to a fractional exponent. In such a case, and in any case where the calculation is illegal, the returned result is a blank/empty string.

Results of exponentiation are summarized in the table. A missing variable may be a blank field, a missing value code or a missing data record. Returned blank/empty values evaluate TRUE with `dfblank` and `dfmissing`.

Table 5.12. Result table for Exponentiation

	Missing[a]	Number	Choice	Check	String	Date	Time	VAS
Missing	Missing	Missing	Missing	Missing				Missing
Number	Missing	Number	Number	Number				Number
Choice	Missing	Number	Number	Number				Number
Check	Missing	Number	Number	Number				Number
String								
Date								
Time								
VAS	Missing	Number	Number	Number				Number

[a] The rows or the columns may be the base or the exponent - the table results are symmetric.

Example 5.13. Calculation of Body Surface Area

The calculation of an individual's body surface area in meters square, given their weight in kilograms and height in centimeters, is:

```
((kg)^0.425 x (cm)^0.725 x 71.84) / 10,000
```

An average adult has a body surface area of 1.73 meters square.

> **Note**
>
> With a sufficiently large base and exponent, the calculated values may be extremely large. Performing large number computations on systems that are capable of accurately handling only numbers of 32 or 64 bits, means that the math libraries internal to the computer's operating system must use algorithms and compromises to handle such large numbers. As a result, with sufficiently large base and exponents, the calculated values may not be reliable. It is unlikely however, that these types of numbers will be used in edit checks.
>
> The same also holds true for calculations performed using very small fractional numbers.

5.7.5. Assignment

The assignment operator, =, is used to store a value in a database or local variable. The assignment operator will cast (i.e. change) values from one type to another, and follows these rules:

- The assignment of a date to a string type causes the string to contain the date value formatted according to the edit check date format, which is `YY/MM/DD` unless otherwise defined by the `date format` statement in the `DFedits` file.
- The assignment of a string to a local date variable causes the string to be converted to a date using the default date format. If the resulting date is stored in the database it is stored according to the date format associated with the database field.
- The assignment of a string to a local time variable causes the string to be converted to a time. If the resulting time is stored in the database it is stored according to the time format associated with the database field.
- The assignment of a time to a string type causes the string to contain the time value formatted hh:mm:ss
- When assigning numeric values to data fields the whole number part of the value is honored, but decimal places may be truncated to the number of decimal places provided by the format. For example, assigning the value `95.1234` to a numeric field with a format of nn.n would store the value as `95.1`, and if the format was nn the stored value would be `95`.
- If the assigned value is too large to fit in the specified data field the result in DFexplore is a blank field, and a dialog appears describing the problem. The dialog identifies the field and the value that could not be assigned. In **DFbatch** the field is left unchanged and an error message is written to the log. For example, this would occur on attempting to assign the value `1000` to a numeric field with a format of nn, nnn, nn.nn, etc., or to an unformatted field with a store length less than 4.
- Missing values are stored in database fields according to their missing value codes. Legal missing value codes are defined in `DFmissing_map`. If `DFmissing_map` has not been defined the default DFdiscover missing value code is an `*`. It is legal to assign a missing value code to any field, regardless of type, e.g. bdate = `"*"`.
- A database field of any type can be blanked by assigning it a blank string, e.g. bdate="".
- Attempting to assign a value to DFdiscover protected fields (e.g. fields 1 to the end of the barcode and the last 3 record status fields), results in the edit check being aborted with an error message.
- Attempting to store a | character in a database field causes the character to be converted to a space.
- Attempting to store an illegal value in a database check or choice field (i.e. a value which does not correspond to any of the defined boxes on the CRF) results in assignment of the no choice code to the database field.
- It is possible to store values into a data field on the current data record by assigning the value to the variable name of the desired field. For example, if the current record has three variables named `dispensed`, `returned` and `compliance` to

track how compliant a subject is at taking their medication, the following example would calculate compliance and store it in the `compliance` variable of the current record:

```
compliance = 100 * ( dispensed - returned ) / dispensed;
```

5.8. Conditional Execution

5.8.1. Comparison Operators

The edit check language provides the standard set of comparison operators:

- less than, <
- less than or equal, <=
- equal, ==
- greater or equal, >=
- greater than, >, and
- not equal, `!=`

Be careful to differentiate between the assignment, =, and the equality, ==, operators.

Example 5.14. Probable erroneous use of the = operator

```
number i=5,j=6;
if (i = j) {
        dferror("i equals j");
} else {
        dferror("i is not equal to j");
}
```

Erroneous use of = results in `i` being assigned the value of `j` and then being checked for a non-zero value, which is probably not what was intended. The correct syntax for checking the equality of `i` and `j` is to use the equality, ==, operator.

String comparisons are done on a character-by-character basis using the ASCII sort order. This means that all uppercase letters come before all lowercase letters.

Date comparisons are done by julian date, regardless of the date format associated with the date.

Comparing two missing values returns TRUE for <=, ==, and >= and FALSE for all others. Comparing a missing value with any other value returns FALSE except for the `!=` operator.

When performing a simple comparison, (e.g. `if( @[15]==@[16] )`), the edit check language does not distinguish between different missing value codes or between blank fields and fields containing missing value codes. Thus a simple comparison of 2 fields will return TRUE when one field is blank and the other contains a missing value code, or when the 2 fields contain different missing value codes. If such distinctions are important the `dfblank` and `dfmisscode` functions should be used.

The edit check language represents FALSE as zero and TRUE as any non-zero number. Do not count on TRUE being any specific non-zero value (such as one).

5.8.2. Logical Operators

The DFdiscover edit check language also provides the logical operators && (AND), || (OR), and ! (NOT). Each of these operators will cast their operands to TRUE/FALSE values as required based on the following rules:

Table 5.13. Casting rules for logical operators

Input Type	TRUE	FALSE
Numeric/Date	non-zero	zero
String	non-zero length	zero-length
Missing/Blank	never	always

The && (AND) operator returns TRUE only if both operands are TRUE. Otherwise it returns FALSE.

The || (OR) operator returns TRUE if at least one of the two operands is TRUE. If both operands are FALSE, it returns FALSE.

The ! (NOT) operator takes one operand and returns TRUE if the operand is FALSE and FALSE if the operand is TRUE.

> **Note**
>
> Prior to DFdiscover 2022 version 5.5, the ! (NOT) operator for string values could return an incorrect result. In these earlier versions, use `!dflength(string)` to test the string value condition.

5.8.3. if/else

The `if` statement provides a conditional execution mechanism. The two basic `if` constructs are:

```
if (condition) statement_1
if (condition) statement_1 else statement_2
```

`statement` in the above examples can be a single statement or a group of statements enclosed in a pair of { and }. `condition` is an expression that evaluates to TRUE or FALSE. If the condition evaluates to TRUE then `statement_1` is executed, otherwise `statement_2` is executed.

`if` statements can be nested and the most deeply nested `else` clause always goes with the most deeply nested `if` clause. These two examples are identical:

```
if (age < 50)
    if (sex == 1)
        dferror("<50 year old male");
    else
        if (sex == 2)
            dferror("<50 year old female");
        else
            dferror("<50 year old, no sex info");
```

and

```
if (age < 50)
if (sex == 1)
    dferror("<50 year old male");
else
if (sex == 2)
    dferror("<50 year old female");
```

```
else
    dferror("<50 year old, no sex info");
```

The only differences are cosmetic.

The addition of braces makes the code even easier to read and understand without changing the meaning:

```
if (age < 50){
    if (sex == 1){
        dferror("<50 year old male");
    } else {
        if (sex == 2){
            dferror("<50 year old female");
        } else {
            dferror("<50 year old, no sex info");
        }
    }
}
```

Indentation, while useful for visually indicating logic flow to the programmer, does not influence program execution. When writing edit checks, use indentation to show the logic flow. It will make maintaining the checks much easier. The addition of braces around blocks of code also helps, and makes your intentions clear to the language compiler and any subsequent reader(s).

5.9. Built-in Functions and Statements

The edit checks language includes a robust set of built-in functions for use in any edit check.

5.9.1. Edit check Function Compatibility Notes

Generally speaking, the built-in functions behave identically across DFexplore, DFcollect and DFweb. However there are some differences dictated by the purpose of, and features available in, each application. The following table details where those differences are.

Table 5.14. Edit check Function Implementation

Function	Implemented in			Notes
	DFexplore	DFcollect	DFweb	
DFopen_study and DFopen_patient_binder	✓	✓	✓	
dfaccess	✓	✓	✓	
dfaccessinfo	✓	✓	✓	
dfaddqc	✓	✓	✓	
dfaddmpqc	✓			
dfaddreason	✓	✓	✓	
dfalias2id	✓	✓	✓	
dfanympqc	✓			
dfanyqc	✓	✓	✓	
dfanyqc2	✓	✓	✓	
dfanyreason	✓	✓	✓	

Function	Implemented in			Notes
	DFexplore	DFcollect	DFweb	
dfask	✓	✓	✓	
dfautoreason	✓	✓	✓	
dfbatch	✓	✓	✓	
dfcapture	✓	✓	✓	
dfcenter	✓	✓	✓	
dfclosestudy	✓	✓	✓	
dfdate2str	✓	✓	✓	
dfday	✓	✓	✓	
dfdelmpqc	✓			
dfdirection	✓	✓	✓	In DFcollect, the return value is always 0.
dfeditqc	✓	✓	✓	In DFweb, there is no confirmation dialog if the query status is changed to delete.
dfentrypoint	✓	✓	✓	
dfexecute	✓	✓	✓	In DFcollect, `dfexecute` does nothing if called while offline.
dfgetfield	✓	✓	✓	
dfgetlevel/dflevel	✓	✓	✓	In DFweb, the return value is always 1.
dfgetseq	✓	✓	✓	
dfhelp	✓	✓	✓	In DFweb, there is no visible effect of `dfhelp` until the user clicks the field help icon.
dfid2alias	✓	✓	✓	
dfillegal	✓	✓	✓	
dfimageinfo	✓	✓	✓	
dflegal	✓	✓	✓	There is no concept of missing plates in DFweb and DFcollect. Hence a `dflegal` test of fields on missing plates always returns FALSE. This is opposite from DFexplore which returns TRUE for `dflegal` test references to fields on missing plates.
dflength	✓	✓	✓	
dflogout	✓	✓	✓	After logout and re-login, DFcollect returns the user to the site list - it does not resume where the user was before logout.
dflookup	✓	✓	✓	
dflostcode	✓			
dflosttext	✓			
dfmail	✓	✓	✓	In DFcollect, `dfmail` does nothing if called while offline.
dfmatch	✓	✓	✓	
dfmessage/dfdisplay/ dferror/dfwarning	✓	✓	✓	In DFweb and DFcollect, the message area is static and does not accept user input.
dfmetastatus	✓	✓	✓	

Function	Implemented in			Notes
	DFexplore	DFcollect	DFweb	
dfmissing	✓	✓	✓	There is no concept of missing plates in DFweb and DFcollect.
dfmissingrecord	✓	✓	✓	There is no concept of missing plates in DFweb and DFcollect. In DFexplore, a missed record will return 1, and in DFweb and DFcollect, it will return 2.
dfmode	✓	✓	✓	
dfmonth	✓	✓	✓	
dfmoveto	✓	✓	✓	DFweb stops infinite loops after 20 iterations. DFcollect only works on plate enter. When dfmoveto(DFSCREEN) is used on plate enter in DFcollect, the cursor moves to the last field.
dfneed	✓	✓	✓	
dfpageinfo	✓	✓	✓	
dfpassword	✓	✓	✓	DFcollect does not remember the previously entered Username. In DFcollect the user must always enter both the Username and Password.
dfpasswdx	✓	✓	✓	DFcollect does not remember the previously entered Username. In DFcollect the user must always enter both the Username and Password.
dfplateinfo	✓	✓	✓	
dfpref	✓	#	#	In DFweb only UseSubjectAlias, SaveLevel, and WorkingMode are supported. In DFcollect only SaveLevel, WorkingMode, and AutoLogout are supported. In addition, WorkingMode doesn't support DDE in DFweb or DFcollect.
dfprefinfo	✓	#	#	In DFweb only UseSubjectAlias, SaveLevel, and WorkingMode can be queried. In DFcollect, AutoLogout timer can be queried, returning a numeric value, as well as SaveLevel, and WorkingMode; otherwise an empty string is returned.
dfprotocol	✓	✓	✓	
dfqcinfo	✓	✓	✓	
dfqcinfo2	✓	✓	✓	
dfreasoninfo	✓	✓	✓	
dfreplyqc	✓	✓	✓	
dfresqc/dfunresqc	✓	✓	✓	
dfrole	✓	✓	✓	
dfsiteinfo	✓	✓	✓	
sqrt	✓	✓	✓	
dfstay	✓	✓	✓	
dfstr2date	✓	✓	✓	
dfstudyinfo	✓	✓	✓	

Function	Implemented in			Notes
	DFexplore	DFcollect	DFweb	
dfsubstr	✓	✓	✓	
dftask	✓	✓	✓	
dftime	✓	✓	✓	
dftoday	✓	✓	✓	
dftool	✓	✓	✓	Respective arguments to test for are: "DFexplore", "DFcollect" and "DFweb".
dftrigger	✓	✓	✓	
dfuserinfo	✓	✓	✓	
dfvarinfo	✓	✓	✓	
dfvarname	✓	✓	✓	
dfview	✓	✓	✓	
dfvisitinfo	✓	✓	✓	
dfwhoami	✓	✓	✓	
dfyear	✓	✓	✓	
int	✓	✓	✓	

5.9.2. dfaccess

Function `dfaccess` can be used to change the user's access to data fields on the the current data entry screen in Data View. This is its only purpose. Changes made by `dfaccess` do not persist after leaving the current data screen and cannot be used to prevent users from seeing or printing data values in List View. For this purpose define Hidden Fields in **DFsetup** and specify whether users are allowed to see them when defining study roles in **DFadmin**.

When `dfaccess` sets a field to 'VIEWONLY', 'MASKED' or 'IMMUTABLE' users can not change the field manually, but an edit check can still change the field; thus some automated change may still occur or users might be prompted using `dfask` or `dfcapture` to consent or provide input for some change that is controlled by an edit check.

When a field is set to 'VIEWONLY', users are not prevented from adding or modifying metadata on that field. This remains subject to the metadata permissions defined in the user's study role.

When a field is set to 'MASKED', users cannot view or change the metadata. But the user can tell whether the field has metadata attached by observing the color of the masked field.

Table 5.15. `dfaccess` usage

Syntax:	dfaccess(variable, mode)
Input Parameters:	variable is a field on the current page. mode is one of: • DFACCESS_IMMUTABLE - allow user to see but not change the data field or metadata. • DFACCESS_VIEWONLY - allow user to see but not change the data field. Allows user to make changes to the metadata. • DFACCESS_MASKED - hide the field value beneath a mask and do not allow the user to change it.

- DFACCESS_HIDDEN - hide the data entry widget so that it does not appear on screen.
- DFACCESS_NORMAL - return to normal field access

Return Value: None

Example:
```
dfaccess(@T, DFACCESS_VIEWONLY); # Set current field to viewonly
```

Example:
```
# Use: make all data fields view only for users with specified roles
# Run: on plate entry
# e.g. VIEWONLY("monitors,statisticians") - applies to only 2 roles
# e.g. VIEWONLY("ALL") - prevent all users from changing data fields
# note -assumes role names are single words
edit VIEWONLY(string roles)
{
   number fn=6;
   number max1=dfvarinfo(DFSCREEN,DFVAR_FLDNUM);
   number max=max1-1;
   string role=dfrole();
   if( roles=="ALL" || dfmatch(role,roles,"W") ) {
     while( fn <= max ) {
       dfaccess(@[fn],DFACCESS_VIEWONLY);
       fn=fn+1;
     }
   }
}
```

Notes: `dfaccess` can be used to prevent users from changing fields manually but it does not prevent fields from being changed by edit checks.

When a field is masked or hidden any queries or reasons are also hidden from view.

For two kinds of special fields, DFCREATE and DFMODIFY, `dfaccess` cannot change the access modes of them and `dfaccessinfo` will always return Normal.

`dfaccess` is implemented only in Data and Fax views in **DFexplore**. It has no effect in List view or in **DFbatch**.

5.9.3. `dfaccessinfo`

`dfaccessinfo` takes one argument, the name of a field on the current page and returns the current access mode for the requested field. The return mode also depends on 'Show Hidden Fields' role permission.

In **DFbatch** only, `dfaccessinfo` will always return 'Normal'.

Table 5.16. `dfaccessinfo` usage

Syntax: dfaccessinfo(variable)

Input Parameters: variable is a field on the current page.

Return Value: Returns one of the following modes:

- normal - User is able to see and change the field values/metadata.
- hidden - The data entry widget is hidden. No change to the field value or metadata is allowed.

- masked - The field value is hidden beneath a mask. No change to the field value or metadata is allowed.
- viewonly - User is able to see but not change the data field. Changes to the metadata is allowed.
- immutable - User is able to see the field values. No change to data field or metadata is allowed.

Example:
```
dfmessage(dfaccessinfo(@T)); # Print the access mode of the current
 field
```

Notes: This is a brief summary of `dfaccessinfo`:

In **DFexplore**:

- If the property 'Hidden' is set to 'No' in **DFsetup**, the permission 'View Hidden Fields' is unchecked in **DFadmin**, `dfaccessinfo` will return 'normal'.
- If the property 'Hidden' is set to 'Masked' in **DFsetup**, the permission 'View Hidden Fields' is unchecked in **DFadmin**, `dfaccessinfo` will return 'masked'.
- If the access mode of the next field is set to 'Hidden' using `dfaccess`, the permission 'View Hidden Fields' is unchecked in **DFadmin**, `dfaccessinfo` will return 'hidden'.
- If the permission 'View Hidden Fields' is checked in **DFadmin**, the access mode can only be changed using `dfaccess`. `dfaccessinfo` will return the current access mode according to the setting of `dfaccess`. If the Hidden property is changed using **DFsetup** instead of `dfaccess`, `dfaccessinfo` will always return 'normal'.

In **DFbatch**, `dfaccessinfo` will always return 'normal'.

As implemented, `dfaccessinfo` is a synonym for

```
dfvarinfo(var,DFVAR_ACCESS)
```

5.9.4. `dfalias2id`

This function returns the numeric ID of the argument string subject alias.

Table 5.17. `dfalias2id` usage

Syntax:	dfalias2id(alias)
Input Parameters:	alias is a string subject alias
Return Value:	`dfalias2id` returns a number that is the ID for the requested subject alias. If the alias is not known and cannot be found, 0 is returned.

Example:	`string alias; number id;`
	`id = dfalias2id( alias );`
	`dfmessage( "This is subject ID ", id );`

5.9.5. `dfask`

The `dfask` function is used to pose to the user a question with two possible answers and wait for the user to respond by choosing one of the answers. `dfask` returns 1 or 2 depending on which response is selected by the user.

Table 5.18. `dfask` usage

Syntax:	dfask(query, default-option, option1, option2)
Input Parameters:	query is the question to be asked (string) default-option is the default response (1 or 2) option1 is the label to appear on button 1 (string, typically `Yes`) option2 is the label to appear on button 2 (string, typically `No`)
Return Value:	1 if button 1 is selected 2 if button 2 is selected
Example:	`if (dfask("Add Query?", 1, "Yes", "No") == 1)`
Notes:	If `dfask` is executed in batch, there is no opportunity for the question dialog to appear and so `default-option` is always returned.

5.9.6. `dfbatch`

The `dfbatch` function returns TRUE/FALSE depending on whether the edit check is executing in batch mode or not.

Table 5.19. `dfbatch` usage

Syntax:	dfbatch()
Input Parameters:	None
Return Value:	TRUE if edit check is executing in batch, FALSE otherwise

Example:	`if (dfbatch())`
	`    dfmessage("See this when in batch");`
	`else`
	`    dfmessage("See this when not in batch");`

Notes:	Executing `dfbatch` in **DFexplore** always returns FALSE.

5.9.7. `dfcapture`

The `dfcapture` function is used to display a dialog for user input.

Table 5.20. `dfcapture` usage

Syntax:	dfcapture(instructions,fieldlist,defaultvalues)
Input Parameters:	Your instructions will appear at the top of the `dfcapture` dialog. They can be in plain text with '\n' used for line breaks, or in html. The field list is a '|' delimited string comprised of field name and field length pairs. The default values are a '|' delimited string of initial field values or an empty string if there are no initial values.
Return Value:	The return value depends on whether the user presses OK or Cancel in the `dfcapture` dialog. If the user presses Cancel `dfcapture` returns an empty string.

If the user presses OK `dfcapture` returns a '|' delimited string containing the values entered in the fields presented by the dialog.

Example 1: Here's a very simple example.

```
string m="Please enter your name and address in the fields below.";
string f="Name|50|Street|50|City|30|State|2|Zip|10";
string v=dfcapture(m,f,"");
```

Example 2: Here's a more complicated example.

```
string mycapture(string a)
{
  string msg= "<HTML><HEAD><STYLE>\n"
          + ".g {background-color: #999; color: #fff; padding: 2px;
 text-align: right;}\n"
          + ".h {background-color: #fff; padding: 2px; text-align:
 right;}\n"
          + "</STYLE></HEAD>\n"
          + "<BODY><DIV>\n"
          + "<P>CHECK FOR DUPLICATES</P>\n"
          + "<P>Enter the following values:</P>\n"
          + "<TABLE BORDER=0 MARGIN=0>"
          + "<TR><TD CLASS=g>First Name:</TD><TD
 CLASS=h>Participant's first name</TD></TR>"
          + "<TR><TD CLASS=g>Last Name:</TD><TD CLASS=h>omit titles:
 Sr., Jr, II, etc.</TD></TR>"
          + "<TR><TD CLASS=g>Birth Month:</TD><TD CLASS=h>1-12</
TD></TR>"
          + "<TR><TD CLASS=g>Birth Year:</TD><TD CLASS=h>yyyy, e.g.
 1950</TD></TR>"
          + "</TABLE>\n"
          + "<P>DFdiscover will check for a match in the database.
\n"
          + "If one is found you will be asked for confirmation.\n
\n"
          + "If name or birth date is missing select cancel to enter
\n"
          + "this subject without checking for duplicates.</P>\n"
          + "</DIV></BODY></HTML>\n";
  string x="First Name|30|Last Name|30|Birth Month|2|Birth Year|4";
  string s;
  s=dfcapture(msg,x,a);
  return(s);
}
```

Notes: `dfcapture` has the following restrictions:

- The maximum number of fields that can be specified is 10.
- No field can contain more than 2000 characters.
- The maximum length of the return string (including all field values and delimiters) is 16384 (4096 if the string contains UNICODE characters).
- If a default value is specified for a field, but exceeds the field length, it will be used but truncated.

- The field name does not allow to be empty.

If the `dfcapture` dialog is moved by the user to a new screen location it will continue to open in that location each time `dfcapture` is called.

5.9.8. `dfcenter`

This function returns the study site number for a specified subject ID.

Table 5.21. `dfcenter` usage

Syntax:	dfcenter(ID)
Input Parameters:	ID, subject ID key field identified by variable name or position
Return Value:	Site ID to which the subject ID belongs.

Example:	`number cid;`
	`cid = dfcenter(SUBJECT); # called using subject ID variable name 'SUBJECT'`
	`cid = dfcenter(@T); # works if edit check is on the subject ID field`
	`cid = dfcenter(@[7]); # always works since the subject ID is always field 7`

Notes:	If the input subject ID is not associated with any of the defined sites, returns the `ERROR MONITOR` site ID. For historical reasons and backwards compatibility, the function continues to be named dfcenter(), not dfsite().

5.9.9. `dfclosestudy`

This function can be used to close the current study and return the user to the DFexplore login dialog and list of studies.

Table 5.22. `dfclosestudy` usage

Syntax:	dfclosestudy(message)
Input Parameters:	message - a string containing a message to be displayed in the close study dialog.
Return Value:	None

Example:	`{`
	`if(dfpasswdx(msg,3) == 0)`
	`  dfclosestudy("Incorrect password. The study will be closed!");`
	`}`

Notes:	When `dfclosestudy` closes a study, all remaining edit checks and pending events will be aborted/canceled. `dfclosestudy` will be ignored and do nothing when executed within `DFopen_patient_binder` and `DFopen_study` edit checks, and when run in batch mode.

5.9.10. `dfdate2str`

This function is used to convert a date to a string using a specified date format.

Table 5.23. `dfdate2str` usage

Syntax:	dfdate2str(date,"format")

Input Parameters:	date is a date variable format is the date format to convert to
Return Value:	`dfdate2str` converts the edit check language's internal representation of a date to a string using the specified date format.

Example:	`# Convert Visit date variable VDATE to a string in yy/mm/dd format`
	`string d;`
	`d = dfdate2str(VDATE, "yy/mm/dd");`

5.9.11. `dfday`

This function returns the day component, as a number, from a date.

Table 5.24. `dfday` usage

Syntax:	dfday(date)
Input Parameters:	date is a date field, a local/global variable or a literal string containing a date
Return Value:	A number equal to the day component of the parameter date

Example:	`number day;`
	`day = dfday( @T );`
	`if ( day == 1 )`
	`    dfmessage( "This is the first day of the month. Reset pill counter." );`

Notes:	The date parameter may be a data field defined as a date, or a local/global date variable. If the parameter cannot be interpreted as a date, the return value is -1. If the parameter contains a partial date in the data field, the day component of the parameter is "00", and partial date imputation is set to 'None', the return value is 0. Otherwise, the day component from the date is returned.

5.9.12. `dfdirection`

The `dfdirection` function is used when an edit check program needs to know the user's field traversal direction while working in DFexplore.

Table 5.25. `dfdirection` usage

Syntax:	dfdirection()
Input Parameters:	None.
Return Value:	>0 if the keyboard traversal direction is forward <0 if the keyboard traversal direction is backward 0 if mouse traversal was used
Example:	`number whichway;` `whichway = dfdirection();`
Notes:	In plate enter and plate exit edit checks `dfdirection` returns a number greater than 0. This ensures that these edit checks fire when traversal direction is being used to abort an edit check during backward traversal and/or mouse jumps. In a field enter edit check `dfdirection` returns <0,0 or >0, depending on the method that was used to enter the field. In field exit edit checks it returns <0,0 or >0 depending on the

method that was used to exit the field. Since the meaning of `dfdirection` is different in field enter and field exit edit checks, the return values may also be different.

In **DFbatch** the traversal method is always forward and so `dfdirection` returns a number greater than 0.

5.9.13. `dfentrypoint`

The `dfentrypoint` function is used to determine from which entry point a given edit check has been called.

Table 5.26. `dfentrypoint` usage

Syntax:	dfentrypoint()
Input Parameters:	None.
Return Value:	`OPEN_STUDY` if the edit check is called in `DFopen_study`
	`OPEN_BINDER` if the edit check is called in `DFopen_patient_binder` *AND* not in **DFbatch** (see Notes)
	`PLATE_ENTER` if the edit check is called at plate entry
	`PLATE_EXIT` if the edit check is called upon plate exit
	`FIELD_ENTER` if the edit check is called at field entry
	`FIELD_EXIT` if the edit check is called upon field exit
Example:	`string s;` `s = dfentrypoint();`
Notes:	In **DFbatch**
	• `dfentrypoint` will be ignored if it is called in `DFopen_patient_binder`,
	• `dfentrypoint` returns `OPEN_STUDY` if it is called in `DFopen_study`.

5.9.14. `dfexecute`

The `dfexecute` function is used to execute shell scripts stored in `$STUDY_DIR/ecbin` from within an edit check and return its output. It takes two arguments - the name of the script and the parameter list to pass to it. This function is available in DFexplore and **DFbatch**.

Table 5.27. `dfexecute` usage

Syntax:	dfexecute("Program",Parameter List)
Input Parameters:	Program is a string containing the name of the executable (program or script) to run. Executables must be registered for each study by storing them in `$STUDYDIR/ecbin`. For security reasons, only registered executables can be run from `dfexecute`. If the progam or script can not be found in this directory, or is not executable, **DFexplore** displays an error dialog with the message `Error: invalid progam name`.
	Parameter List is one or more comma delimited strings containing any input parameters required by the script. Certain characters which have special meaning to the UNIX shell will not be allowed in the command line submitted, including dollar, back quote, semicolon, pipe, and file redirection. If any of these characters are encountered, the script will not run and a zero-length string is returned. Additionally, **DFexplore** displays the following error message:

	`Error: Invalid parameters`. If the ampersand (&) character is passed anywhere in the parameter list, the parameter list will be truncated where the ampersand was encountered.
Return Value:	A string equal to at most the first `16384` ASCII characters (or 4096 UNICODE characters) of output from the command. If, for any reason, the script cannot be executed, a zero-length string is returned.

Example:	`# both of the following examples pass 3 parameters to myscript.sh`
	`string s;`
	`s = dfexecute( "myscript.sh", "10156 2 1" );`
	`s = dfexecute( "myscript.sh", "10156", "2", "1" );`

Notes:	The working directory for a script defaults to the study work directory. The study must be in read-write mode for `dfexecute` to function. If the study is in read-only mode, `dfexecute` will fail and the system will log `error 503 (study is in read-only mode)`. Script names cannot reference files or directories outside of `$STUDYDIR/ecbin`. For example, if the first parameter is set to the string "../myscript.sh", the script will not run because the first parameter references a script that is not registered. Scripts and programs executed by `dfexecute` run with the user's DFdiscover permissions. Thus for example, a script that uses **DFexport.rpc** may produce different results for users with different database get permissions. When run in a batch environment, `dfexecute` evaluates the `APPLY which` setting. If set to `none`, the function call is treated as a no-op and the message `Did not perform dfexecute(Program=xxx, Arguments=xxx)` is written to the batch log. This can be useful during testing to ensure that no external scripts are executed.

5.9.15. `dfgetfield`

The `dfgetfield` function returns a field of an input string. Date variables in the input string are converted to printable strings using the default date specification. Empty strings are converted to `""`, and missing values are converted to * except for dates which are converted to `??/??/??`.

Table 5.28. `dfgetfield` usage

Syntax:	dfgetfield(expn, fnum, delim)
Input Parameters:	expn is the input expression which will be converted to the source string fnum is the desired field number (1st field is numbered 1) delim is the character that is used to delimit fields in expn
Return Value:	Resulting field or empty string if the desired field number does not exist

Example:	`string S = "AB|CD|EF";`
	`F = dfgetfield(S, 2, "|");`
	
	assigns `CD` to `F`.

Notes:	A start value of less than 1 is converted to a 1. An empty delimiter is converted to `|`. If fnum is greater than the number of fields in expn, an empty string is returned. Date fields are first converted to julian dates and then converted to strings using the default date format.

5.9.16. dfgetlevel/dflevel

These two functions are equivalent in purpose. The existence of two functions that do the same thing is for historical reasons and backwards compatibility.

The `dflevel` function returns the validation level that the user is currently validating records to.

Table 5.29. dfgetlevel/dflevel usage

Syntax:	dflevel()
Input Parameters:	None
Return Value:	Validation level that user is validating records to
Example:	`if (dflevel() == 5)` `  dfmessage("Validating at level 5");`
Notes:	In DFweb the return value is always 1. `dfgetlevel` is a synonym for `dflevel` and will likely be removed in a future release. Use `dflevel` for forwards compatibility.

5.9.17. dfgetseq

This function is used to retrieve a comma-delimited list of visit/sequence numbers that exist for a given subject ID and plate combination.

Table 5.30. dfgetseq usage

Syntax:	dfgetseq(id, plate)
Input Parameters:	id, a subject ID (may be omitted if referring to the current subject). plate, a plate number
Return Value:	A comma delimited string of the visit numbers present in the database for the input combination of subject and plate.
Example:	`s = dfgetseq(99001, 1); # returns a list of all visit` `  #numbers for subject 99001 on plate 1`
Notes:	The returned list of visit/sequence numbers can be split using the `dfgetfield`() function. All visits present in the database are returned regardless of record status. Record status can be tested using the 1st data field in each data record, named DFSTATUS with codes: 0=lost, 1=final, 2=incomplete, and 3=pending/error. Status 3 records at level 0 are true pending records, i.e. delayed new data entry, while status 3 records are higher levels are more commonly referred to as 'error' records. Level is the 2nd field in each data record, is named DFVALID, and has values 0-7.

5.9.18. dfhelp

This function allows edit checks to change the help message displayed at the bottom of the DFexplore screen.

Table 5.31. dfhelp usage

Syntax:	dfhelp(expn1, expn2, ...)
Input Parameters:	One or more expressions of any data type

Return Value:	None
Example:	`dfhelp( "Please enter the subject age" );`
Notes:	The `dfhelp` function is only executed in field enter edit checks in **DFexplore** Data and Fax views; it is ignored in **DFbatch**. The message displayed by `dfhelp` appears in the standard one line message window at the bottom of the screen on field entry, replacing any help message specified at the style or field level in **DFsetup**. The message is displayed while the user remains on the field and is cleared when the user leaves the field. If the message is too long to be displayed in the message window it will be truncated. Users can view the entire message by hovering over it, or by clicking the dfhelp icon which appears at the beginning of the message. Any HTML tags are removed in the message window, but clicking the help icon launches a dialog, with Print and OK buttons, which displays the message with HTML formatting. Date expressions are displayed using the default date format. Use dfvarinfo with the STRING_VALUE option to display date fields as they appear on screen. Blank values are printed as empty strings, other missing values are printed as `*`, except for dates which are displayed as `??/??/??`.

5.9.19. `dfid2alias`

This function returns the string alias of the argument numeric subject ID.

Table 5.32. `dfid2alias` usage

Syntax:	dfid2alias(id)
Input Parameters:	id is a numeric subject ID
Return Value:	`dfid2alias` returns a string that is the alias for the requested subject ID. If the subject ID is not known and cannot be found, empty string ("") is returned.

Example:	`string a;`
	`a = dfid2alias( @[7] );`
	`dfmessage( "The subject alias is ", a );`

5.9.20. `dfillegal`

The `dfillegal` function is used to set the validity of the argument field to illegal. In DFexplore this has the side effect of changing the field color of the field to the illegal value color.

Table 5.33. `dfillegal` usage

Syntax:	dfillegal(var, optional_mode)
Input Parameters:	var, which must be a database variable on the current plate. If var is a local variable, the function does nothing optional_mode, an optional parameter which when 0 sets var status to illegal, and when non-zero undoes any illegal status previously set by dfillegal and re-evaluates var.
Return Value:	None

Example:

```
dfillegal(DOB);

dfillegal(DOB,1);
```

Notes: var can be a direct reference via the variable name, a positional reference via @T or the @[var] construct, or a member of a group variable.

This function can be used to set fields to the illegal color (even if the field contains a legal value); and unless the field is returned to legal or optional status, this will have the effect of forcing the user to sign the record off with status Incomplete, rather than Final. However, there are limitations.

1. If executed in batch mode, `dfillegal` has no effect and always returns 0.
2. `dfillegal` has no effect on fields that contain a missing value code, or that have a query - whether resolved or unresolved.
3. The effect is only transitory. It can be undone by the regular field exit processing that occurs as users traverse data fields using the keyboard or the mouse. Thus a field made illegal by `dfillegal` in a field entry edit check, will be reset to legal (if it is) on field exit, unless it is again set to illegal using `dfillegal` in a field exit edit check.
4. The effect only lasts as long as the record is visible on the screen. For example, if a field (with a legal value) is set to illegal by `dfillegal` in a plate exit edit check, on record save the field will turn red and the user will be prevented from assigning the record status Final. But if the user returns to the record, the field will no longer have the illegal color, because the effect of `dfillegal` was not permanent. Further, if the field had been made illegal using `dfillegal` in a field exit edit check, instead of a plate exit edit check, it would be possible for the user to immediately sign the record off with status Final, because field exit edit checks only fire when the user traverses through the field.
5. `dfillegal` has no effect on the value returned by `dflegal`; `dflegal` always applies the legal range specifications specified in the study schema, regardless of what `dfillegal` may have done to the field.

5.9.21. `dfimageinfo`

This function returns context information for the primary or secondary image of the argument keys.

Table 5.34. `dfimageinfo` usage

Syntax: dfimageinfo(ID, visit, plate, image, attr)

Input Parameters: ID, subject identifier

visit, visit number

plate, plate number

image, image ID

attr is one of `DFIMAGE_ARRIVAL`, `DFIMAGE_FIRSTARRIVAL`, `DFIMAGE_LASTARRIVAL`, `DFIMAGE_FORMAT`, `DFIMAGE_SENDER`, `DFIMAGE_PAGES`.

Return Value: The return value is dependent upon the attr. The return value of `dfimageinfo` is a string in all cases. The return value is determined by locating, for the specified keys, the matching system `fax_log` record. From the `fax_log` record (described in *System Administrator*

	Guide, Filesfax_log fax_logfax_log), the value of the requested attribute is returned for `DFIMAGE_ARRIVAL`, `DFIMAGE_FORMAT`, `DFIMAGE_SENDER` and `DFIMAGE_PAGES`. For the attributes `DFIMAGE_FIRSTARRIVAL` and `DFIMAGE_LASTARRIVAL`, the value of `image` is ignored. All of the images for the matching keys are chronologically sorted and either the earliest or the most recent image is selected. This is useful for answering questions like "what is the earliest image information related to these keys?" and "what is the most recent image information related to these keys?".
Example:	`string sender = dfimageinfo( , , , "", DFIMAGE_SENDER );` `dfmessage( "The sender is ", sender );`
Notes:	Any of the `ID`, `visit` and `plate` arguments can be omitted. Omitted arguments are taken from the keys of the current record. The image key, `image`, is required but may be `""`, in which case the image ID of the primary record is used. The argument `attr` is required. If the attr parameter is not valid, a compile-time error message is issued.

5.9.22. `dflegal`

The `dflegal` function does legal range checking on a variable and returns TRUE or FALSE depending on the outcome. Legal range checks are based on the range specifications defined in the setup tool for each variable.

Table 5.35. `dflegal` usage

Syntax:	dflegal(var)
Input Parameters:	var, which must be a database variable defined on any study plate. If var is a local variable, the function always returns TRUE.
Return Value:	FALSE if any of the following conditions apply: • the field is required and the value lies outside the legal range or the field is blank • the field is optional and the value lies outside the legal range. • the field is qualified with keys which reference a data record which does not exist in the study database. TRUE if the data record exists and any of the following conditions apply: • the field is optional and it is blank or contains a value within the legal range • the field is required and it contains a value within the legal range • the field contains a missing value code regardless of whether or not the field is required or optional.
Example:	`if ( !dflegal(DOB) )` `  dfmessage( "The value of DOB is not legal." );`
Notes:	var can be a direct reference via the variable name, a positional reference via @T or the @[var] construct, a fully qualified reference using the @[id,visit,plate,field] construct, or a member of a group variable.

5.9.23. `dflength`

The `dflength` function returns the length of the string conversion of an expression.

String conversion of dates uses the default date specification which is `YY/MM/DD` unless a different format is specified in the `DFedits` file. A date field which is blank, contains a missing value code, is only partially complete, e.g. 90/12, or contains an invalid date, e.g. 99/15/22, is converted to `??/??/??` regardless of what the date format is. Thus `dflength` will always return 8 on blank, missing, incomplete and invalid dates.

For string conversion on all other field types (i.e. other than date) all missing codes are converted to `*`, and thus `dflength` will return 1 for any missing value code.

For numeric fields leading zeros are ignored during string conversion. Thus values 0025, 025 and 25 will all have a length of 2.

For all field types string conversion of a blank field results in a blank string with length zero. This is true for choice and check fields, which have a numeric value when the field is blank, as well as for the other data types which store a true null string in the database when the field is blank.

Table 5.36. `dflength` usage

Syntax:	dflength(expn)
Input Parameters:	expn, an expression of any data type
Return Value:	Length of resulting string conversion
Example:	`if ( dflength( "ABC" ) == 3 )` `  dfmessage( "The length of ABC is 3." );`
Notes:	Date fields are first converted to julian dates and are then converted to strings using the default date format. The actual length of the date field and the date as represented by the default date format may vary.

5.9.24. `dflogout`

This function can be used to log a user out of their current DFexplore session and close the DFexplore login dialog.

Table 5.37. `dflogout` usage

Syntax:	dflogout(message)
Input Parameters:	message - a string containing a message to be displayed in the study logout dialog.
Return Value:	None

Example:	`{`
	`if(dfpasswdx(msg,3) == 0)`
	`  dflogout("Incorrect password. You will be logged out!");`
	`}`

Notes:	When `dflogout` logs the user out of **DFexplore**, all remaining edit checks and pending events will be aborted/canceled. The current **DFexplore** session will close and the standard **DFexplore** auto logout dialog will be displayed informing the user that they have automatically been logged out of their current session. If the user chooses to log back in and re-open the study, they will be asked if they want to resume their previous session. `dflogout` will be ignored and do nothing when executed within `DFopen_patient_binder` and `DFopen_study` edit checks, and when run in batch mode.

5.9.25. `dfmail`

The `dfmail` function can be used to send an email from within an edit check. Email functionality may also be implemented as a shell script using the `dfexecute` edit check function.

Table 5.38. `dfmail` usage

Syntax:	dfmail("to-address","reply-to-address","subject","message")
Input Parameters:	to-address - one or more email addresses to which the message will be sent. If there are multiple email addresses, each is delimited by a space. reply-to-address - the email address of the person who will receive any replies to the emailed message [a] subject - a short subject line for the email message message - a string containing the the body of the email message; the string may be plain text, or HTML formatted content Each of these input parameters is required and none are permitted to be the empty string ("").
Return Value:	TRUE (1), successful; `dfmail` did not detect errors FALSE (0), failed; `dfmail` detected errors

Example:	`edit SubjectRandomized()`
	`{`
	`  string id=dfvarinfo(ID[,1,2],DFVAR_STRING_VALUE,);`
	`  if(ELIG[,1,2]==2)`
	`  dfmail("jill@dfsite1.com john@dfsite1.com",`
	`"jack@centralsite.com",`
	`  "Subject " + id + " Randomization",`
	`  "This subject has now been randomized.");`
	`}`

Notes:	As a pre-requisite, `dfmail` relies on proper configuration of the server's email infrastructure. Consult with your system administrator to confirm that your DFdiscover server is configured to send email. Email systems vary according to the operating system. Email systems are complex and beyond the scope of this document. It is possible for `dfmail` to report success (the function executed as expected) yet the email is not received. Confirm the server's email configuration, recipient email addresses, and possibly the recipient's junk folder. When run in a batch environment, `dfmail` evaluates the `APPLY which` setting. If set to `none`, the function call is treated as a no-op and the message `Did not perform dfmail(To=xxx, Reply=xxx, Subject=xxx, Message=xxx)` is written to the batch log. This can be useful during testing to ensure that no emails are sent. `dfmail` sends email from the DFdiscover server. As a result, the email's sender ID will appear as *`datafax@servername`*. If the body of the message begins with `<HTML` or `<html`, the message is sent with `text/html` MIME content type; otherwise it is sent with `text/plain` content type. [b]

[a] The sender ID in the email is always as *`datafax@servername`*. Use the reply-to-address to ensure that email replies are delivered to a person.

[b] Among other things, content type determines how white-space and newline characters are interpreted and presented. Many resources regarding content type are available on the internet, including here.

5.9.26. `dfmatch`

The `dfmatch` function performs more sophisticated string matching than the basic comparison operators. `dfmatch` has the following capabilities:

- match while ignoring spaces
- match while ignoring punctuation
- keyword/keystring matching
- fuzzy string matching

Table 5.39. `dfmatch` usage

Syntax:	dfmatch(key, str, mode)
Input Parameters:	key is the search string str is the string to be searched mode is the string representation of the search mode(s)
Return Value:	A number equal to the last matched character position (1-based) of the first match found in str, or 0 if the match failed
Example:	`if ( dfmatch( "ASA", DRUG, "C" ) )` `  dfmessage( "The value of DRUG is ASA or asa." );`

Notes:	Valid modes are:
	
	• **C.** Ignore case
	• **P.** Convert each punctuation character to a space
	• **S.** Ignore white-space characters in both the key and string to be searched. The white-space characters are space, newline, carriage return, form feed, and horizontal tab.
	• **B.** Match must occur at beginning of string
	• **F.** Fuzzy match allows for one of the following errors:
	  • one missing character
	  • one extra character
	  • two transposed characters
	  • one mismatching character
	• **W.** Word match. Each word in key is searched for individually and may appear anywhere in the string, except when mode B is also used. In that case, the first word must start at the beginning of the string and subsequent words in the key must follow in the searched string.
	
	Modes may be concatenated. For example CS ignores case and spaces, PS ignores punctuation and spaces, and CPS ignores case, punctuation and spaces. The order in which modes are combined is irrelevant.

5.9.27. `dfmessage/dfdisplay/dferror/dfwarning`

The `dfmessage/dfdisplay/dferror/dfwarning` statements are used to output messages. In DFexplore `dfwarning` and `dferror` pop up their messages in dialogs that the user must acknowledge before continuing. The `dfdisplay` function displays its message in a dialog without any icon but includes a Print button. The `dfmessage` statement writes a message to the edit checks log. In batch, each generates a message that appears in the batch log file.

Table 5.40. `dfmessage/dferror/dfwarning` usage

Syntax:	dfmessage(expn1, expn2, ...) dfdisplay(expn1, expn2, ...) dferror(expn1, expn2, ...) dfwarning(expn1, expn2, ...)
Input Parameters:	One or more expressions of any data type
Return Value:	None
Example:	`dfmessage( "This is a string, ", "2+2=", 2+2 );`
Notes:	Date expressions are displayed using the default date format. Blank values are printed as empty strings, other missing values are printed as *, except for dates which are displayed as ??/??/??. In **DFexplore** the output of `dfmessage` commands is written to a temporary log file that cannot be saved.

5.9.28. `dfmetastatus`

The `dfmetastatus` function is used to return counts of queries or reasons present in the study database.

Table 5.41. `dfmetastatus` usage

Syntax:	dfmetastatus(ID,visit,plate,attr,arg1,arg2,arg3)
Input Parameters:	ID is a list of subject IDs or * (all) visit is a list of visits or * (all) plate is a list of plates or * (all) attr is one of QC or REASON arg1 is a list of numeric QC or REASON status codes from the following tables, or * (all):

Table 5.42. Query Status codes

0	pending
1	new
2	in unsent report
3	resolved NA
4	resolved irrelevant
5	resolved corrected
6	in sent report

Table 5.43. Reason Status codes

1	approved
2	rejected
3	pending

arg2 is a list of numeric query category codes from the table, or * (all):

Table 5.44. Query Category Codes

1	missing value
2	illegal value
3	inconsistent
4	illegible
5	fax noise
6	other problem
21	missing page
22	overdue visit
23	EC missing page
30-99	user-defined category codes

arg3 is a numeric query usage code from the table, or * (all):

Table 5.45. Query Usage codes

1	external use
2	internal use

Return Value: A count of QCs or REASONS. The return value is dependent upon the attr (QC or REASON) and the specifications for each of their applicable input parameters

Example:

```
number n1=dfmetastatus("4001-4050","*","*","QC","0,1,2,6","*","1");
#returns the total number of external, unresolved and pending
 queries
#for subjects 4001-4050
```

```
number n2=dfmetastatus("*","1","1-2","REASON","2,3","*","*");
#returns the total number of rejected and pending reasons on plates
#1-2, at visit 1 for all subjects
```

Notes: `dfmetastatus` can be executed in `DFopen_study`, `DFopen_patient_binder` and in batch.

5.9.29. `dfmode`

Function `dfmode` can be used to determine the user's current working mode.

Table 5.46. `dfmode` usage

Syntax:	dfmode()
Input Parameters:	None
Return Value:	In **DFexplore** `dfmode` returns the user's current working mode: 'view', 'edit', 'modify', 'validate', 'DDE', or 'locked' if the current record is locked by another user. In **DFbatch** `dfmode` always returns 'batch'.
Example:	`if (dfmode()=="DDE") return;`
Notes:	`dfmode` always returns 'validate' when working in **DFexplore** Fax View.

In **DFbatch** locked records are skipped thus `dfmode` will never return 'locked' because the edit check does not fire.

5.9.30. `dfmoduleinfo`

The `dfmoduleinfo` function returns information about the module referenced by the argument, including up to 20 custom module properties.

Table 5.47. `dfmoduleinfo` usage

Syntax:	dfmoduleinfo(var, attr)
Input Parameters:	var, an existed database variable name or the number of an existing database variable when referenced by a record key. attr is one of `DFMODULE_NAME`, `DFMODULE_DESC`, `DFMODULE_USER1`, `DFMODULE_USER2`, `DFMODULE_USER3`, `DFMODULE_USER4`, `DFMODULE_USER5`, `DFMODULE_USER6`, `DFMODULE_USER7`, `DFMODULE_USER8`, `DFMODULE_USER9`, `DFMODULE_USER10`, `DFMODULE_USER11`, `DFMODULE_USER12`, `DFMODULE_USER13`, `DFMODULE_USER14`, `DFMODULE_USER15`, `DFMODULE_USER16`, `DFMODULE_USER17`, `DFMODULE_USER18`, `DFMODULE_USER19`, `DFMODULE_USER20`.
Return Value:	The return value is dependent upon the attr. The possible values for attr, and their meaning, are: • **`DFMODULE_NAME`.** returns the module name • **`DFMODULE_DESC`.** returns the module description • **`DFMODULE_USER#`.** returns the module information of the corresponding custom module property
Example:	

```
edit test_dfmoduleinfo()
{
# List the module name, module description, first, second and third
 user defined module property information of the selected field on
 current plate.
dfmessage("dfmoduleinfo(@T,DFMODULE_NAME)=" +
 dfmoduleinfo(@T,DFMODULE_NAME));
dfmessage("dfmoduleinfo(@T,DFMODULE_DESC)=" +
 dfmoduleinfo(@T,DFMODULE_DESC));
dfmessage("dfmoduleinfo(@T,DFMODULE_USER1)=" +
 dfmoduleinfo(@T,DFMODULE_USER1));
dfmessage("dfmoduleinfo(@T,MODULETAG2)=" +
 dfmoduleinfo(@T,MODULETAG2));
dfmessage("dfmoduleinfo(@T,DFMODULE_USER3)=" +
 dfmoduleinfo(@T,DFMODULE_USER3));

# List the module name of FirstName field on current plate.
dfmessage("dfmoduleinfo(FirstName,DFMODULE_NAME)=" +
 dfmoduleinfo(FirstName,DFMODULE_NAME));

# List the module name of Field 9 belongs to Plate 3, Visit 1 of
 Subject 1.
dfmessage("dfmoduleinfo(subject 1, visit 1, plate 3, field 9,
 DFMODULE_NAME)=" + dfmoduleinfo(@[1,1,3,9],DFMODULE_NAME));
```

```
}
```

Notes: If the plate number referenced is not a valid plate number (less than 1, greater than 511, or a plate number not defined in the study setup), the edit check runtime will issue an error message to that effect.

If the attr parameter is not valid, a compile-time error message is issued.

The return value of `dfmoduleinfo` is a string in all cases.

Tags for custom properties can be used interchangeably with the default names.

5.9.31. dfmonth

This function returns the month component, as a number, from a date.

Table 5.48. dfmonth usage

Syntax:	dfmonth(date)
Input Parameters:	date is a date field, a local/global variable or a literal string containing a date
Return Value:	A number equal to the month component of the parameter date, typically 1-12

Example:	`number month;`
	`month = dfmonth( @T );`
	`day = dfday( @T );`
	`if ( month == 4 && day == 1 )`
	`  dfmessage( "It is April Fool's Day. Be skeptical." );`

Notes:	The date parameter may be a data field defined as a date, or a local/global date variable. If the parameter cannot be interpreted as a date, the return value is -1. If the parameter contains a partial date in the data field, the month component of the parameter is "00", and partial date imputation is set to 'None', the return value is 0. Otherwise, the month component from the date is returned, which is always in the range 1 to 12, inclusive.

5.9.32. dfmoveto

The `dfmoveto` statement can be used to change the normal (keyboard) order of field traversal on a record.

Table 5.49. dfmoveto usage

Syntax:	dfmoveto(var)
Input Parameters:	var, a database or positional variable on the current record
Return Value:	None

Example:	`dfmoveto(DOB);`
	
	`dfmoveto(@(T+3)); # 3 vars after current var`

Notes:	The first variable that can be moved to on the current record is the sequence number, if it is not barcoded; otherwise, it is the subject ID. Without edit checks, the focus moves to this first variable when the current record is displayed. Using `dfmoveto` in a plate enter edit check, the programmer can change this so that the focus starts on a different variable. Attempting to move to a variable in advance of the first variable will quietly move to the first variable. The last variable that can be moved to is the `DFSCREEN` variable, which DFdiscover

maintains at the bottom of every CRF page. It is not possible to move to any variable after `DFSCREEN`. Attempts to do so will generate an error message and the focus will move to the next sequential variable after the current variable.

It is not possible to move to a variable on another record. If multiple `dfmoveto` calls are executed in one edit check, the active variable becomes the last variable moved to.

`dfmoveto` is ignored:

- in field enter and exit edit checks if the mouse is used to set variable focus. Variable focus remains on the selected variable if the variable is selected with the mouse.
- in plate exit edit checks. At plate exit, each variable on the current record is always visited in sequential order - `dfmoveto` cannot be used to alter this order.

It is possible to create a loop by repeated calls to `dfmoveto`. For example, variables A and B each have field enter edit checks that execute `dfmoveto` to the other variable. Loops are detected, and aborted, after 20 consecutive executions of `dfmoveto` via edit checks without an intervening field exit action.

5.9.33. dfneed

This function can be used to alter the subject binder icons and determine which visits and plates are shown when working in a subject binder. It is typically used in special edit check `DFopen_patient_binder`, which if present runs each time a new subject binder is opened.

Table 5.50. dfneed usage

Syntax:	dfneed(action, visits, plates)
Input Parameters:	Action can have one of the following values: • DFNEED_TRIM - do not show empty visit or empty plate • DFNEED_HIDE - do not show visit or plate even if it is not empty • DFNEED_OPTIONAL - display visit or plate with the circle icon • DFNEED_REQUIRED - display visit or plate with the square icon • DFNEED_UNEXPECTED - display visit or plate with the diamond icon • DFNEED_RESET - re-evaluate the status of the listed visits and plates, updating the status icons in the subject binder Visits is a comma delimited list of visit numbers and ranges Plates is a comma delimited list of plate numbers and ranges
Return Value:	none

Example:	`edit DFopen_patient_binder() {`
	`# Adverse Event report form comes in 2 versions (plates 4 and 5)`
	`# For each recorded AE (seq 101-199) hide the empty version`
	`number n=mymaxseq(4); # get last plate 4 AE report number`
	`number x=mymaxseq(5); # get last plate 5 AE report number`
	`if( x>n ) n=x;  # set n to last recorded AE report number`
	`while(n>=101) {`

```
if( !dfmissing(DFPLATE[,n,4]) )  dfneed(DFNEED_TRIM,n,5);
if( !dfmissing(DFPLATE[,n,5]) )  dfneed(DFNEED_TRIM,n,4);
n = n - 1;
}

# Hide follow-up visits (2-99) until eligibility criteria have been
 met
if( !myeligible() ) dfneed(DFNEED_TRIM,"2-99","");

# Hide endpoint adjudication form (visit 0 plate 9) from all roles
# except the endpoint adjudicators
if( dfrole()!="adjudicator" ) dfneed(DFNEED_HIDE,0,9);
}
```

Notes:

- Trim is ignored if the data record exists or the visit contains records.
- If all plates in a visit are hidden the visit will also be hidden.
- `dfneed` only operates on subject binders; hidden records will be visible in List view and in task lists if the user's role can get the record. `dfneed` can be called within plate enter or exit edit checks as well as within `DFopen_patient_binder`.

5.9.34. `dfpageinfo`

This function returns the label for the page referenced by the argument keys.

Table 5.51. `dfpageinfo` usage

Syntax:	dfpageinfo(ID, visit, plate, attr)
Input Parameters:	ID, subject identifier visit, visit number plate, plate number attr is `DFPAGE_LABEL`
Return Value:	The return value is dependent upon the attr. In the current implementation, the only defined attr is `DFPAGE_LABEL`. The return value of `dfpageinfo` is a string in all cases. The return value is determined by locating, for the specified visit and plate, the matching record from `DFpage_map` record (described in DFpage_map - page map). If there is no matching entry, the plate description property from the setup is returned. Substitution of field values, from the record selected by ID, visit and plate, is possible using the standard %n or %n:d notations.
Example:	`string label = dfpageinfo( , , , DFPAGE_LABEL );` `dfmessage( "The page label is ", label );`
Notes:	Any of the `ID`, `visit` and `plate` arguments can be omitted. Omitted arguments are taken from the keys of the current record. The argument `attr` is required. If the attr parameter is not valid, a compile-time error message is issued.

5.9.35. `dfpassword`

This function can be used to ask users to re-enter their DFdiscover password.

Table 5.52. `dfpassword` usage

Syntax:	dfpassword(message,limit)
Input Parameters:	message - a string containing a message to be displayed on the password entry dialog. limit - the maximum number of attempts allowed for the user to enter the correct password. See Notes for more detail.
Return Value:	True (1) if the user enters their login password. False (0) if the user fails to enter the correct password within the specified `limit` or gives up by selecting Cancel.

Example:	`string msg = "Please enter your password to obtain a randomization code.";`
	`if( dfbatch() ) return; # do not continue if this edit check is called in a batch job`
	`if( dfpassword(msg,3) ) dfexecute("Randomization.shx");`
	`else { dferror("Password was incorrect.");`
	`dfexecute("RandomizationFailure.shx"); }`

Notes:	If the user enters an incorrect value in the password dialog the message **Error: at least one of Username and Password is incorrect.** is displayed and the user may be able to try again, or select Cancel, to exit the dialog. The `limit` parameter alone is used by **DFcollect** in offline mode. In all other applications (**DFcollect** on-line, **DFbatch**, **DFexplore**, DFweb), if the `limit` parameter is less than the system specified `limit of failed login attempts` and greater than `1`, it will be used to limit password attempts returning 0 if the limit is reached. If the `limit` parameter is less than 1 or greater than the system specified limit, then the system specified limit is used to limit password attempts and the `limit` parameter is ignored. [a] Generally `dfpassword` should not be called in batch but, if it is, it will always return TRUE.

[a] The system specified limit on failed login attempts is defined in the **Master** tab of **DFadmin**.

5.9.36. `dfpasswdx`

This function is similar to `dfpassword` and can be used to ask users to re-enter their DFdiscover password.

Table 5.53. `dfpasswdx` usage

Syntax:	dfpasswdx(message,limit)
Input Parameters:	message - a string containing a message to be displayed on the password entry dialog. limit - the maximum number of attempts allowed for the user to enter the correct password. See Notes for more detail.
Return Value:	1 if the user enters their login password correctly. 0 if the user fails to enter the correct password within the specified `limit` -1 if the user selects Cancel.

Example:	`string msg = "Please enter your password to obtain a randomization code.";`
	`if(dfpasswdx(msg,3) == -1)`
	`dfwarning("You have canceled password entry.");`

Notes:	`dfpasswdx` is similar to `dfpassword` except that it accommodates an additional return value of -1 to allow programmers to distinguish between the entry of an incorrect password and a cancel operation. `dfpasswdx` displays the same password dialog as `dfpassword`. The `limit` parameter alone is used by **DFcollect** in offline mode. In all other applications (**DFcollect** on-line, **DFbatch**, **DFexplore**, DFweb), if the `limit` parameter is less than the system specified `limit of failed login attempts` and greater than `1`, it will be used to limit password attempts returning 0 if the limit is reached. If the `limit` parameter is less than 1 or greater than the system specified limit, then the system specified limit is used to limit password attempts and the `limit` parameter is ignored. [a] Generally `dfpasswdx` should not be run in batch: it will always return 1 (password was entered correctly).

[a] The system specified limit on failed login attempts is defined in the **Master** tab of **DFadmin**.

5.9.37. `dfplateinfo`

The `dfplateinfo` function returns information about the plate referenced by the argument, including up to 20 custom plate properties.

Table 5.54. `dfplateinfo` usage

Syntax:	dfplateinfo(plate, attr)
Input Parameters:	plate, the number of an existing plate. attr is one of `DFPLATE_DESC`, `DFPLATE_FIELDS`, `DFPLATE_SEQCODING`, `DFPLATE_USER1`, `DFPLATE_USER2`, `DFPLATE_USER3`, `DFPLATE_USER4`, `DFPLATE_USER5`, `DFPLATE_USER6`, `DFPLATE_USER7`, `DFPLATE_USER8`, `DFPLATE_USER9`, `DFPLATE_USER10`, `DFPLATE_USER11`, `DFPLATE_USER12`, `DFPLATE_USER13`, `DFPLATE_USER14`, `DFPLATE_USER15`, `DFPLATE_USER16`, `DFPLATE_USER17`, `DFPLATE_USER18`, `DFPLATE_USER19`, `DFPLATE_USER20`.
Return Value:	The return value is dependent upon the attr. The possible values for attr, and their meaning, are: • **`DFPLATE_DESC`.** returns the plate label • **`DFPLATE_FIELDS`.** returns the number of fields on the plate • **`DFPLATE_SEQCODING`.** returns the coding method of the sequence on the plate, with 1 meaning predefined and 2 meaning that the sequence number is in the first data field • **`DFPLATE_USER#`.** returns user-defined plate information of corresponding custom plate property
Example:	

```
edit listvars()
{
#   List the field names of all fields for a given plate
number count;
number nplates;
string scount;
string splate;
splate=DFPLATE;
dfmessage("Plate "+splate+": "+dfplateinfo(DFPLATE,DFPLATE_DESC));
scount = dfplateinfo(1,DFPLATE_FIELDS);
nplates=scount;
```

```
count=1;
while( count <= nplates ) {
    dfmessage("\t"+dfvarinfo( @[count], DFVAR_NAME) );
    count = count +1;
    }
}
```

Notes:

If the plate parameter is not a valid plate number (less than 1, greater than 511, or a plate number not defined in the study setup), the edit check runtime will issue an error message to that effect.

If the attr parameter is not valid, a compile-time error message is issued.

The return value of `dfplateinfo` is a string in all cases.

Tags for custom properties can be used interchangeably with the default names.

5.9.38. `dfpref`

Function `dfpref` is used to set DFexplore user preferences, most commonly in edit checks `DFopen_study` and `DFopen_patient_binder`, which if present run when the study is selected and when a subject binder is opened respectively.

Table 5.55. `dfpref` usage

Syntax: dfpref(prefname, prefvalue, duration)

Input Parameters: `dfpref` takes 3 parameters:

1. prefname - one of the **DFexplore** user preferences
2. prefvalue - one of the settable values for the preference
3. duration - how long the preference setting lasts, which may be:
   - DFPREF_CURRENT = current page only
   - DFPREF_SESSION = current user session
   - DFPREF_LOCK = always, can not be modified by the user

   An edit check might call `dfpref` to set a preference on opening a subject binder or on opening a page. If the duration is `DFPREF_CURRENT` or `DFPREF_SESSION` the user may still change the preference via the **DFexplore** interactive preference dialog - that is, the preference is advisory only. If the preference duration is set to `DFPREF_LOCK`, the user is prevented from interactively changing the specified preference value. However additional calls to `dfpref` in subsequent edit checks, can make further changes without restriction.

The preference names and values listed below are entered in the parameter list as quoted strings. They are given in the order in which they appear within the **DFexplore** preferences dialog. Refer to *DFexplore User Guide, User Settings* for a description of each preference. Case is not significant when specifying preference name and value.

```
PreferenceName       PreferenceValue
-----------------    ---------------
UseSubjectAlias      Yes, No
DefaultView          Dashboard, Schedule, Image, Data, Queries,
 Reasons, Reports, Status, List, Batch Edits
```

```
AutoLogout           minutes

Data Window:
ExpandVisits         Yes, No
OpenFirstPage        Yes, No
AdvanceField         Yes, No
OpenTaskPage         Yes, No
WarnTraverse         Yes, No
RetainPosition       Yes, No
ShowDatePicker       Yes, No
AutoAlignText        Yes, No
ShowMetaPanel        Yes, No
ShowDocumentPanel    Yes, No
eCRFColor            #D4E6F1 (hex RRGGBB code)

Image Window:
AutoOpenImage        Yes, No
ScreenSplit          Toggle, StickyToggle, DataLeft, DataRight,
 DataTop, DataBottom

Record List:
ShowVisit            NumberLabel, Number, Label
ShowPlate            NumberLabel, Number, Label
ShowSite             NumberLabel, Number, Label
RecordListNavigation Yes, No

Query Defaults:
QueryUsage           External, Internal
QueryType            Clarification, Correction

List View:
ShowFieldName        Generic, Unique, NumberGeneric, NumberUnique
ShowCodedField       Code, Label
ShowDateField        Default, Calendar, Julian, CalendarImpute,
 JulianImpute
ShowFieldColor       Yes, No
ExpandText           Yes, No

Image View:
ReviewOnLoaded       Yes, No
ReviewOnSaved        Yes, No

Reports View:
NewReportTab         Yes, No

Background Options:
BackgroundColor      Black, White, Color
BackgroundType       Default, (any values defined in DFCRFType_map)


Schedule View:
ShowSubjectSchedule          Yes, No
ShowVisitScheduleInfo        Yes, No
ShowMissingAndOverdue        Yes, No
```

```
ShowUnexpectedVisitsAndPlates Yes, No
ShowCycles                    Yes, No
ShowCycleVisits               Yes, No
ShowCorrectionQueries         Yes, No
ShowClarificationQueries      Yes, No

Mode and Level:
WorkingMode          View, Edit, Modify, Validate, DDE
SaveLevel            1, 2, 3, 4, 5, 6, 7

PendingPlateExitEC   On, Off
```

Schedule View preferences, as well as WorkingMode, SaveLevel and PendingPlateExitEC do not appear in the **DFexplore** preferences dialog, but can be set in edit checks by `dfpref` as follows:

ShowSubjectSchedule, ShowVisitScheduleInfo, ShowMissingAndOverdue, ShowUnexpectedVisitsAndPlates, ShowCycles, ShowCycleVisits, ShowCorrectionQueries, ShowClarificationQueries. Provide edit check control over which schedule sub-windows are visible in Schedule View. Each schedule sub-window is identified by a specific keyword from the list. The setting for each keyword is "yes" or "no" (case insensitive). The setting "yes" indicates that the sub-window is visible, "no" indicates that the sub-window is not visible.

WorkingMode.

- Mode can be set in `DFopen_study` and `DFopen_patient_binder` but not in any other edit checks.
- dfpref sets mode for all records in data view only; Validate mode is always in effect in fax view.
- The mode set by dfpref can be over-ridden by users with 'data with select' permission using 'Select-Change Mode & Level', except when WorkingMode is set and locked using DFPREF_LOCK
- When mode is set and locked, users who have 'data with select' permission will not be able to change the mode of any add hoc tasks they create in data or list view, however since these users have permission to define new tasks they will be able to create new tasks with any mode and level and assign the task to any user or role, including their own.
- The mode set by dfpref is ignored while working on a task; the mode specified in the task definition has priority.
- Setting WorkingMode to View prevents users from making changes to both data and metadata
- Setting WorkingMode to Edit, Modify, Validate or DDE will not enable a user who does not have permission to write data records to make data changes. Function `dfpref` cannot be used to grant permissions that are not present in the user's study role.
- Setting WorkingMode to View will disable all subsequent edit checks if 'Run Edit checks in View Mode' is set to 'No' in **DFsetup**.
- Users with permission to use 'Batch Validate' to change the level of all records in their current task set can still use this feature; dfpref settings only apply to individual record saves.

- DFweb and DFcollect do not support the 'DDE' working mode.

SaveLevel.

- SaveLevel has the same restrictions and behavior described above for WorkingMode with the following exceptions.
- SaveLevel can be used in plate exit edit checks in both Data and Fax views, but only with DFPREF_CURRENT, to set the level at which the current data record will be saved.
- When performing a task the SaveLevel set in a plate exit edit check has priority over the level specified in the task definition.
- The dfpref request is ignored if the user does not have permission to write records at the specified level.

PendingPlateExitEC.

- This preference is used to turn off/on all plate exit edit checks when saving records as Pending in **DFexplore**. It can also be used to turn off/on all field exit edit checks attached to the current field (e.g. the field having the focus), at the time that the current record is saved as Pending. If PendingPlateExitEC is not set, the default behaviour is "On" (e.g. always run plate exit edit checks when saving records as Pending).
- PendingPlateExitEC does not appear in the **DFexplore** Preferences dialog and can only be set by an edit check. For this reason, DFPREF_LOCK and DFPREF_SESSION behave in the same way.
- Mode can be set in `DFopen_study`, `DFopen_patient_binder` or in any other edit check.
- DFPREF_CURRENT, if set, will overwrite DFPREF_LOCK/DFPREF_SESSION.
- PendingPlateExitEC can be called anywhere except in plate exit edit checks.

Return Value: none

Example #1:

```
# Lock down user preferences for the clinical sites
edit DFopen_patient_binder() {
  if ( dfrole()=="Clinical Site" ) {
    dfpref("ExpandVisits","Yes",DFPREF_LOCK) ;
    dfpref("AutoOpenImage","Yes",DFPREF_LOCK) ;
    dfpref("AdvanceField","No",DFPREF_LOCK) ;
    dfpref("BackgroundType","SITE",DFPREF_LOCK) ;
    dfpref("PendingPlateExitEC","Off",DFPREF_LOCK) ;
  }
}
```

Example #2:

```
# During site monitoring using the 'Source Verification' task
# records are saved to the task level when incomplete, but when
 final
# are saved to level 5 where the sites can no longer change them.
edit SVfinal() {
  if ( dftask()!="Source Verification" ) return;
  if( DFSTATUS==1 ) dfpref("SaveLevel","5",DFPREF_CURRENT) ;
}
```

Notes:	`dfpref` is ignored in **DFbatch**. In DFweb only UseSubjectAlias, SaveLevel, and WorkingMode are supported. In DFcollect only SaveLevel, WorkingMode, and AutoLogout are supported.

5.9.39. `dfprefinfo`

This function is used to return the current value of DFexplore user preferences.

Table 5.56. `dfprefinfo` usage

Syntax:	dfprefinfo(prefname)
Input Parameters:	`dfprefinfo` takes 1 parameter, the name of an **DFexplore** user preference. The preference name is entered as a quoted string. Case is not significant. Valid preference names and the values returned by `dfprefinfo` are shown below. Refer to *DFexplore User Guide, User Settings* for a description of each preference.

```
PreferenceName       ReturnValue
-----------------    ---------------
UseSubjectAlias      Yes, No
DefaultView          Dashboard, Schedule, Image, Data, Queries,
 Reasons, Reports, Status, List, Batch Edits
AutoLogout           minutes

Data Window:
ExpandVisits         Yes, No
OpenFirstPage        Yes, No
AdvanceField         Yes, No
OpenTaskPage         Yes, No
WarnTraverse         Yes, No
RetainPosition       Yes, No
ShowDatePicker       Yes, No
AutoAlignText        Yes, No
ShowMetaPanel        Yes, No
ShowDocumentPanel    Yes, No
eCRFColor            #D4E6F1 (hex RRGGBB code)

Image Window:
AutoOpenImage        Yes, No
ScreenSplit          Toggle, StickyToggle, DataLeft, DataRight,
 DataTop, DataBottom

Record List:
ShowVisit            NumberLabel, Number, Label
ShowPlate            NumberLabel, Number, Label
ShowSite             NumberLabel, Number, Label
RecordListNavigation Yes, No

Query Defaults:
QueryUsage           External, Internal
QueryType            Clarification, Correction

List View:
```

```
ShowFieldName         Generic, Unique, NumberGeneric, NumberUnique
ShowCodedField        Code, Label
ShowDateField         Default, Calendar, Julian, CalendarImpute,
 JulianImpute
ShowFieldColor        Yes, No
ExpandText            Yes, No

Image View:
ReviewOnLoaded        Yes, No
ReviewOnSaved         Yes, No

Reports View:
NewReportTab          Yes, No

Background Options:
BackgroundColor       Black, White, Color
BackgroundType        Default, (any values defined in DFCRFType_map)

Mode and Level:
WorkingMode           View, Edit, Modify, Validate, DDE
SaveLevel             1, 2, 3, 4, 5, 6, 7

PendingPlateExitEC    On, Off
```

WorkingMode, SaveLevel and PendingPlateExitEC do not appear in the **DFexplore** preferences dialog, but can be tested in edit checks using `dfprefinfo`.

Return Value: value is always a string; see table above

Example:

```
# On study selection show Auto Logout setting to clinical site users
edit DFopen_study() {
  if ( dfrole()=="Clinical Site" ) {
    string msg = "NOTE!\n\n"
                + "Auto Logout is set to " + dfprefinfo("AutoLogout")
 + " min.\n"
                + "To change this and other user preferences select:
\n"
                + "'Preferences...' from the 'File' menu in Data
 View." ;
    dfwarning(msg);
  }
}
```

Notes: `dfprefinfo` returns an empty string if the preference name is spelled incorrectly, or if `dfprefinfo` is run in **DFbatch**. In DFweb, all preferences except WorkingMode, SaveLevel, and UseSubjectAlias return an empty string. In DFcollect, all preferences except WorkingMode, SaveLevel, and AutoLogout return an empty string.

5.9.40. `dfprotocol`

This function returns the protocol version in effect for the argument subject ID on the argument date.

Table 5.57. `dfprotocol` usage

Syntax: dfprotocol(ID, date)

Input Parameters:	ID, subject identifier date, date in the format "yyyy/mm/dd", "today" or "" (same as "today")
Return Value:	The return value of `dfprotocol` is a string in all cases. Return the protocol version in effect on the argument `date`. The protocol version is identified by: 1. determining the site ID for the argument subject identifier, 2. for the site ID, comparing the `date` which each of the 5 `DFSITE_PROTOCOLDATE` values and returning the matching `DFSITE_PROTOCOL` value. If `date` is before `DFSITE_PROTOCOLDATE1` return ""; if `date` is after `DFSITE_PROTOCOLDATE5` return `DFSITE_PROTOCOL5`; otherwise return `DFSITE_PROTOCOLn` where `date` is on or after `DFSITE_PROTOCOLDATEn` and before `DFSITE_PROTOCOLDATEn+1`.

Example:	`string protocol_vers = dfprotocol( , "2019/01/01" );`
	`dfmessage( "The protocol version in effect on 2019/01/01 is ", protocol_vers );`
	
	Determine the protocol in effect for the current subject for their current visit.
	
	`edit ProtocolAtVisit()`
	`{`
	`  string vdate = dfvisitinfo( , , DFVISIT_DATE);`
	`  date  dt = dfstr2date(vdate, "yy/MM/dd", 1990, 0);`
	
	`  # dates are in different formats - need to switch`
	`  string version = dfprotocol( , dfdate2str(dt, "yyyy/MM/dd"));`
	
	`  dfmessage("On visit date ", vdate, ", effective protocol version is ", version);`
	`}`

Notes:	If `ID` is omitted, it is taken as the subject ID of the current record.

5.9.41. `dfrole`

The `dfrole` function is used to determine the study role by which a user has read access to specified data keys.

Table 5.58. `dfrole` usage

Syntax:	dfrole(id, visit, plate)
Input Parameters:	The key fields (id, visit, and plate) for the CRF to be tested. One or more of id, visit and plate values may be omitted and will default to the id, visit or plate of the current record. When omitting keys remember to include all commas, e.g. dfrole(,,44) returns the role by which the user has access to plate 44 of the current visit for the current subject.
Return Value:	Returns the study role name by which the user has read access to the specified keys. If the user does not have read access, `dfrole` will return an empty string.
Example:	`if ( dfrole() == "Full Permissions" )` `  dfmessage ("You have permission to save data for these keys." );`

Notes:	The `dfrole` function can be used to make edit check behavior dependent upon a user's role in cases where an edit check is only be relevant or needs to behave differently for users with different roles. In DFopen_study dfrole() returns a pipe delimited list of all roles the user has been assigned in the current study.

5.9.42. `dfsiteinfo`

The `dfsiteinfo` function returns attribute information about the site overseeing the argument subject ID.

Table 5.59. `dfsiteinfo` usage

Syntax:	dfsiteinfo(ID, attr)
Input Parameters:	ID, subject identifier attr is one of `DFSITE_ID`, `DFSITE_NAME`, `DFSITE_CONTACT`, `DFSITE_ADDRESS`, `DFSITE_FAX`, `DFSITE_PHONE`, `DFSITE_INVESTIGATOR`, `DFSITE_SUBJECTS`, `DFSITE_TEST`, `DFSITE_COUNTRY`, `DFSITE_BEGINDATE`, `DFSITE_ENDDATE`, `DFSITE_ENROLL`, `DFSITE_PROTOCOL1`, `DFSITE_PROTOCOLDATE1`, `DFSITE_PROTOCOL2`, `DFSITE_PROTOCOLDATE2`, `DFSITE_PROTOCOL3`, `DFSITE_PROTOCOLDATE3`, `DFSITE_PROTOCOL4`, `DFSITE_PROTOCOLDATE4`, `DFSITE_PROTOCOL5`, `DFSITE_PROTOCOLDATE5`, `DFSITE_REPLYTO`.
Return Value:	The return value is dependent upon the attr. The return value of `dfsiteinfo` is a string in all cases. The possible values for attr, and their meaning, are: • **`DFSITE_ID`.** the unique, numeric identifier of the site • **`DFSITE_NAME`.** the descriptive name of the site • **`DFSITE_CONTACT`.** the name of the primary contact person at the site • **`DFSITE_ADDRESS`.** the street address of the site • **`DFSITE_FAX`.** the fax number, or email address, of the site • **`DFSITE_PHONE`.** the telephone number of the site • **`DFSITE_INVESTIGATOR`.** the name of the site's primary investigator • **`DFSITE_SUBJECTS`.** the possible and actual subject IDs enrolled at the site • **`DFSITE_TEST`.** yes, if the site has test subjects/data only; no, otherwise • **`DFSITE_COUNTRY`.** 3-letter country code, from the ISO country codes list • **`DFSITE_BEGINDATE`.** the begin date for the site, in `yyyy/mm/dd` format • **`DFSITE_ENDDATE`.** the actual, or anticipated, end date for the site, in `yyyy/mm/dd` format • **`DFSITE_ENROLL`.** the expected number of subjects to be enrolled by the site • **`DFSITE_PROTOCOL1`.** the first protocol version in use at the site • **`DFSITE_PROTOCOLDATE1`.** the begin date of the first protocol version in use at the site

- **DFSITE_PROTOCOL2, DFSITE_PROTOCOL3, DFSITE_PROTOCOL4, DFSITE_PROTOCOL5.** additional protocol versions, up to 5, in use at the site
- **DFSITE_PROTOCOLDATE2, DFSITE_PROTOCOLDATE3, DFSITE_PROTOCOLDATE4, DFSITE_PROTOCOLDATE5.** the begin date of additional protocol versions in use at the site
- **DFSITE_REPLYTO.** emails sent to the site include this replyto email address

Example:
```
string enroll_target = dfsiteinfo( , DFSITE_ENROLL );
dfmessage( "The site enrollment target is ", enroll_target );
```

Notes: If the `ID` is omitted, the subject ID of the current record is used.

If the attr parameter is not valid, a compile-time error message is issued.

`dfcenter( ID )` is equivalent to `dfsiteinfo( ID, DFSITE_ID )`.

5.9.43. `sqrt`

The `sqrt` function calculates the square root of the argument number, and returns it as an integer (if the result can be expressed as an integer with no loss of precision), or as a fixed point number.

Table 5.60. `sqrt` usage

Syntax:	sqrt(expn)
Input Parameters:	expn is any numeric expression
Return Value:	the square root of expn; as an integer if the result can be represented as an integer with no loss of precision, otherwise, as a fixed point
Example:	`sqrt(65)`
	returns 8.062258
	`sqrt(16.0)`
	returns 4

5.9.44. `dfstay`

Function `dfstay` is used in edit checks triggered on record Save, to abort the save operation and keep the user on the current page with the focus on a specified data field.

Table 5.61. `dfstay` usage

Syntax:	dfstay(var)
Input Parameters:	var, a database or positional variable on the current record,
Return Value:	None
Example:	`dfstay(DOB);# stay on field DOB`
	`dfstay(@T); # stay on the current field`
Notes:	Function `dfstay` is implemented only in **DFexplore** and has no effect in **DFbatch**.
	Function `dfstay` is ignored until record Save is selected. Thus, `dfstay` is only honored in plate exit edit checks and in any field exit edit checks on the data field (if any) that has the

focus when Save is selected, because any field exit edit checks on this field will run before the plate exit edit checks begin.

When `dfstay` is honored: all subsequent edit checks are canceled, the record save operation is canceled, and the focus moves to the field specified in the `dfstay` argument. These features make `dfstay` useful in edit checks designed to offer the user the opportunity to fix a problem before committing the record and moving on to the next record. And, in cases where several edit checks are triggered on plate exit they allow the user to stop and fix each problem as it is identified.

A typical example would be an edit check that used dfask to describe the problem and offer the user the option to 'fix it now' or 'fix it later'. If the user selects 'fix it later' a query could be added to the field, but if the user selects 'fix it now' `dfstay` would be used to put the focus back on the field and stop. The user could then resolve the problem by correcting the value, adding a reason or replying to a query, before again selecting Save to commit the record to the database.

Since `dfstay` cancels the record save request it can also be used to block users from saving changes to the study database under specified conditions. In such cases it would be wise to display a message explaining this to the user, e.g. 'This record requires a visit date and cannot be saved without one'.

`dfstay` can only put the focus on a data field on the current page. It can not be used to move to a field on some other page.

5.9.45. `dfstr2date`

This function is used to convert a specified string to a date using a specified date format, start year, and imputation method. It can be used to create a local date variable or assign a value to a date field (see examples).

Table 5.62. `dfstr2date` usage

Syntax:	dfstr2date("date","format",start_year,imputation_method)
Input Parameters:	date is a string containing the date, e.g. "09/01/15" for Jan 15, 2009 in yy/mm/dd format. format is the date format, e.g. "yy/mm/dd" start_year is the first year of an imputed century for 2 digit years, e.g. 1950 imputation method is one of: • `0` never • `1` beginning of the month or year • `2` middle of the month or year • `3` end of the month or year
Return Value:	`dfstr2date` converts the specified date string to the edit check language's internal representation of a date using the specified date format rather than the standard global edit check date format. As for all dates the edit check language converts an invalid date string to it's internal representation of a missing value.

Example:	`# Get the record creation date and store it in a user defined date field`
	`string c = dfgetfield(DFCREATE,1," ");`
	`@T = dfstr2date(c,"yy/mm/dd",2000,0);`

Example:	`# Store the number of days between record creation and last modification`
	`# in a user defined numeric field`
	`date cd,md;`
	`string cs = dfgetfield(DFCREATE,1," ");`
	`string ms = dfgetfield(DFMODIFY,1," ");`
	`cd = dfstr2date(cs,"yy/mm/dd",2000,0);`
	`md = dfstr2date(ms,"yy/mm/dd",2000,0);`
	`@T = md - cd;`

5.9.46. dfstudyinfo

This function returns attribute information about the study, including the study number, name, start year and up to 20 custom study properties.

Table 5.63. dfstudyinfo usage

Syntax:	dfstudyinfo(attr)
Input Parameters:	attr is one of DFSTUDY_NAME, DFSTUDY_NUMBER, DFSTUDY_YEAR, DFSTUDY_USER1, DFSTUDY_USER2, DFSTUDY_USER3, DFSTUDY_USER4, DFSTUDY_USER5, DFSTUDY_USER6, DFSTUDY_USER7, DFSTUDY_USER8, DFSTUDY_USER9, DFSTUDY_USER10, DFSTUDY_USER11, DFSTUDY_USER12, DFSTUDY_USER13, DFSTUDY_USER14, DFSTUDY_USER15, DFSTUDY_USER16, DFSTUDY_USER17, DFSTUDY_USER18, DFSTUDY_USER19, DFSTUDY_USER20.
Return Value:	The return value is dependent upon the attr. Specifically, the descriptive name of the study, the study number and the start year of the study (as defined by the value of **Study launched in the year** in the study global settings) are returned respectively for the DFSTUDY_NAME, DFSTUDY_NUMBER, and DFSTUDY_YEAR attributes. Corresponding user-defined description is returned for its custom study property. The return value of dfstudyinfo is a string in all cases.
Example:	`string studyname = dfstudyinfo( DFSTUDY_NAME );` `dfmessage( "This is study  ", studyname );`
Notes:	Tags for custom properties can be used interchangeably with the default names.

5.9.47. dfsubstr

The dfsubstr function returns a substring of an input expression converted to a string.

Table 5.64. dfsubstr usage

Syntax:	dfsubstr(expn, start, len)
Input Parameters:	expn is the input expression which will be converted to the source string. start is the starting character position of the desired substring (1st character position is 1). len is the length in characters of the desired substring.

Return Value:	Desired substring. If len is greater than the number of characters remaining to the end of the string, len is adjusted to include only the characters remaining in the string.

Example:	`string s="Hello world!";`
	`A = dfsubstr( s, 3, 5 );`
	
	assigns "llo w" to A.

Notes:	A start value of less than 1 is converted to 1. A len of less than 1 is converted to 0. If start is greater than the length of the string, or len is 0, an empty string is returned. Date fields are first converted to julian dates and are then converted to strings using the edit check date format. This may lead to unexpected results.

Example 5.15. Date format conversion issues

```
date format "mmm/dd/yy"
...
edit example()
{
    string A;
    # at this point EDATE, a database variable, contains 98/11/14
    A = dfsubstr( EDATE, 1, 3 );
}
```

In this example, the date format of the EDATE variable, `yy/mm/dd`, and that of the edit checks global default, `mmm/dd/yy`, do not match. The conversion of EDATE to a string creates the string `NOV/14/98` The subsequent `dfsubstr` execution extracts the first 3 characters, assigning "NOV" to A.

5.9.48. `dftask`

The `dftask` function is used to determine the current task name in DFexplore and the current batch name in **DFbatch**.

Table 5.65. `dftask` usage

Syntax:	dftask()
Input Parameters:	dftask may be used with no parameters or with a set of keys (id,visit,plate).
Return Value:	dftask returns a task name or an empty string as follows: When called with no parameters: • returns the current task name, even if the current record is not in the task set, or • returns a blank string if there is no active task When called with a set of record keys (id,visit,plate): • returns the current task name, if the specified record is in the task set, otherwise • it returns a blank string. • Since functions default to current values if any of the keys are not specified, dftask(,,) returns the task name if the current record is in a task set, otherwise a blank string.

	When 'Import Subject Documents' is used in **DFexplore** Data View to 'Import data entry worksheets/CRFs' a task set is created for all imported pages, and dftask() returns "Import Subject Documents' as the task name. In batch dftask() can only be called without parameters and returns the 'name' attribute of the current 'BATCH' element. If a **DFbatch** input file has multiple BATCH elements the current one will be returned.

Example:	`number answer;`
	`string task = dftask();`
	`if ( task == "SiteMonitoring" )`
	`  ans = dfask("Does the recorded data match medical records?",1,"Yes","No");`
	`if ( answer == 1 ) ...`

Notes:	Task and batch names are case sensitive and will be returned exactly as defined in **DFexplore** or **DFbatch**.

5.9.49. `dftime`

The `dftime` function returns the current time on the machine in HH:MM:SS format.

Table 5.66. `dftime` usage

Syntax:	dftime()
Input Parameters:	None
Return Value:	A string value representing the current time on the client in HH:MM:SS format
Example:	`string now;` `now = dftime();`
Notes:	The time value returned is the time on the machine running the **DFexplore** or **DFbatch** software. In the case of **DFexplore**, this will be the time on the PC and will be in its local timezone. PCs that are not time synchronized to a time server may return incorrect times.

5.9.50. `dftoday`

The `dftoday` function returns a date value representing today's date.

Table 5.67. `dftoday` usage

Syntax:	dftoday()
Input Parameters:	None
Return Value:	A date value representing today's date on the client.

Example:	`date today;`
	`today = dftoday();`
	`if ( VDATE > today )`
	`  dferror( "Visit occurred in the future!" );`

Notes:	The date returned is the date on the machine running the **DFexplore** or **DFbatch** software. In the case of **DFexplore**, this will be the date on the PC and will be in its local timezone. PCs that are not time synchronized to a time server may return incorrect dates.

5.9.51. dftool

The dftool function returns TRUE/FALSE depending on whether the edit check is executing in the named tool or not.

Table 5.68. dftool usage

Syntax:	dftool(toolname)
Input Parameters:	toolname is a literal string equal to the name of the tool to test for. Valid tool names are DFexplore, DFbatch, DFcollect and DFweb. Additionally, for backwards compatibility, iDataFax is accepted as a synonym for DFexplore. The argument must be a literal string - it cannot be a string from a variable. **Note** If edits checks are running in **DFexplore** within Batch View, the correct tool name is DFbatch.
Return Value:	TRUE if the edit check is running in the specified environment, FALSE otherwise.

Example:	`if (dftool("DFexplore")) dfmessage("running in DFexplore");`
	
	`if (dftool("iDataFax")) dfmessage("running in DFexplore");`

5.9.52. dftrigger

This function is executed, if it is found in plate exit edit checks, when a record is saved in Fax View or Data View using DFexplore or processed in **DFbatch**. It is a no-op when encountered in plate enter edit checks or field enter/exit edit checks.

dftrigger can be used to add a new record to the current subject binder and/or to execute all or specified plate entry edit checks on a specified data record in the current subject binder. This provides a mechanism for creating conditional plates and updating data fields on other records that depend on values entered and saved on the current record.

In **DFbatch**, dftrigger can be used to add new records to the database or to visit them to update their data fields programmatically.

dftrigger verifies user permissions and attempts to perform record locking. If the subject ID in the argument keys is different than the current subject ID, a record level lock for the single record identified by the keys is requested. If the subject ID in the argument keys is the same as the current subject ID,

1. in Data View, the lock is already held (subject level locking) and no further record locking is required, or

2. in Fax View and Batch Edits View a record level lock is requested.

If permissions are insufficient or the locking request fails, dftrigger does nothing and returns 0, otherwise it returns 1.

If the target data record already exists in the database and no plate entry edit checks are specified dftrigger then can be used to change the status and/or level of the target record, and/or to change to a different plate when the target record is saved.

New records added to the current subject binder by dftrigger in Data View will immediately appear in the subject record list, and if the user is working on a task set the new record will be added to the task set list.

Table 5.69. dftrigger usage

Syntax:	dftrigger(id,visit,plate,status,level,"edit checks",action)
Input Parameters:	id, visit, and plate identify the keys of the target record.

One or more of id, visit and plate values may be omitted and will default to the id, visit or plate of the current record. When omitting keys remember to include all commas, e.g. dftrigger(,,44,3,0,"GetInitials",0) will run the GetInitials plate entry edit check for plate 44 for the current subject and visit, but will not open the record. If plate 44 doesn't exist it will be created and added to the study database with status pending and level 0.

Status must be one of: 1=final, 2=incomplete, 3=pending, or blank. When blank the status of an existing record will not be changed and the status of any newly created records will be set to 3=pending. The following restrictions apply:

- if an existing record has status incomplete because of illegal values or unresolved queries it's status can not be changed to 'Final'.
- if any of the specified plate entry edit checks add an illegal value or unresolved query to a new or existing data record status is set to incomplete.

Level is the workflow or validation level which must be: 0-7 or blank. When blank the level of an existing record will not be changed and the level of any newly created records will be set to 0. However, level cannot be reset from 1+ back to zero - any such requests will be ignored. When using dftrigger to set status or level on a target plate, neither status or level can be left blank. If either status or level is left blank, then it will have the same result as leaving both of them blank.

The edit check parameter may be an empty string if no edit checks are to be run, "ALL" to run all plate entry edit checks, or a list of edit check names separated by commas or spaces, e.g. "GetInitials,CalcTargetDate". Only plate entry edit checks will run; any other edit check names will be silently ignored. For dialogs, most of dialogs will not appear and the default action will be taken for dialogs that prompt the user for input. Specifically, the dialogs that will not appear include dfask, dfmessage/dfdisplay/dfwarning/dferror, dfaddqc, dfeditqc, dfreplyqc, and dfaddreason. The dialogs that will still appear include dfcapture, dfclosestudy, dflogout, dfpassword, and dfpasswdx.

The final action parameter determines whether the triggered record should be created, opened, and added to the current task set. Actions 0-4 create the specified data record with status pending and level 0 if it does not already exist in the study database. The action parameter is ignored in **DFbatch** and in Fax View. In Data View it functions as follows:

- 0 = Run the edit checks but do not open the data record.
- 1 = Open the record only if it was changed, i.e. a new pending level 0 record was created, or an existing record was modified by a plate entry edit check. Do not add the record to the current task set.
- 2 = Open the record even if it was not changed. Do not add it to the current task set.
- 3 = Same as action 1, but record is added to the current task set (if any).
- 4 = Same as action 2, but record is added to the current task set (if any).
- 5 = Open the record. If it does not exist in the study database open a new blank record; do not create a pending level 0 record, and do not add it to the current task set.

Unlike other edit check statements dftrigger requests are not executed immediately, instead they are added to a dftrigger queue and executed in order as a final step during plate exit edit check processing.

In **DFexplore** actions 1-5 add the data record to the current list of open records and takes the user to that record instead of going to the next record in the list. Since dftrigger is ignored in all but plate exit edit checks the action request cannot be used to interrupt data entry on the current page.

If all 3 keys are omitted action 1-4 can be used to return to the current data record after it is saved to the study database. Only those plate entry edit checks specified in the edit check parameter will be executed. In the following example the user will remain on the current page after selecting a Save button, and plate entry edit check INIT2 will be re-executed.

```
edit EXIT2() { # run on exit from plate 2
    if( NewRandomization() ) {
        dfwarning("Please print this page and take it to the
 hospital pharmacy.") ;
        dftrigger(,,,,,"INIT2",2) ;
    }
}
```

If plate exit edit checks contain multiple dftrigger functions with non-zero actions, all of the relevant target data records will be added to the current record list and the focus will move to the first such record identified during plate exit edit check processing.

Return Value: If **DFexplore** is able to add the dftrigger request to the end of the dftrigger queue it returns 1, otherwise it returns 0, which may occur because: (a) it can not get a lock on the target data record, (b) the user does not have permission to create or modify the target record, or (c) the target record has already been added to the dftrigger queue.

Example:

```
# If subject was hospitalized and hospitalization record (plate 56)
 does
# not exist at this visit, create the hospitalization record, run
 the
# GetInitials plate entry edit check, and then open the record
if ( HOSPITALIZED == TRUE && dfmissingrecord(,,56)==2 ) {
  dfwarning("Please complete hospitalization details on the next
 page.") ;
  dftrigger(,,56,3,0,"GetInitials",1) ;
}
```

Notes: If the target record exists in the database with status "missed" the missed record will be deleted and a new record will be created. If this is not desired make sure you test for missed records before executing dftrigger. This can be done using dfmissingrecord which returns 1 for missed records.

5.9.53. `dfuserinfo`

The `dfuserinfo` function returns information about the user running the edit check, including their login name, full name, and email as defined in **DFadmin**.

Table 5.70. `dfuserinfo` usage

Syntax: dfuserinfo(property)

Input Parameters: `dfuserinfo` takes 1 parameter, the name of a property.

The property name is entered as a quoted string. Case is not significant. Valid property names are UserName, FullName, and Email, which returns the user's login name, full name,

	and email address respectively, as defined in **DFadmin**. Refer to *System Administrator Guide, DFadmin - UsersDFadmin - Users* for details.
Return Value:	The return value is always a string.

Example:	`edit AboutMe() {`
	`  dfwarning("My username is: ", dfuserinfo("UserName"));`
	`  dfwarning("My full name is: ", dfuserinfo("FullName"));`
	`  dfwarning("My email is: ", dfuserinfo("Email"));`
	`}`

Notes:	`dfuserinfo` returns an empty string if the property name is spelled incorrectly. If the full name property is blank in **DFadmin**, dfuserinfo("FullName") returns the username. If the email property is blank in **DFadmin**, dfuserinfo("Email") returns an empty string. dfuserinfo("UserName") returns the same value as `dfwhoami`.

5.9.54. `dfvarinfo`

The `dfvarinfo` function returns information about the variable referenced by the argument, including up to 20 custom variable properties.

Table 5.71. `dfvarinfo` usage

Syntax:	dfvarinfo(var, attr, optional_arg)
Input Parameters:	var, which must be a database variable. attr is one of `DFVAR_NAME`, `DFVAR_GENERIC`, `DFVAR_UNIQUE`, `DFVAR_TYPE`, `DFVAR_DESC`, `DFVAR_HELP`, `DFVAR_FORMAT`, `DFVAR_LABEL`, `DFVAR_ENTER_VALUE`, `DFVAR_LEGAL`, `DFVAR_REQUIRED`, `DFVAR_ESSENTIAL`, `DFVAR_FLDNUM`, `DFVAR_STRING_VALUE`, `DFVAR_PROMPT`, `DFVAR_UNITS`, `DFVAR_COMMENT`, `DFVAR_INSTRUCTION`, `DFVAR_ACCESS`, `DFVAR_MODNUM`, `DFVAR_MODNAME`, `DFVAR_MODDESC`, `DFVAR_USER1`, `DFVAR_USER2`, `DFVAR_USER3`, `DFVAR_USER4`, `DFVAR_USER5`, `DFVAR_USER6`, `DFVAR_USER7`, `DFVAR_USER8`, `DFVAR_USER9`, `DFVAR_USER10`, `DFVAR_USER11`, `DFVAR_USER12`, `DFVAR_USER13`, `DFVAR_USER14`, `DFVAR_USER15`, `DFVAR_USER16`, `DFVAR_USER17`, `DFVAR_USER18`, `DFVAR_USER19`, `DFVAR_USER20` optional_arg is required only when specifying the `DFVAR_LABEL` attribute. In this case, optional_arg is the numeric code for which the choice label is being requested.
Return Value:	The return value is dependent upon the attr. The possible values for attr, and their meaning, are: • **`DFVAR_NAME` and `DFVAR_GENERIC`.** variable's name (previously known as the generic name) • **`DFVAR_UNIQUE`.** variable's alias (previously known as the unique name) • **`DFVAR_DESC`.** the variable's description • **`DFVAR_HELP`.** the variable's help message • **`DFVAR_TYPE`.** string equal to the variable's type from the following list of variable types: number, string, date, time, vas, choice, check • **`DFVAR_FORMAT`.** the variable's format string

- **DFVAR_LABEL**[a]**.** the label associated with the numeric code specified as the third argument. If the code and/or label is not found, an empty string is returned. DFVAR_LABEL is only applicable where coding exists for field types choice, check and numeric
- **DFVAR_ENTER_VALUE.** the variable's value when the plate was entered. If the variable is not on the current record, an empty string is returned. If after saving a data record the focus remains on the saved record, the enter value of all fields is updated to the saved value.
- **DFVAR_LEGAL.** the variable's legal range string or an empty string if no legal range is defined. If the definition of the legal range is the meta-word `$(ids)` (meaning the list of subject IDs defined in the sites database), the meta-word is returned, rather than its expansion into the actual list of subject IDs.
- **DFVAR_REQUIRED.** string, from the following choices, identifying if a value in the field is required: `Y` (value is required or essential), `N` (value is not required or essential, e.g. value is optional)
- **DFVAR_ESSENTIAL.** string, from the following choices, identifying if a value in the field is essential: `Y` (value is essential), `N` (value is not essential (e.g. is required or optional)
- **DFVAR_FLDNUM.** the variable's number (tab order position) as a string
- **DFVAR_STRING_VALUE.** the string representation of the variable's current value, including literals representing any missing value codes. If the variable is not on the current record, and the requested record does not exist, an empty string is returned
- **DFVAR_PROMPT.** the variable's prompt property
- **DFVAR_UNITS.** the variable's units property
- **DFVAR_COMMENT.** the variable's comment property
- **DFVAR_INSTRUCTION.** the variable's instruction property
- **DFVAR_ACCESS.** the variable's access mode
- **DFVAR_MODNUM.** the instance number of the module containing the variable
- **DFVAR_MODNAME.** the name of the module containing the variable
- **DFVAR_MODDESC.** the description of the module containing the variable
- **DFVAR_USER#.** the user-defined variable information for corresponding variable custom property

Example:

```
if ( dfvarinfo(@(T+2), DFVAR_TYPE) == "number" )
    dfmessage( dfvarinfo( @(T+2), DFVAR_NAME ), " is a number." );

# get MYDATE value as a string from plate 1 for the current id
str=dfvarinfo(MYDATE[,0,1],DFVAR_STRING_VALUE);
dfmessage("MYDATE on plate 1 is " + str);

# get the label for the current choice code
dfmessage( "You marked ", dfvarinfo( @T, DFVAR_LABEL, @T ) );

# get the label for a specific choice code
```

```
dfmessage( "Code 1 has the label ", dfvarinfo( @T, DFVAR_LABEL,
 1 ) );

#get the current field's prompt property
dfmessage( "field ", @T, " has the prompt property: ", dfvarinfo(@T,
 DFVAR_PROMPT));

#get the current field's comment property
dfmessage( "field ", @T, " has the comment property: ",
 dfvarinfo(@T, DFVAR_COMMENT));

#is this field in an AE module
if ( dfvarinfo( @T, DFVAR_MODNAME ) == "AE" )
...
```

Notes: `dfvarname` is implemented as

```
dfvarinfo(var, DFVAR_NAME)
```

`dfaccessinfo` is implemented as

```
dfvarinfo(var,DFVAR_ACCESS)
```

Tags for custom properties can be used interchangeably with the default names.

[a] This is the only attribute for which the third argument is required.

5.9.55. `dfvarname`

The `dfvarname` function returns the name of the variable referenced by the argument.

Table 5.72. `dfvarname` usage

Syntax:	dfvarname(var)
Input Parameters:	var, which must be a database variable
Return Value:	Name of variable
Example:	`if ( dfvarname(@(T+2)) == "PTID")`
Notes:	Although var can be any variable, it is only really useful with positional variables and group references. See also dfvarinfo function for additional information about variables.

5.9.56. `dfview`

Function `dfview` can be used to determine the user's current working view.

Table 5.73. `dfview` usage

Syntax:	dfview()
Input Parameters:	None
Return Value:	In **DFexplore**, `dfview` returns the user's current **DFexplore** view: 'data' or 'image', which are the only 2 views in which edit checks can be run. In **DFbatch** `dfview` always returns 'batch'.

Example:	`if (dfview()=="image") return;`
Notes:	none

5.9.57. dfvisitinfo

The `dfvisitinfo` function returns information about the visit, or visit map metadata, referenced by the argument.

Table 5.74. dfvisitinfo usage

Syntax:	dfvisitinfo(ID, visit, attr)
Input Parameters:	ID, subject identifier visit, visit number attr is one of `DFVISIT_DATE`, `DFVISIT_TYPE`, `DFVISIT_ACRONYM`, `DFVISIT_LABEL`, `DFVISIT_DUE`, `DFVISIT_OVERDUE`, `DFVISIT_REQUIREDPLATES`, `DFVISIT_OPTIONALPLATES`, `DFVISIT_ORDERPLATES`, `DFVISIT_MISSEDPLATE`.
Return Value:	The return value is dependent upon the attr. The return value of `dfvisitinfo` is a string in all cases. If attr is `DFVISIT_DATE`, the visit date for the requested subject ID and visit number is selected from the database and returned. All other attributes have static values that are extracted from the visit map definition of the requested visit number (the subject ID is ignored as it is not relevant). The return values for each attribute, and their meaning, are detailed in *Study Setup User Guide, Visit Map*).
Example:	`string vdate = dfvisitinfo( , , DFVISIT_DATE );` `dfmessage( "The visit date is ", vdate );`
Notes:	If the `ID` is omitted, the subject ID of the current record is used. If the `visit` is omitted, the visit number of the current record is used. If the attr parameter is not valid, a compile-time error message is issued.

5.9.58. dfwhoami

The `dfwhoami` function returns the login name of the user running the edit check.

Table 5.75. dfwhoami usage

Syntax:	dfwhoami()
Input Parameters:	None
Return Value:	A string representing the login name of the user executing the edit check, whether in **DFexplore** or in batch.

Example:	`string username;`
	`username = dfwhoami();`
	`if ( username == "bob" )`
	`  dfmessage( "hey bob, how are ya?" );`

Notes:	If the user name cannot be determined, generally due to a system mis-configuration, the string `unknown` is returned.

5.9.59. dfyear

This function returns the year component, as a number, from a date.

Table 5.76. `dfyear` usage

Syntax:	dfyear(date)
Input Parameters:	date is a date field, a local/global variable or a literal string containing a date
Return Value:	A number equal to the year component of the parameter date

Example:	`number year;`
	`year = dfyear( @T );`
	`if ( year < 2000 )`
	`  dfmessage( "The event occurred in the 2nd millenium." );`

Notes:	The date parameter may be a data field defined as a date, or a local/global date variable. If the parameter cannot be interpreted as a date, the return value is -1. Otherwise, the year component from the date is returned - year cutoff is applied to reported 2-digit years so that a 4-digit number is always returned.

5.9.60. `int`

The `int` function is used to return the integer portion of a floating point number.

Table 5.77. `int` usage

Syntax:	int(expn)
Input Parameters:	expn is any numeric expression
Return Value:	the integer portion of expn
Example:	`int(365.25)` returns 365

5.10. Query operations

The edit check language provides several functions for dealing with queries:

- `dfaddqc`
- `dfaddmpqc`
- `dfanyqc`
- `dfanyqc2`
- `dfanympqc`
- `dfdelmpqc`
- `dfeditqc`
- `dfresqc`
- `dfunresqc`
- `dfqcinfo`

- `dfqcinfo2`

By way of example, the following generic edit check could be used to add a missing value query to a field which has been left blank.

```
edit addmissing()
{
    if( dfblank(@T) ) dfaddqc(@T,1,"",1,2,"");
}
```

5.10.1. `dfaddqc`

The `dfaddqc` function allows an edit check to add a query to a field on the current record. It is not possible to add queries to other records. It is possible to add more than one query to a field, provided that the category code is different.

In DFexplore and **DFbatch** query creation permissions matter; depending on which of the 3 possible query creation permissions the user has for fields on the current data record, behavior will vary as follows. The **Query Add** dialog (DFexplore) is only displayed if the user has full query creation permission. If the user has permission to create queries within edit checks only, the **Query Add** dialog (DFexplore) is not displayed and the query is added automatically. And if the user has no query creation permission `dfaddqc` is a no-op; it does nothing.

Additionally, when using **DFbatch** to execute edit checks, the actions of `dfaddqc` are further impacted by the attributes of the `APPLY` element.

The behavior of `dfaddqc` is the same in DFexplore and **DFbatch** with regard to which data records can have queries added. In both cases a user will only be able to add queries to records for which they have access (read) permission; any restrictions on sites, subjects, visits, and plates will be applied.

Table 5.78. `dfaddqc` usage

Syntax:	dfaddqc(var, code, query, usage, refax, note, optional_mode)
Input Parameters:	var is a database variable on the current plate and is the variable to which the query is to be attached.
	code is a category code from the table:

Table 5.79. Category codes

1	missing
2	illegal
3	inconsistent
4	illegible
5	fax noise
6	other category
30-99	user-defined category codes

query is the text that should appear as the query field, or "" if there is no text. [a]

usage is a numeric usage code from the table:

Table 5.80. Query Usage codes

1	external use

2	internal use

refax is a numeric refax code from the table:

Table 5.81. Refax codes

1	Q & A query (clarification)
2	refax query (correction)

note is the text that should appear in the resolution note, or "" for no text.[a]

optional_mode is a numeric value which can be used to suppress the default behavior of showing the **Query Add** dialog. If it is omitted or has the value 0 the dialog is displayed and the query may be accepted, modified, or canceled by the user. If the value is 1 the dialog is not displayed and the query is silently added, if possible (i.e. if the field does not already have a query with the same category code, and in **DFexplore** if the user has permission to create queries).

Return Value: TRUE if the query dialog was displayed, FALSE otherwise.

Example:

```
if ( dfaddqc( VDATE, 1, "Date missing", 1, 2, "" ) )
    dfmessage( "Added a query to VDATE." );
```

Note: It is possible to add queries to variables that already have queries attached to them, provided the category codes differ for each query. If a field already has a query with the same category code, `dfaddqc` does nothing and returns FALSE. It is possible to modify or completely replace existing queries using function `dfeditqc`.

[a]The text is "sanitized" by replacing each non-printable character with a space/blank and each '|' with a '?'.

5.10.2. `dfaddmpqc`

The `dfaddmpqc` function allows an edit check to add a user-defined missing page query.

Table 5.82. `dfaddmpqc` usage

Syntax: dfaddmpqc(id, visit, plate, query, usage, refax, note)

Input Parameters: id, visit, and plate provide the key information for the data record that is missing.

query is the text that should appear as the note field, or `""` if there is no query. Any invalid (i.e., '|' or control characters) are converted to blank.

usage is a numeric usage code from the table:

Table 5.83. Query Usage codes

1	external use
2	internal use

refax is a numeric refax code from the table:

Table 5.84. Refax codes

1	Q & A query (clarification)
2	refax query (correction)

	note is the text that should appear in the resolution note, or "" for no text. Any invalid (i.e., '|' or control characters) are converted to blank.
Return Value:	TRUE if the query was added, FALSE otherwise.
Example:	`if ( dfaddmpqc( 12345, 0, 1, "Excl. crit. required", 1, 2, "" ) )` `  dfmessage( "Added a missing page query." );`

Notes:	Attempts to add a missing page query will fail if the data record exists, regardless of it's status (final, incomplete, pending or lost), or if a missing page query already exists.
	
	In **DFexplore** the user must have permission to create queries for the specified data record, otherwise `dfaddmpqc` is a no-op; it does nothing. In **DFbatch** no restrictions are applied; missing page queries can be created for any record regardless of user permissions.
	
	Some, but not all, of the id, plate and visit parameters may be omitted in which case they will default to the current id, visit, and plate respectively. Although it is legal to use the default for all three key fields, thereby indicating the current record, this will never produce a missing page query, as one cannot add a missing page query to the current page, which clearly is not missing.
	
	Setting the refax option has no effect on `dfaddmpqc`. User-defined and DFdiscover-created missing page queries, together with DFdiscover-created overdue visit queries, always appear in the refax (correction) list.
	
	Missing plate queries are removed by the study server when the data record arrives regardless of the status of the data record (final, incomplete, pending or lost).
	
	These queries can also be removed using edit check function dfdelmpqc. We recommend using complimentary add and delete statements, and running these edit checks in batch. Designing edit checks like this:
	
	`if ( condition is TRUE )`
	`  dfaddmpqc(...);`
	`else`
	`  dfdelmpqc(...);`
	
	allows the edit check to correct the Query database if the subject data changes in a way that makes the query no longer required.

5.10.3. `dfanyqc`

The `dfanyqc` function returns the query status of a variable.

Table 5.85. `dfanyqc` usage

Syntax:	dfanyqc(var, optional_category_code)
Input Parameters:	var may be any variable in the study database. It may be a direct, positional or group reference. optional_category_code may be any category code in the study's query category map. It is an optional parameter.
Return Value:	If optional_category_code is omitted or has value 0, the status of the first query is returned. If optional_category_code is greater than 0, the status of the query matching optional_category_code is returned.

A numeric status from the table:

Table 5.86. Query status codes

0	none
1	new
2	in unsent report
3	resolved NA
4	resolved irrelevant
5	resolved corrected
6	in sent report, or pending

Example:

```
if ( dfanyqc( VDATE ) == 1 )
    dfmessage( "VDATE has a new query." );
```

Notes:

If optional_category_code is greater than 0, and if optional_category_code is not found or there is an error, the return value is 0.

If optional_category_code is illegal (negative), the status of the first query is returned.

If var is not a database variable, the return value is 0. `dfanyqc` will not report deleted as a query status, but instead will report no note exists for a deleted query.

If in a study with single query permission, the optional_category_code is ignored, and the status of the first (only) query is returned.

When executed within `DFopen_patient_binder` and `DFopen_study` edit checks, the return value is 0.

5.10.4. `dfanyqc2`

The `dfanyqc2` function returns the query statuses of a variable.

Table 5.87. `dfanyqc2` usage

Syntax:	dfanyqc2(var)
Input Parameters:	var may be any variable in the study database. It may be a direct, positional or group reference.
Return Value:	Returns a string of all query status codes for the referenced variable, each status code delimited by pipe (|).

Each numeric status is from the table:

Table 5.88. Query status codes

0	none
1	new
2	in unsent report
3	resolved NA
4	resolved irrelevant
5	resolved corrected

	6 in sent report, or pending
Example:	`dfmessage( dfanyqc2(@T) );`
Notes:	If var is not a database variable, the return value is an empty string. `dfanyqc2` will not report deleted as a query status, but instead any such query will be skipped in the output. If only one query exists for a field, `dfanyqc` and `dfanyqc2` return the same value. When executed within `DFopen_patient_binder` and `DFopen_study` edit checks, the return value is an empty string.

5.10.5. dfanympqc

The `dfanympqc` function determines if a missing page (code 21), EC missing page (code 23) or overdue visit (code 22) query exists for the specified arguments.

Table 5.89. dfanympqc usage

Syntax:	dfanympqc(id, visit, plate)
Input Parameters:	id, visit, and plate provide the key information for the missing page (code 21), EC missing page (code 23) or overdue visit (code 22) query.
Return Value:	TRUE if a missing page, EC missing page or overdue visit query exists in the database for the specified keys, FALSE otherwise.
Example:	`if ( dfanympqc( 12345, 1, 12 ) )` `  dfmessage( "A missing page query already exists in the database." );`
Notes:	If a missing page, EC missing page or overdue visit query does not exist in the database for the specified keys, `dfanympqc` returns FALSE. Some, but not all, of the id, plate and visit arguments may be omitted in which case they will default to the current id, visit, and plate respectively. Although it is legal to use the default for all three key fields, thereby indicating the current record, `dfanympqc` will always evaluate to FALSE as the `dfanympqc` function will only execute if the current page exists in the database. `dfanympqc` will detect missing page, EC missing page and overdue visit queries when executed within a `DFopen_patient_binder` edit check or in batch mode. `dfanympqc` will be ignored when executed within a `DFopen_study` edit check.

5.10.6. dfdelmpqc

The `dfdelmpqc` function deletes a missing page (code 21), EC missing page (code 23) and overdue visit (code 22) query. The EC missing page query must have been previously created by an invocation of `dfaddmpqc`, while the missing page or overdue visit query must have been previously created by **DF_QCupdate**.

Table 5.90. dfdelmpqc usage

Syntax:	dfdelmpqc(id, visit, plate)
Input Parameters:	id, visit, and plate provide the key information for the query to be deleted.
Return Value:	TRUE if the missing page (code 21), EC missing page (code 23) or overdue visit (code 22) query was deleted, FALSE otherwise
Example:	`if ( dfdelmpqc( 12345, 0, 1 ) )`

```
    dfmessage( "Deleted a missing page query." );
```

Notes: If the referenced CRF exists or there is no missing page, EC missing page, or overdue visit query for the keys, `dfdelmpqc` returns FALSE.

Some, but not all, of the id, plate and visit parameters may be omitted in which case they will default to the current id, visit, and plate respectively. Although it is legal to use the default for all three key fields, thereby indicating the current record, this will always fail as one cannot delete a missing page, EC missing page or overdue visit query from the current page, which clearly cannot have one.

`dfdelmpqc` will delete missing page, EC missing page and overdue visit queries when executed within a `DFopen_patient_binder` edit check or in batch mode. `dfdelmpqc` will be ignored when executed within a `DFopen_study` edit check.

5.10.7. `dfeditqc`

The `dfeditqc` function can be used to modify several properties of a query, namely: status, current data field value, category, refax status, query, note, reply type, and usage type.

Table 5.91. `dfeditqc` usage

Syntax: dfeditqc(var, attr, value, attr, value, ..., optional_mode)

Input Parameters: var is any database variable (of the current record).

attr is the name of the attribute of interest, from the list `DFSTATUS`, `DFQCVAL` [a], `DFQCPROB`, `DFQCRFAX`, `DFQCQRY`, `DFQCNOTE`, `DFQCREPLY`, `DFQCUSE`. These are the schema names for the data fields defined in Table 2.8, “`DFqc.dat` - the Query database”.

value is the new value to assign to the attribute.

optional_mode is a numeric value which can be used to suppress the default behavior of showing the **Query Edit** dialog. If it is omitted or has the value 0, the dialog is displayed and the edit may be accepted, modified, or canceled by the user. If the value is 1 the dialog is not displayed and the edit is applied without confirmation.

Return Value: The return value is 0 if `dfeditqc` determines that the requested change is not allowed because: the record status is secondary, edit mode is view only or DDE, the specified data field does not have a query on it, or one or more attribute literals are not from the list above; otherwise, the return value is 1.

The return value does not indicate if the user actually accepted the edits by choosing OK interactively, or query actions are applied in **DFbatch**.

Example:

```
# Resolve a missing value query if data present
edit ResolvQuery()
{
   string curstatus;
   # use: on exit from a required field
   # resolve a missing value query if the field is no longer blank
   if(dfqcinfo(@T,DFQCPROB) == "1" )
   {
       # if there is a query but it is already resolved, skip
       curstatus = dfqcinfo(@T,DFSTATUS);
       if (curstatus < 3 || curstatus > 5)
       {
```

```
            if( ! (dfblank(@T)) )
            {
                dfeditqc(@T,DFSTATUS,5,DFQCRFAX,1,DFQCNOTE,"Resolved
 by
                ResolvQC edit check");
            }
        }
    }
}
```

Notes:

If DFQCPROB attribute is not specified, edit the first query.

If DFQCPROB attribute is specified, edit the query with the category code.

If an edit check using `dfeditqc` is run interactively via **DFexplore**, **DFexplore** checks that the current record is defined, the mode is not double data entry, the record status is primary, and that the referenced field has a query already on it. If any of these conditions fail, `dfeditqc` simply returns 0. Otherwise, the query dialog is displayed, unless optional_mode has been set to 1, in which case the edit is applied directly and the query dialog is not displayed.

In the special case of changing the query status to delete (to delete the query) a confirmation dialog is immediately displayed to indicate that the query will be deleted and cannot be undone. Once the query edit dialog or query delete confirmation dialog appear on-screen, the return status of the function is set to 1. Choose OK or Cancel to confirm the dialog is reflected in the return statuses with 1 or 0, respectively.

If an edit check using `dfeditqc` is run in **DFbatch**, two new elements have been added: EQ and NEQ, to record the actions of the function. The first element has the same attributes and child elements as the existing Q element. The attribute values are 0 unless they have been changed by the edit check function call. The query and note child elements appear only if their respective values have been set by the function. Note that the element values do not identify whether it has been changed from its previous value, simply that the value was specified as an argument in the function call. The second element records the number of times that the function was called. Again, note that it does not record the number of times that edited values were changed - just the number of times that the function was called.

The behavior in response to changes to DFQCPROB depends upon the study global setting for **Allow Multiple Queries per Field**. If multiple queries are not enabled, changing the value of the query category code, (DFQCPROB), causes the existing query to be deleted and a new query to be added with the specified category code. If multiple queries are enabled, the query with the matching query category code is edited. In both cases, if there is no matching query, no edit is applied.

[a]Changes to the value of this attribute are limited to interactive edit checks only. Attempts to change the attribute value in **DFbatch** are silently ignored.

5.10.8. `dfreplyqc`

The `dfreplyqc` function can be used to add/modify the reply text of an existing outstanding query.

Table 5.92. `dfreplyqc` usage

Syntax:	`dfreplyqc`(var, category, reply_text, optional_mode)
Input Parameters:	var is any database variable (of the current record).
	category is the unique query category.

	reply_text is the user-supplied reply text. If not supplied, the user will need to enter the reply text. optional_mode is a numeric value which can be used to suppress the default behavior of showing the **Query Reply** dialog. If it is omitted or has the value 0, the dialog is displayed and the reply may be accepted, modified, or canceled by the user. If the value is 1 the dialog is not displayed and the reply, if provided, is applied without confirmation.
Return Value:	The function fails and the return value is 0 if `dfreplyqc` determines that the requested change is not allowed because there is no such query, the user does have not permission, or optional_mode is 1 and reply_text was not supplied. The return value is 1 on success. If the user accepted the edits by choosing OK, the return value is 1. If the user chose Cancel, the return value is 0. The return value does not indicate if query actions are applied in **DFbatch**.

Example:	`# Reply to a category 30, clinicalQC for example, query`
	`if ( dfreplyqc( @T, 30, "Confirmed", 0 ) )`
	`dfmessage ("A reply has been added to the query." );`

Notes:	If the reply is successfully applied and the query status is Outstanding, the query status is updated to Pending. If the query status is already Resolved or Pending, the query status is not changed.

5.10.9. `dfresqc/dfunresqc`

The `dfresqc/dfunresqc` functions return TRUE/FALSE depending on whether the variable contains a resolved/unresolved query.

Table 5.93. `dfresqc` usage

Syntax:	dfresqc(var, optional_category_code) dfunresqc(var, optional_category_code)
Input Parameters:	var may be any variable in the study database. It may be a direct, positional or group reference. optional_category_code may be any category code defined in the study's query category map. It is an optional parameter.
Return Value:	If optional_category_code is omitted or has value 0, TRUE/FALSE is returned for the first query. If optional_category_code is greater than 0, TRUE/FALSE is returned for the query matching optional_category_code. For `dfresqc`, TRUE if the variable has a resolved query, FALSE otherwise. For `dfunresqc`, TRUE if the variable has an unresolved (including status pending) query, FALSE otherwise.
Example:	`if ( dfresqc( VDATE ) )` `dfmessage( "VDATE has a resolved query." );`
Notes:	If var is not a database variable, the return value is FALSE.

5.10.10. `dfqcinfo`

The `dfqcinfo` function returns information about the query on any database variable. The information returned can be selected from any of the fields defined for a query.

Table 5.94. `dfqcinfo` usage

Syntax:	dfqcinfo(var, attr, optional_category_code)
Input Parameters:	var is any database variable (of the current record).
	attr is the name of the field of interest and must be one of `DFSTATUS`, `DFVALID`, `DFRASTER`, `DFSTUDY`, `DFPLATE`, `DFSEQ`, `DFPID`, `DFQCFLD`, `DFQCCTR`, `DFQCRPT`, `DFQCPAGE`, `DFQCNAME`, `DFQCVAL`, `DFQCPROB`, `DFQCRFAX`, `DFQCQRY`, `DFQCNOTE`, `DFQCREPLY`, `DFQCCRT`, `DFQCMDFY`, `DFQCRSLV`, `DFQCUSE`. These are the schema names for the data fields defined in Table 2.8, "`DFqc.dat` - the Query database".
	optional_category_code may be any category code defined in the study's query category map. It is an optional parameter.
Return Value:	If optional_category_code is omitted or has value 0, the attribute value of the first query is returned.
	If optional_category_code is greater than 0, the attribute values of the query matching the optional_category_code is returned.
	The return value is the string equivalent of the value in the requested query field of the specified database variable.
	If the value is from a coded list, the return value is the code not the label of the code.
	If the referenced variable does not exist, or does not have a query note, the return value is "".

Example:	`if ( dfqcinfo(@(T+2), DFQCPROB) == "1" )`
	`  dfmessage( dfvarinfo( @(T+2), DFVAR_NAME ),`
	`  " has a query for a missing value." );`

5.10.11. `dfqcinfo2`

The `dfqcinfo2` function returns information about the (multiple) queries on any database variable. The information returned can be selected from any of the fields defined for a query.

Table 5.95. `dfqcinfo2` usage

Syntax:	dfqcinfo2(var, attr)
Input Parameters:	var is any database variable (of the current record).
	attr is the name of the field of interest and must be one of `DFSTATUS`, `DFVALID`, `DFRASTER`, `DFSTUDY`, `DFPLATE`, `DFSEQ`, `DFPID`, `DFQCFLD`, `DFQCCTR`, `DFQCRPT`, `DFQCPAGE`, `DFQCNAME`, `DFQCVAL`, `DFQCPROB`, `DFQCRFAX`, `DFQCQRY`, `DFQCNOTE`, `DFQCREPLY`, `DFQCCRT`, `DFQCMDFY`, `DFQCRSLV`, `DFQCUSE`. These are the schema names for the data fields defined in Table 2.8, "`DFqc.dat` - the Query database".
Return Value:	A string is returned of all query attribute values delimited by pipe (|).
	If the attribute values are from a coded list, the delimited values returned are the codes, not the labels of the codes.
	If the referenced variable does not exist, or does not have a query, the return value is "".
Example:	`dfmessage( dfqcinfo2(@(T+2), DFQCPROB) );`
Notes:	If only one query exists for a field, `dfqcinfo` and `dfqcinfo2` return the same value.

5.11. Reason operations

The edit check language provides several functions for dealing with reasons:

- `dfaddreason`
- `dfanyreason`
- `dfautoreason`
- `dfreasoninfo`

5.11.1. `dfaddreason`

The `dfaddreason` function allows an edit check programmer to add a custom reason to a data field. When a data field is changed by an edit check, the system will immediately attach the static reason text `Set by edit check ecname`, where `ecname` is the edit check name, to the changed field, and will replace any existing reason on that field. The `dfaddreason` function can then be used by the edit check programmer to overwrite the static reason with a custom reason.

Table 5.96. `dfaddreason` usage

Syntax:	dfaddreason(var, text, optional_mode)
Input Parameters:	var must be a database variable. text is the text string containing the reason. optional_mode is a numeric value which determines whether or not the reason dialog box is displayed. If it is omitted or has the value 0 the dialog is displayed and the reason may be accepted, modified, or canceled by the user. If the value is 1 the dialog is not displayed and the reason is silently added.
Return Value:	the actual reason added "" if the action was canceled or it is not possible to add the reason.
Example:	`dfaddreason(@T, "clarification from site");`
Notes:	If a **DFexplore** user does not have corresponding permission - Create Reason permission if there is no reason currently on the field or Modify Reason by Edit Check permission if there is a reason already on the field within edit checks, `dfaddreason` does nothing, regardless of the optional_mode setting. If a **DFexplore** user has permission to both create and approve reasons any reasons added using `dfaddreason` will be automatically approved, but if the user does not have permission to approve reasons any reasons added using `dfaddreason` will have status pending regardless of the optional_mode setting. If the user has permission to approve reasons only within edit checks, (the shaded or dash setting) then reasons added using optional_mode 1 will be automatically approved while reasons added via the reason dialog will always have status pending whether added manually or through `dfaddreason`. The reason text is "sanitized" by replacing each non-printable character with a space/blank and each '|' with a space. When the reason dialog is displayed in **DFexplore** both the current reason (if there is one) and the new reason are shown in the dialog. The new reason may be accepted, modified, or

canceled by the user. The user cannot apply a new blank reason; a valid text string must be entered before a new reason can be saved; this can be as little as a single valid character.

The return value of `dfaddreason` is the supplied reason (with any invalid characters converted to blank), or the empty string if the dialog is canceled.

If `dfaddreason` is executed in batch, the new reason replaces the current reason if one exists. The reason text string is returned by the function, with any invalid characters converted to blank. Reasons will be saved to the database only if the <APPLY which="data"> element is set in the batch file.

The system will automatically generate a `Set by edit check ecname` reason as soon as a data field is changed, subject to the `dfautoreason` setting. A subsequent `dfaddreason` will overwrite this automatically generated reason.

If the edit check changes the data value after a `dfaddreason` call, then the system will automatically generate another `Set by edit check ecname` reason that will overwrite the previous reason from the `dfaddreason` call.

No record is kept of reasons that were not saved.

5.11.2. dfanyreason

The `dfanyreason` function is used to determine whether a data field has a reason attached to it. If `dfanyreason` is used in batch mode, it will only report on reasons that are already present on the field. In batch mode, it will not detect auto-generated reasons added by the execution of edit checks.

Table 5.97. dfanyreason usage

Syntax:	dfanyreason(var)
Input Parameters:	var may be any variable in the study database. It may be a direct, positional or group reference.
Return Value:	A numeric status from the table:

Table 5.98. Reason status codes

0	none
1	approved
2	rejected
3	pending approval

Example:

```
if ( dfanyreason( VDATE ) == 1 )
    dfmessage( "VDATE has an approved reason." );
```

Notes: If var is not a database variable, the return value is 0.

5.11.3. dfautoreason

The `dfautoreason` function can be used to suppress the automatic addition of reasons to data fields that are changed by edit checks.

Table 5.99. dfautoreason usage

Syntax:	dfautoreason(mode)

Input Parameters:	mode is one of 0 (do not add reasons for data change) or 1 (add reasons)
Return Value:	None
Example:	

```
dfautoreason(0); # do not add reason for subsequent data changes
FLD1 = 44;       # no reason will be added for this change
dfautoreason(1); # turn autoreasons back on for subsequent data
 changes
FLD2 = 22;       # an autoreason will be added for this change
```

Notes: Whenever a data field is changed by an edit check a reason is automatically added to the field, such as `set by edit check EditCheckName`. This is the default behavior in both **DFbatch** and **DFexplore**. It is not necessary to include `dfautoreason(1)` to produce this behavior.

Used with caution, `dfautoreason(0)` can be deployed to suppress the automatic generation of reasons. There is however one important exception: if a data field already has a reason it can not be changed without providing a new reason to explain the new value. Thus an autoreason will always be added if needed to replace an existing reason.

Automatic reasons can be added or suppressed for each change made by an edit check. The scope of any call to `dfautoreason(0)` is limited to the current edit check. It is not possible to disable automatic reason creation across many edit checks with one call to `dfautoreason(0)`.

> **Important**
>
> Disabling automatic reasons using this language feature must always be given careful consideration before implementation. Please consider all appropriate regulatory guidance first.

5.11.4. `dfreasoninfo`

The `dfreasoninfo` function is used to determine attribute information of the reason, if any, attached to a data field.

Table 5.100. `dfreasoninfo` usage

Syntax:	dfreasoninfo(var, attr)
Input Parameters:	var is any database variable (of the current record). attr is the name of the field of interest and must be one of `DFSTATUS`, `DFVALID`, `DFRASTER`, `DFSTUDY`, `DFPLATE`, `DFSEQ`, `DFPID`, `DFRSNFLD`, `DFRSNCDE`, `DFRSNTXT`, `DFRSNCRT`, `DFRSNMDF`. These are the schema names for the data fields defined in Table 2.10, "`DFreason.dat` - reason for change records".
Return Value:	The return value is the string equivalent of the value in the requested reason field for the specified database variable. If the value is from a coded list, the return value is the code not the label of the code. If the referenced variable does not exist, or does not have a reason, the return value is "".
Example:	

```
string status, msg;
status = dfreasoninfo(@(T+2), DFSTATUS);
if ( status == "" )
    msg = "does not have a reason";
else if ( status == "1" )
```

```
    msg = "has an approved reason";
else if ( status == "2" )
    msg = "has a rejected reason";
else if ( status == "3" )
    msg = "has a pending reason";
dfmessage( dfvarinfo( @(T+2), DFVAR_NAME ), " ", msg, "." );
```

5.12. Lookup Tables

Lookup tables provide a mechanism for coding information based on a key field. This mechanism can be used for several applications, including:

- Adverse event coding
- Drug name lookup
- Initial to name conversion for signature fields
- Consistent queries
- Spell checking

5.12.1. Pre-requisites

Lookup tables are defined in the `DFlut_map` file in the study `lib` directory. The `DFlut_map` file contains entries which link the table name used in edit checks with the file name containing the lookup records. Lookup table files must be stored in the study lut directory, or the DFdiscover lut directory. The study level file has priority if both exist.

Lookup tables themselves are comprised of entries containing a key followed by zero or more fields of return result. Within a lookup table there is one entry per line, and fields within each entry are delimited by `|`. A lookup table must be a plain ASCII text file. If it is anything other than this, an error message will appear in a blocking, warning dialog upon starting DFexplore. If **DFbatch** is used, an error message will appear on the command-line upon starting **DFbatch**.

Entries can have one of three possible formats.

- **single field.** This field is both the search key and returned value
- **2 fields.** The first field is the search key and the second field is the returned value, as in this example:

  ```
  AIDS|autoimmune deficiency syndrome
  ```

- **3+ fields.** The first field is the search key and all other fields are returned as a single `|` delimited string that can be parsed using the `dfgetfield` function.

A detailed description of both lookup table files and `DFlut_map` can be found in Lookup tables and DFlut_map - lookup table map.

5.12.2. `dflookup`

The `dflookup` function is the interface between the edit check language and DFdiscover lookup tables. The `dflookup` function can do silent lookups or, in DFexplore it can display the lookup table, optionally position the cursor and ask the user to make a selection.

Table 5.101. `dflookup` usage

Syntax:	dflookup(table, var, default, alg)
Input Parameters:	table is the symbolic name of the table as defined in `DFlut_map` var is any variable default is the string return value if no match is found alg is the search algorithm to use from the following possible values: • **`-1`.** Exact match - do not display the lookup table. Return a result for an exact match only, otherwise return default • **`0`.** Choose match - always display the lookup table and highlight the first entry in the table. In batch mode, this algorithm always returns default. In interactive mode, the default value is not used and a null string is returned if the lookup table dialog is canceled. • **`>0`.** Partial match - always display the lookup table. Display the lookup table and highlight the first entry in the table that matches on the specified number of characters. In batch mode, this algorithm *always* returns default. In interactive mode, the default value is not used and a null string is returned if the lookup table dialog is canceled.
Return Value:	Matching string from the lookup table, or default if no match is made. Note that matching is performed case-insensitive.
Example:	`string s;` `s = dflookup("drugs", @T, "unknown", -1);`
Notes:	If a lookup table contains multiple fields for a key, the return result is the string containing all of the fields after the key. The `dfgetfield` function can subsequently be used to extract individual fields from the return result.

5.13. Looping

It is often desirable to execute certain parts of an edit check several times. An example would be a total dose calculation based on multiple fields on a form. The edit check language provides the while loop construct for this purpose.

5.13.1. `while`

The `while` statement executes its body (either a single statement, or a group of statements surrounded by braces) as long as the condition is true. If the condition is FALSE when the `while` statement is first started, the body of the loop is not executed and execution continues at the first statement following the end of the `while` statement.

Example 5.16. A simple edit check that prints all the numbers from 1 to 10

```
edit printnums()
{
        number counter;
        counter = 1;
        while (counter <= 10) {
                dfmessage("count is now ", counter);
                counter = counter + 1;
        }
}
```

In this example, the variable `counter` is initialized to 1 (remember that local variables are set to blank when they are declared). The body of the while loop is executed as long as the value counter is less than or equal to 10, causing the 'count is now' messages to be produced.

If you are using a variable as the condition in the while loop it is very important to make sure that the body of the while loop changes the value in such a way that the condition will eventually be false and the while loop is exited. Failure to do this results in an endless loop. The edit check language interpreter places an upper limit on the number of instructions that can be executed to gracefully recover from this programming error.

Example 5.17. Compare visit date fields of adjacent visits

```
edit vdatecheck()
{
        number v;
        v = DFSEQ;
        while (v > 0) {
                if( vdate[,v,] <= vdate[,v-1,] )
                        dferror("Visit ", v-1, "follows visit ", v);
                v = v- 1;
        }
}
```

In this edit check a local variable, `v`, is first set to the value of the current visit number (this by default, is the DFSEQ data variable) and then, using a while loop, is successively set to the visit number of the preceding visit until the value reaches zero. A message is printed if the date for a given visit is earlier than the date of the visit that precedes it. This is written under the assumption that the plate on which the `vdate` variable appears is to be collected at each visit. If visit dates appeared on different plates for different visits, the edit check would have to be modified.

> **Note**
>
> This example assumes that all visit/sequence number fields (field 6) in the database have been assigned the DFdiscover name of `DFSEQ`. Field 6 has this name only if the field is defined to be in the barcode; otherwise the name is user-defined. It is legal however, for field 6 to be assigned a user-defined name of `DFSEQ`.

5.13.2. `break`

Occasionally there is the need to break out of a loop prematurely. In the case of nested loops, the break applies to the innermost while loop.

Example 5.18. Example use of `break`

```
edit find_headache()
{
        number seq;
        seq = DFSEQ;
        while (seq >= 0) {
                if (AEevent[,seq,] == "headache")
                        break;
                seq = seq - 1;
        }
        if (seq >= 0) {
                dfmessage("headache on seq ", seq);
        } else {
                dfmessage("no headache found!");
```

```
}
```

In this example we have an adverse event form and would like to see if the subject had a headache event on a prior form. The edit check looks at all prior adverse event forms until it finds one with AEevent == "headache". When we find the headache event, we print out the sequence number for that form and break out of the loop;

> **Note**
>
> that the local variable `seq` retains its value when the loop is terminated.

5.13.3. `continue`

The `continue` statement also modifies looping behavior, but unlike the `break` statement, it causes execution to resume at the top of the loop. In the case of nested while loops, the `continue` statement causes control to be transferred to the top of the innermost active loop skipping the remaining steps in the loop.

If a variable is being used in the `while` condition, it needs to be adjusted before the `continue` statement, otherwise an endless loop may occur.

5.14. User-Defined Functions

In addition to the built-in functions, the edit check language allows users to define their own functions. User-defined functions allow an edit checks programmer to create sections of code that can be reused by different edit checks, and in generic cases, by multiple studies.

Functions are similar to edit checks but some differences exist:

- Unlike edit checks, user functions can return values,
- Edit checks can be assigned to data fields in the setup tool, whereas user functions are executed when called by an edit check.

User functions have the same general form as edit checks, but instead of beginning with the word `edit` they begin with the keyword of the type of value which they return. This is followed by the name of the function and the opening bracket, `(`, just like in an edit check. The functions arguments, if any, are declared next and are followed by the closing bracket, `)`. This ends the function and argument declaration and is then followed by the opening brace, `{`, and the body of the user function.

Example 5.19. User-defined function to add two numbers and report when the sum is greater than 10

```
number add(number n1, number n2)
{
        number result;
        result = n1 + n2;
        if (result > 10) {
                dferror(result, " is greater than 10");
        }
        return(result);
}
```

The result of calculations in the user function is returned via the `return` statement.

Functions can be used for many purposes such as to implement sophisticated calculations that are used over and over again.

Example 5.20. User function that calculates a dose level based on the subject's weight and sex

```
number calcdose(number wt, number sex)
{
        if (dfmissing(wt) || dfmissing(sex)) return(0);
        if ((wt < 40) || (wt > 400)) {
                dferror("Subject weight error");
                return(0);
        }
        if (sex == 1) return(200 + .2*wt);
        if (sex == 2) return(100 + .1*wt);
        dferror("Unable to calculate dose. Sex not 1 or 2.");
        return(0);
}
```

The last 2 lines may seem unnecessary given we have returned at the top of the edit check if `sex` is missing, as long as there are only 2 options for `sex`. But, it never hurts to be cautious.

Several edit checks can now share the `calcdose` function and if any dosage calculations need to be changed, only the `calcdose` function needs to be altered.

Example 5.21. Calling a user defined function from an edit check

```
edit drugcheck()
{
        number dose;
        dose = calcdose(lbs, sex);
        if ((dose != 0) && (DRUGDOSE > dose)) {
                dferror("Drug overdose given!");
        }
}
```

5.14.1. Sharing edit check files with the #include directive

The **#include** directive can be used to include other files into a `DFedits` file. This can be useful in cases where a number of user functions or common edit checks are to be shared across multiple studies.

To include another file in a `DFedits` file, use the following syntax:

```
#include other filename
```

where *`other filename`* is the file to be included, represented as a string. All include files must be located in the study ecsrc directory or in the DFdiscover ecsrc directory. The study level file has priority if the same file exists in both places.

Example 5.22. Including `DFedits.gen` in the `DFedits` file

```
#include my generic edit checks
#include "DFedits.gen"
#the rest are my local edit checks
edit checkAge()
{
...
```

Included text is treated exactly the same way as text that appears directly in the `DFedits` file. A side effect of this is that care must be taken when naming edit checks. It is not valid to define an edit check named `checkAge` in a file to be included

and define an edit check with the same name in the local edit check file. To reduce this possibility, consider naming generic edit checks with a common prefix such as `GEN_`.

> **Note**
>
> It is not possible to start a line with the comment phrase **#include** as this is interpreted as an include directive. In such a case, use **# include** to start a comment with the word *include* (note the intervening space).

5.15. Examples and Advice

Earlier we saw this simple edit check to convert pounds to kilograms.

Example 5.23. Convert pounds to kilograms

```
# This is a comment
edit lbs2kgs()
{
        kgs = lbs / 2.205;
}
```

Although syntactically correct the edit check does not take into account the possibility that the `lbs` field might be missing or contain an illegal value.

Procedure 5.1. Steps for a more rigorous solution

A more rigorous solution might include the following steps.

1. Ignore the edit check if `lbs` is blank or contains a missing value code.
2. Only calculate `kgs` if `lbs` contains a legal value.
3. If `lbs` does not contain a legal value add a query to `lbs`.

Example 5.24. Convert pounds to kilograms with error checking

```
edit lbs2kgs() {
        # exit if lbs is blank or has a missing value code
        if( dfmissing(lbs) ) return ;
        else if( lbs>=40 && lbs <=400 ) kgs = lbs / 2.205;
        else dfaddqc(lbs,2,"Please verify weight.",1,2,"");
}
```

The most difficult task in writing edit checks is to decide *exactly* what you want the edit check to do. The most appropriate action might be viewed differently by different users and might depend on various conditions involving legal and missing values for one or more other variables. Using the previous compliance check as an example, is it the intent to:

- always insert the calculated value of compliance into the database?,

```
compliance = 100 * ( dispensed - returned ) / dispensed;
```

- insert a calculated value of compliance into the database only when it is not already recorded?,

```
if ( dfblank( compliance ) )
```

```
        compliance = 100 * ( dispensed - returned ) / dispensed;
```

- insert a calculated value of compliance into the database only when the record is at or below a certain validation level?,

```
if ( DFvalid <= 3 )
        compliance = 100 * ( dispensed - returned ) / dispensed;
```

- or warn the user when the calculated value does not match the recorded value?

```
number calculated;
calculated = 100 * ( dispensed - returned ) / dispensed;
if ( !dfblank(compliance) && calculated != compliance )
        dferror( "Reported compliance of ", compliance,
        "does not match calculated compliance of ", calculated );
```

> **Note**
>
> Remember that an edit check can be executed at *different times* i.e. on entry to the plate, on entry to a field, on exit from the plate or on exit from a field, or at *multiple times* , e.g. on exit from the field and again on exit from the plate. Also remember that a field entry or exit edit check will be executed *every time* that the field with the edit check is traversed, and *skipped entirely* if the user scrolls past the field, never entering it.

Most edit checks are written as field exit edit checks and placed on the last field of those involved in the edit check so that all information has been validated before the edit check is executed. But only you can determine the best time to execute a particular edit check.

Be careful with illegal values, missing values, blank fields, existing queries, and calculated fields that have already been filled. Errors can easily arise from failure to account for unexpected data.

It is up to the programmer to design edit checks that take appropriate account of the variety of conditions which may arise. Although more time consuming to write, carefully crafted edit checks are more likely to do what you really want, and to be easily accepted by those performing data entry and validation for the study.

Finally, keep the following in mind with respect to assigning calculated values to database variables. The FDA's Guidance for Industry: Computerized Systems Used in Clinical Trials explicitly states

> Features that automatically enter data into a field when that field is bypassed should not be used.

Hence, consider carefully edit checks that assign values to data fields. If the data value is a reported value on the CRF, a preferred alternative is to compute the expected value of a field and then compare it against the recorded value, signaling an error when the two do not match.

5.16. Optimizing Edit checks

Like any langauge, the quality of edit check code benefits from repeated definition and use; the experience of the edit checks creator. Your first challenge is learning the language - what does the syntax allow me to do? Getting your first edit check to compile is a rewarding feeling.

As you learn the syntax, you then make decisions about the semantics of the edit checks code - is this the desired behavior or result of the edit check? Do I display a message, add a query, prompt the user to fix something? Syntactically, one can write several different edit checks to solve a problem - they each compile. But which one has the desired effect?

As you become even more proficient, it's worthwhile spending time and effort to optimize your edit checks. Can they execute quicker? Is the edit checks code clear to another reader? The suggestions in the following sections are intended to give you resources to increase the efficiency of your edit checks.

5.16.1. Saving Time for the User

Each edit check takes time to execute. Most are extremely quick, hardly noticable. Some take more time and that time can become noticeable. Imagine the impact of that edit check if it is executed once on each CRF. Imagine the impact of that edit check if it is executed five times on each CRF. What is the impact if the user is geographically located several time zones away, or on a slow internet connection?

It is worthwhile improving the execution time of every edit check. If you can save 0.1 sec per edit check, over the duration of a study this can amount to hours or even days.

5.16.2. Limitations in the Language

One of the most valuable, yet more expensive features in edit checks in terms of execution time, is the ability to request data for other CRFs, other visits, and even other subjects. It's an incredibly valuable feature - it does however require a request from the database and hence some execution time.

The edit checks language executes every clause in conditional statements. It does not implement shortcut evaluation, which you may have experienced in other programming languages.

In DFexplore, edit check logic is executed in the client and the edit check definition file, `DFedits.bin`, is stored on the server. This means that the file must be transmitted to DFexplore from the server each time that DFexplore starts. Edit checks that are included, but never referenced, should be removed to help reduce the size of the file that is transmitted.

5.16.3. Maximize Cache

In DFexplore, an edit check cache is maintained for each record request. If a record request matches the subject ID of the currently open subject binder (which it typically would), the result of the first request is added to the cache and the result for each subsequent request is pulled from the cache. Results for requests for other subject IDs continue to come directly from the database.

In this example, there are 5 requests for data records from the database. 3 are fulfilled by database responses and 2 (displayed in bold) are fulfilled from the local cache.

```
if (var1[,21,5] >= 100) dfmessage( msg1 );
if (var2[,22,5] < 150 && var1[,21,5] >= 150) dfmessage( msg2 );
if (var1[99001,11,1] == 1) dfmessage( msg3 );
if (var2[,22,5] < 150) dfmessage( msg4 );
```

5.16.4. Simplify Conditional Testing

Some conditional tests can be simplified with one or more `else` clauses. Some conditional tests may not be necessary. Consider this example:

```
if ( Date[,0,1] < "01/01/16" )
    value = 1;
if ( Date[,0,1] >= "01/01/16" && Date[,0,1] < "01/01/17" )
    value = 2;
if ( Date[,0,1] >= "01/01/17" )
    value = 3;
```

The `Date[,0,1] >= "01/01/16"` test is not necessary if an `else` clause is used. Similarly, `Date[,0,1] >= "01/01/17"` is not necessary.

The logic can be simplified:

```
date v1date = Date[,0,1];
if ( v1date < "01/01/16" )
    value = 1;
else if ( v1date < "01/01/17" )
    value = 2;
else
    value = 3;
```

5.16.5. Reduce the Number of Function Calls

Function calls in edit checks have a cost. If the same function is called several times in the same context, it may be more efficient to store the function result in a local variable and use the local variable. For example:

```
if ( dflevel() == 1 || dflevel() == 2 || dflevel() == 3 || dflevel() == 4 || dflevel() ==
 5 ) # do something
```

can be more efficiently written as:

```
number mylevel = dflevel();
if ( mylevel == 1 || mylevel == 2 || mylevel == 3 || mylevel == 4 || mylevel == 5 ) # do
 something
```

or even more efficiently as:

```
number mylevel = dflevel();
if ( mylevel >= 1 && mylevel <= 5 ) # do something
```

5.16.6. Shortcut, and Order of, Evaluation

There is no shortcut evaluation in DFdiscover edit checks. Hence it can be more efficient to simplify multiple conditions. In this example, all 5 conditions are evaluated even if the first one, or any one, fails.

```
if ( condition1 && condition2 && condition3 && condition4 && condition5 && condition6 )
    something_happens;
return;
```

Although it appears longer, this re-writing will execute quicker because any failed condition will prevent the other conditions from being tested.

```
if ( !condition1 ) return;
if ( !condition2 ) return;
if ( !condition3 ) return;
if ( !condition4 ) return;
if ( !condition5 ) return;
if ( !condition6 ) return;
something_happens;
return;
```

5.16.7. Delay Message Construction

Messages that are displayed for the user, or written to a new query, benefit from having as much detail in them as possible. This often involves inserting context into the message.

```
string msg1 = "The visit date " + dfvarinfo( @T, DFVAR_STRING_VALUE ) + " is in the
 future.";
string msg2 = "The subject reported " + @(T-1) + ". Was follow-up prescribed?";
if ( dfblank( @T ) )
    return;
...
```

In this example, the work to construct the two messages is immediately wasted if the simple exclusion test is true.

A more efficient solution delays construction of the messages until they are actually needed:

```
string msg1, msg2;
if ( dfblank( @T ) )
return;
msg1 = "The visit date " + dfvarinfo( @T, DFVAR_STRING_VALUE ) + " is in the future.";
msg2 = "The subject reported " + @(T-1) + ". Was follow-up prescribed?";
...
```

5.17. Creating generic edit checks

While some edit checks are unique, i.e. used only once in the entire study database, other edit checks may need to be repeated at several locations. In such cases there is considerable advantage in being able to create a generic edit check that can be written once and then applied to all of the data fields on which it needs to be executed. To do this we need a way of referring to data fields other than by explicit variable names, as the relevant variable names will likely change depending on the field to which the generic edit check is attached.

As an example consider a list of medical history items (diabetes, hypertension, etc.) with a Yes/No question followed by a Duration question for each history item. Duration is only required when the Yes/No question is answered Yes. The following is a generic edit check that could be applied to each duration field to check such medical history questions.

```
edit medhx() {
        if( @T==0 || dfblank(@T) ) { # duration is zero or blank
                if( @(T-1)==1 ) dferror("duration is missing"); }
        else { # a duration has been specified or marked missing
                if( @(T-1)==2 ) dferror("should history = Yes?"); }
}
```

Note the use of `@T` and `@(T-1)` to refer to data fields in the above example. `@T` refers to the data field to which the edit check is attached. Other fields can be referenced relative to this field by adding or subtracting the desired number of fields. Thus `@(T-1)` refers to the field immediately before `@T`, `@(T+1)` refers to the field immediately after `@T`, and `@(T+5)` refers to the fifth field following `@T`. Don't forget the brackets: `@T+1` adds 1 to the value of the field to which the edit check is attached, whereas `@(T+1)` refers to the value of the field following the field to which the edit check is attached. Writing an edit check this way allows you to attach the same edit check to different fields in the CRF which share the same meaning and variable block structure.

In the previous example, the edit check is attached to the `duration` field and the Yes/No question is thus `@(T-1)`. In this example we have assumed that 1=Yes and 2=No. The edit check generates a message if `duration` is missing when a history item is marked Yes, and also complains if a `duration` has been specified or marked with a missing value code when the `history` variable has been answered No.

Why did we attach the edit check in this example to the `duration` field and not to the Yes/No question? In general it is best to write edit checks with the intention of attaching them to the last field in the block of fields to be checked. This allows data entry to be completed on all fields within the block before the edit check is executed. Data entry staff will quickly get frustrated with edit checks if they pop-up messages just as they are about to make a correction which would have fixed the

problem. Also, if the edit check is executed too soon, it may fail to detect an error condition that only becomes apparent after the block of fields has been completed.

Generic edit checks may also include references to data fields on other plates, but must do so explicitly, by using the variable name of each such field.

5.17.1. More Examples

In the following examples, any variable names that are not locally declared are assumed to be the names of variables specified in the study schema.

Example 5.25. If "Other" Race check box has been checked, does the "Other, specify" field also contain a value?

This example deals with 2 scenarios. If "Race" = "Other", then the "Other, specify" field must contain a value. If "Race" does not equal "Other", then the "Other, specify" field should not contain a value With this type of edit check, it is also a good idea to first check for existing queries on either the "Race" or "Other, specify" field. If queries exist, the edit check should probably abort as the problem has already been dealt with.

```
edit checkrace(){
    #this is a field exit edit check attached to RACEOTH
    #abort if either RACE or RACEOTH has a query
    if( dfanyqc(RACE) || dfanyqc(RACEOTH) ) return;

    if( RACE==4 && dfblank(RACEOTH) )
        dfaddqc(RACEOTH,1,"",1,2,"");
    if( RACE!=4 && !dfblank(RACEOTH) )
        dfwarning("Other race was specified when unexpected.");
}
```

Example 5.26. Does the reported date of surgery occur before the study enrollment date?

```
edit days2surg() {
    number diff;
    diff = surgDate - entryDate;
    if ( diff < 0 )
        dfwarning( "Surgery occurred ", -diff,
        " days before enrollment?" );
}
```

Example 5.27. Does the subject meet all eligibility criteria?

This example also shows one way to use local variables that are symbolic names for choice values. This can be useful because the current version of the edit checks language does not interpret references to choice or check variable labels.

```
edit isElig() {
    choice         no, yes;
    yes = 1; no = 2;
    if ( crit1 == yes && crit2 == yes &&
    crit3 == yes && crit4 == yes &&
    crit5 == yes && crit6 == yes )
    {
        if ( elig != yes )
            dfwarning( "Subject meets eligibility criteria",
```

```
                "but is not reported as eligible." );
    }
    else
    {
        if ( elig == yes )
            dfwarning( "Subject has not met all eligibility",
                "criteria but is reported as eligible." );
    }
}
```

Example 5.28. Compute age from birth date and compare with Age field.

The local variable age is declared at the beginning of the edit check. Within the body of the edit check, age must be coerced to an integer because it is possible that the calculation used to assign a value to age will yield one or more decimal places. If the age value contains decimals, age and the database variable AGE will never match when compared because AGE is defined in the database as an integer.

```
edit checkage(){
    number age;
    string s, m;
    if( dfmissing(AGE[,0,1]) || dfunresqc(AGE[,0,1]) ||
        !dflegal(BDATE) || dfunresqc(BDATE) ||
        !dflegal(EDATE) || dfunresqc(EDATE) ) return;

    age = int( (EDATE - BDATE)/365.25 );
    if(age!=AGE[,0,1]){
        m = "Age (" + (s=age) + "yrs) computed from birth" +
        " and entry dates\ndiffers from age (" +
        (s=AGE[,0,1]) + "yrs) on Form 1.";
        if(dfask(m + "\nAdd Query.",1,"Yes","No")==1 )
            dfaddqc(BDATE,3,m+
            "Explain below and refax corrected page.",
            1,1,"");
    }
}
```

Example 5.29. If an adverse event has been checked on a follow-up form has the adverse event report been received?

This is an example of a cross-plate consistency check. This particular test can be dependent on the order that CRFs are validated from the new queue and hence should be programmed carefully. If the adverse event report is the subsequent page to the follow-up form during new record entry, it will not be present in the database when the follow-up form's edit checks are executed. A possible solution, as shown here, it to only execute this edit check when the follow-up form has been validated to at least level 1.

```
edit haveAEreport() {
    number         AEplate = 10; # Using a variable as a symbolic name
    if ( DFVALID < 1 ) return;
    if ( hadAE == 1 ) # the hadAE choice box was checked "yes"
        # The assumption in this example is that the AE
        # form has the same visit number as the visit that
        # it is reported on.
        if ( dfmissingrecord( ,,AEplate )
            dfwarning( "An adverse event was reported but" +
```

```
                " the AE report has not been received." );
}
```

Example 5.30. Is the subject's weight within the normal range for their gender?

In some cases a single legal range will not apply to all subjects. Rather than settle for a single range in the study schema that is wide enough to accommodate all subjects, we can write an edit check to apply different legal ranges to different subjects.

```
edit weightLegal() {
    if ( sex == 1 ) { # male
        if ( weight < 120 || weight > 275 ) {
            dfwarning( "Weight is outside normal range for males." );
            dfillegal( weight );
         }
    }
    else if ( sex == 2 ) { # female
        if ( weight < 90 || weight > 210 ) {
            dfwarning( "Weight is outside normal range for females." );
            dfillegal( weight );
         }
    }
}
```

Example 5.31. Compute body mass index

This example computes a value for a database variable, `bmi`, that is stored in the database but is not on the original CRF. Remember that all you need to do this is to leave placeholders for these computed variables in your database schema when defining the CRF in DFsetup. This example also uses the `dfmoveto` function to move to the `bmi` variable if it can be computed, or to skip to a subsequent field if it cannot.

```
edit storeBmi() {
    if ( !dfmissing( weight ) && !dfmissing( height ) ) {
        # store the computed value and move to it
        bmi = weight / ( height * height );
        dfmoveto( bmi );
    }
    else
        # skip over bmi and move to dbp
        dfmoveto( dbp );
}
```

Example 5.32. Send an e-mail notification of elevated blood pressure

The first part of the example uses two pieces: the edit check and the shell script that it calls. Note that this could all be done within the edit check, as is shown the second part of the example, but it could be harder to read.

The following example will send mail to a user named 'brian' each time a subject with elevated blood pressure is encountered when validating new records.

```
edit bpsendmail()
{
    # send only on initial entry (validation = 0)
    if ((DFVALID == 0) && (dbp > 95 || sbp > 140))
        dfexecute("bpalert", "brian ", ID,
        " ", DFSEQ, " ", dbp, " ", sbp);
```

```
}
```

Note the use of extra spaces in the `dfexecute` call. These spaces are needed to ensure that the parameters passed to the script are not combined into one argument.

The `bpalert` script might be written as follows:

```
#!/bin/sh
# bpalert - alert user in $1 that subject $2, visit $3
#        has elevated blood pressure dbp = $4, sbp = $5
mail -s "HYPERTENSION ALERT" $1 <<END
        SUBJECT = $2, VISIT = $3
        DBP/SBP = $4 / $5
END
```

Example 5.33. Use batch edit checks to verify consistency of subject initials

This example uses the `dfbatch` function to first determine if this edit check is being executed in batch or interactive mode. If `dfbatch` evaluates to TRUE, the edit check is being executed in batch and consistency checking will occur. If this edit check is triggered interactively, it will not execute. As this edit check executes only in batch mode, it is important to include a useful error message.

```
edit batchcheckinitials(){
    #check consistency of subject initials in batch mode
    string m = "Different initials: visit 0 plate 1 = " ;
    if( !dfbatch() )
        exit;
    if( @T != PINIT[,0,1] ) {
        m = m + PINIT[,0,1]
         + " visit ", @[6], " plate ", @[5], " = ", @T;
        dferror(m) ;
    }
}
```

Example 5.34. Check visit date order

Errors in visit dates can result in incorrect overdue visit and next visit calculations. This edit check verifies that visit dates are in the expected order. This edit check makes use of the `group` statement to define an array of visit date variables for visits 1 through 6. It will abort if it comes to a visit date variable that is blank or contains a missing value code. It is important that the error message is descriptive enough to help the user identify which visit date is likely in error.

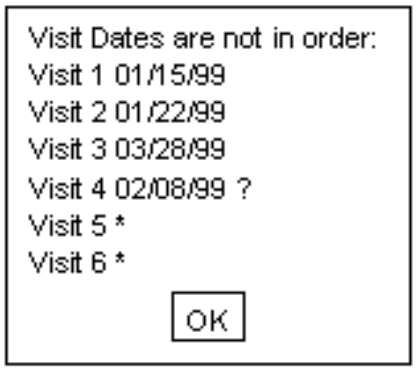
```
edit checkvisitdates(){
    #check order of visit dates across visits 1 to 6
    #this is a field exit edit check attached to the variables
    #used as VisitDates

    number v=1, flag=0;
    string s, m = "Visit Dates are not in order:";
    group vd vdt[,1,5], vdt[,2,5], vdt[,3,5], vdt[,4,5], vdt[,5,5], vdt[,6,5];

    if( dfmissing(@T) ) exit;
    while( v<=6 ){
        m = m + "\nVisit " + (s=v) + "" + (s=vd[v]);
        if( v<@[6] && !dfmissing(vd[v]) && vd[v]>=@T ){
        flag=1 ; m = m + "?";}
```

```
        if( v>@[6] && !dfmissing(vd[v]) && vd[v]<=@T ){
        flag=1 ; m = m + "?";}
        v = v + 1
    }
    if( flag==1 )
        dferror("Visit Date Problem(s)\n",m);
}
```

The following message would be displayed in a pop-up dialog box during data entry if the edit check detected a visit date discrepancy.



Example 5.35. Define a look-up table of study investigators

There are 2 steps involved in defining this edit check. The first step is to create a file containing a list of investigator names (e.g., `$STUDY_DIR/lib/investigators.lut`). For example:

```
Dr. Joseph Smith
Dr. Sally Brown
Dr. Jane Doe
Dr. Michael Green
```

The file `investigators.lut` must also be registered in `$STUDY_DIR/lib/DFlut_map`. For example, the following entry would be appended:

```
INVESTIGATORS|investigators.lut
```

The second step is the definition of the edit check.

```
edit investigatorpicklist(){
    #this is a field exit edit check attached to the
    #Investigator style

    string s, m ;

    #look for an exact match, if found abort
    s = dflookup("INVESTIGATORS",@T,"",-1);
    if( !dfblank(s) ) return;

    #display pick list for user selection
    s = dflookup("INVESTIGATORS",@T,"",4);
    if( !dfblank(s) ){ @T=s; return;}
```

```
    #if user does not pick a value from pick list and leaves
    #the field blank, add a missing value query
    if( dfblank(@T) )
        dfaddqc(@T,1,"",1,2,"");
    else{
        #if user does not pick a value from pick list and enters
        #some other value, add an illegal value query
        m = @T + "is not a registered investigator.";
        dfaddqc(@T,2,m,1,2,"");
    }
}
```

Example 5.36. Define a generic function that will fill fields in the specified range of field numbers with the specified value

A generic function such as this can be referenced by name within any other edit check in the study. If you define generic functions in your `DFedits` file, be sure to define them at the beginning of the file. In this example, the generic function is called `GEN_Fill`, `f` and `f2` define *by their numeric position* the range of fields that are to be filled, and `value` represents the string value that is to fill the specified fields.

```
#GEN_Fill(f,f2,value)
#enter the specified value into fields in the specified range
number GEN_Fill(number f, number f2, string value)
{
    while(f<=f2){
        @[f]=value;
        f = f + 1;
    }
}
```

Note that the function body does not actually return a number per its declaration. In such a case, the edit check environment returns a 0 value from the function, but this behavior should not be relied on. It is better to be explicit.

5.18. Debugging and Testing

5.18.1. Debugging

Here are some tips to help debug edit checks:

- Use `dferror`/`dfmessage`/`dfwarning` statements at strategic places in your edit check.
- Remember that local variables are initialized to blank and any operation on blank data produces a blank result.
- Variables are passed by value and not by reference - it is not possible to add a query to a function argument from within a function.
- Be careful to use a double equals, ==, in if statements if you are trying to compare values. A single equal, =, is valid and performs an assignment and test for non-zero. The compiler will produce a warning message if you try to assign values in an 'if' statement.
- If the Check Syntax function in the setup tool reports problems, the actual error may be on the line just before the reported line number.
- Do not use the same name for both edit checks and database variables. If you do, the compiler will issue an error message.

- Do not use the same name for a local variable and a database variable. If you do, the local variable declaration hides the database variable until the end of the edit check or function.
- The single quote, ', and the double quotes, '', are not interchangeable. Use double quotes whenever you are dealing with strings. Single quotes return the ASCII value of the single character they contain.

5.18.2. Testing

- Use raw data entry to quickly test correct behavior.
- Think about what happens if fields contain missing values.
- Think about what happens when fields used in your calculations have queries attached to them.
- Think about what happens if your edit check is executed again.

5.18.3. Compiling and Reloading Edit checks

The shell level program **DFcompiler** can be used to compile the edit checks for DFexplore. Edit checks can be compiled from the command line as follows:

```
% DFcompiler -s # -o DFedits.bin DFedits
```

It is easiest to run **DFcompiler** from the study `ecsrc` directory and `DFedits.bin` will be saved in the same `ecsrc` directory.

Edit checks can also be compiled by selecting **Publish** in the **Edits Checks** dialog of **DFsetup**. Edit checks are loaded automatically when DFexplore, DFweb or DFcollect starts and can also be reloaded following a new compile, in DFexplore only, from the **File** > **ReloadEdit checks** menu.

The recommended procedure, when it is necessary to implement and test new edit checks or modifications of existing edit checks, is to use **DFsetup**'s Development and Production studies feature. Among other benefits, this allows study users to continue using the existing edit checks without interference until the new version has been fully tested. It is also recommended that previous production versions of `DFedits` be preserved in case you ever need to rollback. A simple way to do this, for a study administrator, is simply to rename `DFedits` to `DFedits_`*yyyymmdd*, where *yyyymmdd* is the date on which the `DFedits` file was replaced by a new version.

5.19. Language Reference

5.19.1. Identifiers (edit check and variable names)

- Allowable characters: A-Z, a-z, 0-9, _
- No length limit
- Case sensitive
- First character must be a letter

5.19.2. String Constants

- Modifiers: `\n` (new line), `\r` (carriage return), `\t` (tab), `\f` (form feed), `\\` (backslash)
- Maximum length: 1024 characters

5.19.3. Maximum number of instructions per edit check execution

The edit check language interpreter limits the number of instructions that can be executed per edit check to 1,000,000. This limit is imposed to provide endless-loop detection and prevention.

5.19.4. Reserved Words

Reserved words cannot be used as edit check or variable names.

@PID
@PLATE
@T
@VISIT
DFACCESS_HIDDEN
DFACCESS_IMMUTABLE
DFACCESS_MASKED
DFACCESS_NORMAL
DFACCESS_VIEWONLY
DFIMAGE_ARRIVAL
DFIMAGE_FIRSTARRIVAL
DFIMAGE_FORMAT
DFIMAGE_LASTARRIVAL
DFIMAGE_PAGES
DFIMAGE_SENDER
DFMODULE_USER1
DFMODULE_USER2
DFMODULE_USER3
DFMODULE_USER4
DFMODULE_USER5
DFMODULE_USER6
DFMODULE_USER7
DFMODULE_USER8
DFMODULE_USER9
DFMODULE_USER10
DFMODULE_USER11
DFMODULE_USER12
DFMODULE_USER13
DFMODULE_USER14
DFMODULE_USER15
DFMODULE_USER16
DFMODULE_USER17
DFMODULE_USER18
DFMODULE_USER19
DFMODULE_USER20
DFNEED_HIDE
DFNEED_OPTIONAL
DFNEED_REQUIRED
DFNEED_RESET
DFNEED_TRIM
DFNEED_UNEXPECTED
DFPAGE_LABEL
DFPLATE_DESC
DFPLATE_FIELDS
DFSITE_CONTACT
DFSITE_FAX
DFSITE_ID
DFSITE_NAME
DFSITE_PHONE
DFSITE_BEGINDATE
DFSITE_COUNTRY
DFSITE_ENDDATE
DFSITE_ENROLL
DFSITE_INVESTIGATOR
DFSITE_PROTOCOL1
DFSITE_PROTOCOLDATE1
DFSITE_PROTOCOL2
DFSITE_PROTOCOLDATE2
DFSITE_PROTOCOL3
DFSITE_PROTOCOLDATE3
DFSITE_PROTOCOL4
DFSITE_PROTOCOLDATE4
DFSITE_PROTOCOL5
DFSITE_PROTOCOLDATE5
DFSITE_REPLYTO
DFSITE_SUBJECTS
DFSITE_TEST
DFSTUDY_NAME
DFSTUDY_NUMBER
DFSTUDY_USER1
DFSTUDY_USER2
DFSTUDY_USER3
DFSTUDY_USER4
DFSTUDY_USER5
DFSTUDY_USER6
DFSTUDY_USER7
DFSTUDY_USER8
DFSTUDY_USER9
DFSTUDY_USER10
DFSTUDY_USER11
DFSTUDY_USER12
DFSTUDY_USER13
DFSTUDY_USER14
DFSTUDY_USER15
DFSTUDY_USER16
DFSTUDY_USER17
DFSTUDY_USER18
DFSTUDY_USER19
DFVAR_UNITS
DFVAR_USER1
DFVAR_USER2
DFVAR_USER3
DFVAR_USER4
DFVAR_USER5
DFVAR_USER6
DFVAR_USER7
DFVAR_USER8
DFVAR_USER9
DFVAR_USER10
DFVAR_USER11
DFVAR_USER12
DFVAR_USER13
DFVAR_USER14
DFVAR_USER15
DFVAR_USER16
DFVAR_USER17
DFVAR_USER18
DFVAR_USER19
DFVAR_USER20
DFVISIT_ACRONYM
DFVISIT_DATE
DFVISIT_DUE
DFVISIT_LABEL
DFVISIT_MISSEDPLATE
DFVISIT_OPTIONALPLATES
DFVISIT_ORDERPLATES
DFVISIT_OVERDUE
DFVISIT_REQUIREDPLATES
DFVISIT_TYPE
DFopen_patient_binder
DFopen_study
break
check
choice
continue
date
dfaccess
dfaccessinfo
dfaddmpqc
dfaddqc
dfaddreason
dfalias2id
dfid2alias
dfillegal
dfimageinfo
dflegal
dflength
dflevel
dflogout
dflookup
dflostcode
dflosttext
dfmail
dfmatch
dfmessage
dfmetastatus
dfmisscode
dfmissing
dfmissingrecord
dfmissval
dfmode
dfmonth
dfmoveto
dfneed
dfpageinfo
dfpasswdx
dfpassword
dfplateinfo
dfpref
dfprefinfo
dfprotocol
dfqcinfo
dfqcinfo2
dfreasoninfo
dfresqc
dfrole
dfsiteinfo
dfstay
dfstr2date
dfstudyinfo
dfsubstr
dftask
dftime
dftoday
dftool
dftrigger

DFPLATE_SEQCODING
DFPLATE_USER1
DFPLATE_USER2
DFPLATE_USER3
DFPLATE_USER4
DFPLATE_USER5
DFPLATE_USER6
DFPLATE_USER7
DFPLATE_USER8
DFPLATE_USER9
DFPLATE_USER10
DFPLATE_USER11
DFPLATE_USER12
DFPLATE_USER13
DFPLATE_USER14
DFPLATE_USER15
DFPLATE_USER16
DFPLATE_USER17
DFPLATE_USER18
DFPLATE_USER19
DFPLATE_USER20
DFPREF_CURRENT
DFPREF_LOCK
DFPREF_SESSION
DFSITE_ADDRESS
DFSTUDY_USER20
DFSTUDY_YEAR
DFSUBJECT_ALIAS
DFSUBJECT_ID
DFVAR_ACCESS
DFVAR_COMMENT
DFVAR_DESC
DFVAR_ENTER_VALUE
DFVAR_ESSENTIAL
DFVAR_FLDNUM
DFVAR_FORMAT
DFVAR_GENERIC
DFVAR_HELP
DFVAR_INSTRUCTION
DFVAR_LABEL
DFVAR_LEGAL
DFVAR_MODDESC
DFVAR_MODNAME
DFVAR_MODNUM
DFVAR_NAME
DFVAR_PROMPT
DFVAR_REQUIRED
DFVAR_STRING_VALUE
DFVAR_TYPE
DFVAR_UNIQUE
dfanympqc
dfanyqc
dfanyqc2
dfanyreason
dfask
dfautoreason
dfbatch
dfblank
dfcapture
dfcenter
dfclosestudy
dfdate2str
dfday
dfdebug
dfdelmpqc
dfdirection
dfdisplay
dfeditqc
dfentrypoint
dferror
dfexecute
dfgetfield
dfgetlevel
dfgetseq
dfhelp
dfunresqc
dfuserinfo
dfvarinfo
dfvarname
dfview
dfvisitinfo
dfwarning
dfwhoami
dfyear
edit
else
exit
format
group
if
int
number
return
sqrt
string
time
vas
while

Chapter 6. Batch Edit checks

6.1. Introduction

6.1.1. Overview

Batch is a framework for edit check execution in unattended (batch) mode. The framework specifies which data records are to be operated upon by edit checks and what is to happen when edit checks are invoked. It uses the same edit checks that are used in interactive edit checks through **DFexplore** and introduces no changes to the language.

From this point forward we'll refer to batch edit checks as **DFbatch**, the name of the program that oversees the batch edit checks process.

With **DFbatch**, it is possible to:

- add queries to data fields in the study database,
- add (and remove) missing page queries to the study database,
- generate and log messages that report inconsistencies, data values that need further review, etc,
- perform coding from lookup tables,
- change data values on records in the study database, and
- execute all of the same edit checks that **DFexplore** already does.

With **DFbatch** all of this is possible in an unattended mode.

6.1.2. About this chapter

This chapter contains overview descriptions as well as step-by-step instructions for most of the tasks you will perform with **DFbatch**.

> **Read entire chapter before proceeding**
>
> **DFbatch** is a very powerful, and potentially dangerous if misused, application. We recommend that you read each section before using **DFbatch** for the first time. If you do not have time to read everything before starting, read DFbatch Basics and Using DFbatch at a minimum.

If you have previously used **DFbatch**, Using DFbatch, BATCHLIST Element Reference, and BATCHLOG Element Reference are good reference sections.

Limitations of **DFbatch** are outlined in Limitations.

A great deal of the value added by **DFbatch** is in the log information that it records. The syntax and semantics of the log information is described in Reference Pages. The XML nature of the log information lends itself to presentation in an HTML-enabled, web browser environment.

Sample control files and their purpose are listed in Example Control Files. Where file examples are given throughout the chapter, they may be fragments of a complete file, or a complete file themselves. If the example file begins with the XML declaration,

```
<?xml version="1.0"?>
```

it is the complete file, otherwise it is only a fragment from a file.

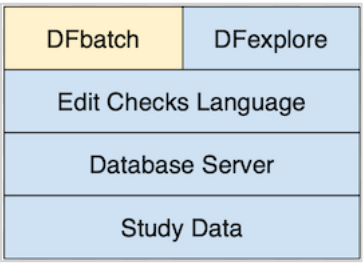
Common Pitfalls and System Messages describes common pitfalls and enumerates all of the possible error messages.

6.2. DFbatch Basics

6.2.1. The DFbatch Layer

DFbatch can be thought of as an additional layer that sits on top of the edit checks language, in much the same way that **DFexplore** is another layer, albeit interactive, that sits on top of the same edit checks.

Figure 6.1. DFbatch interacts with the study database and the edit checks language in the same manner as DFexplore



DFbatch reads the edit checks file as input, in the same way that **DFexplore** does. Where **DFexplore** provides interactive control over the records that are to be processed, **DFbatch** provides a language, stored in a control file, wherein the records to be processed can be specified non-interactively by the user. That specification can subsequently be applied to a study database on a regular (or irregular!) basis, in an efficient and unattended manner. This causes **DFbatch** to retrieve from the study database, one-by-one, the records selected by the control file, and apply the edit checks, field-by-field, to every field where they are referenced. Data field changes and queries are sent back to the study database, and all messages are logged. This is equivalent to retrieving sets of task records in **DFexplore** and traversing over each field of each record with the keyboard or mouse to invoke the edit checks.

6.2.2. Do you need DFbatch?

While **DFbatch** is useful in most situations where edit checks are processed, it is not necessarily appropriate in all situations. Before proceeding to implement **DFbatch**, consider the following situations where it is inappropriate:

- **Application of edit checks to level 0 records .** Batch edit checks cannot be applied to level 0 (new) records. If your workflow model is such that most edit checking must be performed during validation of new records, batch edit checks may not be appropriate.
- **Creation of queries that require user confirmation.** In batch, calls to `dfaddqc()` must always return with either a success status (equivalent to the user clicking OK) or a fail status (equivalent to clicking Cancel). It is not possible within a batch for some function calls to return success and some function calls to return false. If there is some uncertainty in the response (possibly because additional external information that is not available to the edit check must be reviewed), **DFbatch** is not appropriate.
- **Display of lookup tables.** **DFbatch** returns the default response for `dflookup()` in all circumstances unless an exact match can be found. If matching must be performed by a visual search of the lookup table, **DFbatch** is inappropriate.
- **Changes to record key fields.** The record key fields cannot be modified in batch, this includes: the study number, plate number, visit number, and subject ID.

On the other hand, **DFbatch** is appropriate in many more situations where interactive edit checks are not workable or painfully inefficient.

- **Cross-plate edit checks.** Records are generally processed in the order that they are received within a fax. In an interactive setting, it is very possible that the other plate involved in a cross-plate check is not yet in the database. Typically, the logic of the edit check will gracefully fail because the other plate is missing. However, in batch, the likelihood of this occurring is substantially reduced, and at those times when it does occur likely represents a plate that is truly missing.
- **Re-application of edit checks.** When the logic of an edit check changes mid-study, it is too time consuming to re-apply study edit checks interactively via **DFexplore**, except for all but the smallest databases. With **DFbatch**, re-applying edit checks is trivial.
- **Application of new edit checks.** Using **DFbatch**, it is easy to add new edit checks over the course of a study and apply them retrospectively to existing data.
- **Improved audit information.** **DFbatch** logs a great deal of information about the environment in which edit checks execute. This can prove to be valuable debugging or audit information that is simply not available during interactive edit checks.

6.2.3. How does DFbatch work?

DFbatch is a command-line utility as well as a view in **DFexplore**. This section describes the command-line version of **DFbatch** which, apart from how it's invoked, is identical to the **DFexplore DFbatch** view. The commmand-line version of **DFbatch** is invoked from a command prompt or a scheduled **cron** or Windows Task Scheduler task.

DFbatch reads a control file of instructions as input, uses those instructions to select records from the study database, and executes all referenced or requested edit checks for those records, sending additions and changes back to the study database. At the same time, all actions taken by **DFbatch** are logged to an output file.

The output is a complete record of what happened during the execution of **DFbatch**. It is created so that incremental changes can be easily identified and is in a format that is amenable to post-processing. It is by default post-processed to an HTML document, which is only one possible view of the log results. The post-processing can be skipped, delayed, or subsequently re-applied to create a different view of the same results. **DFbatch** goes to great lengths to separate the creation of log information from its presentation.

It should be noted that **DFbatch** does not bypass the normal database activities that already define DFdiscover. Database records are requested from the study server in the same manner as existing applications, permissions and record locking are enforced, and changes are similarly sent back to the study server, where updates are performed and journal records are written. Record locks are observed so that **DFbatch** cannot modify a record that is currently locked by another DFdiscover application.

Certain aspects of edit checks are intrinsically interactive and do not lend themselves naturally to a batch environment. The `dfask()` edit check function, for example, is an interactive function where the user selects one of the two presented responses. Lookup table functions, via `dflookup()`, are also inherently interactive. Fortunately, each of these functions also requires the programmer to provide a default response as an argument. **DFbatch** uses this default response as the function return value in batch mode. This allows an edit check that would otherwise require user interaction to complete in a non-interactive environment.

6.2.4. Getting Started

Perhaps the easiest way to learn **DFbatch** is to look at an example.

6.2.4.1. Example batch control file

DFbatch needs a batch control file as input. This must be created by the user in advance of invoking **DFbatch**. The purpose of the batch control file is to specify criteria that select records from the study, optionally name edit checks to be executed (by default all edit checks referenced by variables of selected records are executed), and state actions to be applied as the edit checks are executed.

Example 6.1. Example batch control file

```
<?xml version='1.0'?>
<BATCHLIST version='1.0'>
    <BATCH name="simple">
        <TITLE>This is a very simple batch</TITLE>
        <DESC>This batch executes edit check aeCoding on all
        records that are currently at level 2.</DESC>
        <ACTION>
            <APPLY which="none"/>
            <LOG which="data msg qc" file="simple_out.xml"/>
        </ACTION>
        <CRITERIA>
            <LEVEL include="2"/>
            <EDIT>aeCoding</EDIT>
        </CRITERIA>
    </BATCH>
</BATCHLIST>
```

6.2.4.2. Features of the batch control file

The first thing that you will notice is a new language. The batch control file is specified in eXtensible Markup Language, XML. In XML parlance, the input file is a *document*. It turns out that the log output from **DFbatch** is also written in XML. There are many public domain tools (written in Java, Perl, C, etc) that are to parse and transform XML. Some web browsers are even able to display XML directly.

XML is a markup language and the markup is in *elements* and *attributes*. The extent of an element is marked with *tags*, namely a *start tag* and an *end tag*. The start tag and end tag for an element have the same name but different notation. The start tag is denoted with `<TAG>` and the matching end tag is denoted with `</TAG>`. The terminology is important: for the *element* named `TAG`, the *start tag* is `<TAG>` and the *end tag* is `</TAG>`.

The content of an element is the data between the start and end tags. The relationships in the content are achieved by *nesting* elements.

In the example,

- `BATCHLIST`
- `BATCH`
- `TITLE`
- `DESC`
- `ACTION`
- `APPLY`
- `LOG`
- `CRITERIA`
- `LEVEL`
- `EDIT`

are elements. Each document must have exactly one element, called the root, within which all other elements are nested. In the example, BATCHLIST is the root element. It is an error for any text to appear after the end tag of the root element.

Nested elements must be properly balanced or the document will be invalid, meaning that it cannot be parsed.

Example 6.2. Properly balanced, nested elements

```
<A><B></B></A>
```

Example 6.3. Improperly balanced, nested elements

```
<A><B></A></B>
```

In this example the relationship between A and B is ambiguous and so is not valid.

Elements that have no content are called empty elements. Empty elements are denoted with a single tag that represents both the start tag and the end tag. The notation for an empty tag is <TAG/>. In the example,

- APPLY
- LOG
- LEVEL

are empty elements. Empty elements are typically used to convey information via their attributes.

Data about elements can be kept in nested elements or, if the data is itself not structural, in attributes. In the example,

- version is an attribute of BATCHLIST
- name is an attribute of BATCH
- which and file are attributes of LOG
- include is an attribute of LEVEL

6.2.4.3. What the example does

The example control file contains a single BATCH named simple. The batch has a brief TITLE and a more verbose description in DESC. These two elements are present for documentation purposes only and do not influence the processing.

The records to be processed are selected by the CRITERIA element. In this example, only those records that have a current validation level equal to 2 and reference the aeCoding edit check are selected. For each selected record (those records that have a validation level of 2), the data fields are traversed in tab order and the edit check aeCoding is executed at every data field that references it by name through at least one of the variable's plate enter, field enter, field exit, or plate exit attributes. Other edit checks are not executed. Any actions that cause messages to be generated, queries to be added, or data field values to be changed are logged to the file simple_out.xml. The changes are not however applied to the database as is indicated by the which attribute of the APPLY element.

Of equal importance to the behavior that is stated, is the behavior that is not stated. In particular,

- **There is nothing about the input control file that specifies which study it applies to.** **DFbatch** control files are meant to be re-used across studies. Hence the input file itself does not state which study it belongs to. The association with a particular study is made when **DFbatch** is executed.
- **Many possible retrieval criteria are not stated.** As is true in the task set building dialog of **DFexplore**, criteria that are not stated match everything on that criteria. So for example, since no selection has been done by subject ID or visit number, all subject IDs and visit numbers are included.

6.2.4.4. Running the example

The example control file must be saved to a named file that is accessible to the **DFbatch** program. There are two possible locations:

- **Stored on the server.** Server-side study-specific control files must be kept in the `STUDY_DIR/batch` directory.
- **Stored locally.** Locally stored control files can be stored anywhere on the system that you have access to.

For file naming conventions, we recommend that the control file use the name of the batch as the basename with a `_in.xml` extension (meaning input XML file). For example, a control file named `simple` for study 254 which is stored on the server where study 254 has a `STUDY_DIR` of `/opt/studies/val254` would be saved to `/opt/studies/val254/batch/simple_in.xml`.

To process the control file, **DFbatch** needs to login to your DFdiscover server the same way **DFexplore** does when you login. If you need to use a proxy server to access the internet, **DFbatch** automatically uses the same proxy settings as **DFexplore**. If you need to change these settings, use the Proxy Setting window in **DFexplore** to do this. Next, you need to tell **DFbatch** the name of your DFdiscover server, your username and your password. You can do this using -S, -U and -C command line options, by setting DFSERVER, DFUSER and DFPASSWD environment variables or by using DFpass. **DFbatch** is invoked with the command:

```
% cd /opt/studies/val254/batch
% DFbatch -S server.somedomain.com -U datafax -C passwd 254 -i simple_in.xml
```

The login, study number and control file arguments can appear in any order. For more invocation options, see Invoking DFbatch.

The result of the command is the execution of the batch and the creation of the log file, `/opt/studies/val254/batch/simple_out.xml` on the server (as requested by the `file` attribute of the `LOG` element). The log file records the details of the batch execution but is not post-processed in any way.

6.2.4.5. Running the example and post-processing the output to an HTML file

A more common way of running **DFbatch** is to process the batch, applying any actions and creating the log file as before, and then immediately post-processing the log to create a viewable HTML page. This is achieved with `-p xsl` as in:

```
% cd /opt/studies/val254/batch
% DFbatch -S server.somedomain.com -U datafax -C passwd  -p xsl 254 -i simple_in.xml -
o somedir/simple.html
```

The option requests post-processing via a default XSL transformation (supplied with **DFbatch**) and the result is written to `simple.html`, typically in a directory that can be viewed from a web browser. The HTML output is explicitly re-directed to an output file at execution time (rather than making that file an attribute of the input control file) to allow for the various web-publishing infrastructures that are present at DFdiscover installations.

Alternatively, an existing log file can be transformed at any time into an HTML file using **DFstyle**, a companion program to **DFbatch**. The invocation of **DFstyle** requires a log file created by a previous invocation of **DFbatch** (not an input control file).

```
% cd /opt/studies/val254/batch
% DFstyle -p xsl simple_out.xml > somedir/simple.html
```

6.2.4.6. DFbatch exit status

The exit status of **DFbatch** reflects the success of the command. If the exit status is `0`, **DFbatch** executed successfully. Any other exit status indicates that an error occurred. The text of the error will appear in one of the last elements of the log file.

Example 6.4. Testing DFbatch exit status in C-shell

```
% /opt/dfdiscover/bin/DFbatch -S server.somedomain.com -U datafax -C passwd 254 -i
 simple_in.xml
% echo $status
0
```

6.2.5. Summary

In this section, we have introduced **DFbatch** and worked through our first example demonstrating creation of an execution log file and an HTML file.

The next section covers the control file layout, syntax, and semantics in greater detail.

6.3. Using DFbatch

This section covers the **DFbatch** control file language in detail and also provides addition detail for how **DFbatch** can be used.

6.3.1. General Control File Layout

The control file is an XML document that must address two needs:

- it must state selection criteria for records to retrieve and/or edit checks to execute, and
- it must state actions to take as edit checks are applied.

The document root element of the control file is always `BATCHLIST`. A `BATCHLIST` contains one or more `BATCH` elements. A `BATCHLIST` that contains zero `BATCH` elements is an empty input file. Although this is syntactically valid, it has no semantic purpose, and results in no processing. Most users will define one `BATCH` per control file as this is an easy organizational way to think about batches.

The basic processing element of the control file is a `BATCH`. BATCHes appear sequentially within the input and cannot be self-nested (that is, a `BATCH` may not contain another `BATCH`).

Example 6.5. The general format of an input file

```
<?xml version="1.0"?>                          ❶
<BATCHLIST version="1.0">                      ❷
<BATCH name="batch1">                          ❸
        <TITLE>title of the batch</TITLE>      ❹
        <DESC>description of the batch</DESC>
        <ACTION>                               ❺
                action directives
        </ACTION>
        <CRITERIA>                             ❻
                record selection criteria
                edit checks to be included
        </CRITERIA>
</BATCH>
<BATCH name="batch2">
<!-- another batch definition appears here --> ❼
</BATCH>
```

```
</BATCHLIST>
```

❶ This declaration **must** appear as the first line of the input file to indicate that the contents are an XML document.
❷ The default `version` is currently 1.0 and this identifies the version of the input file language. Since the input file language will undoubtedly evolve, it is a good practice to future-proof your input files and explicitly identify the version. This version number has a different purpose than the version number that appears in the preceding XML declaration, which is required, and identifies the version of the XML language itself.
❸ A `BATCH` has one required attribute, `name`. The `name` attribute uniquely identifies each `BATCH` within the `BATCHLIST`. A `BATCH` `name` is not checked for uniqueness outside of the current `BATCHLIST`. Hence it is possible for two different batch control files to name batches with the same `name`, but it is not possible for two batches with the same name to co-exist in one control file.
❹ An optional description for the batch and its purpose can be placed in `TITLE` and `DESC` elements. Although not required nor enforced, the intention is for the `TITLE` to define a brief synopsis and `DESC` to provide a verbose description. The content of the `TITLE` element, if any, is copied through to the comment line of any DRF created by the `ODRF`.
❺❻ The processing rules of the `BATCH` are in the `ACTION` and `CRITERIA` elements. The `CRITERIA` element defines the record selection criteria for records to be processed, while the `ACTION` element defines the actions that are to be taken.
❼ This is the required notation for a comment. Comments are for internal documentation of an XML file - they are read but otherwise not processed.

The input file elements serve one of four purposes:

- **Descriptive.** These elements, `TITLE` and `DESC`, are present for identification and documentation purposes only.
- **Processing Directive.** These elements, `CONTROL` and `MOVETO`, allow the user to modify the behavior and limits of **DFbatch** as it executes.
- **Action.** These elements, `ACTION`, `APPLY`, `LOG` and `ODRF`, are used to specify what actions are to be taken as edit checks are executed.
- **Record and Edit check Selection.** These elements, `CRITERIA`, `IDRF`, `ID`, `PLATE`, `VISIT`, `CREATE`, `MODIFY`, `LEVEL` and `STATUS`, are used to select from the database the records that are to be processed, and optionally, `EDIT`, to select the specific edit checks that are to be applied to the fields of those records.

6.3.1.1. Special Characters

Certain characters have special meaning to an XML parser and hence cannot appear directly in an XML document. This includes the input control file. To use one of these five special characters in an XML document, the corresponding entity must instead be used.

Table 6.1. Special characters

To display this character	Use this entity
&	&
<	<
>	>
"	"
'	'

Example 6.6. Use of entity for special character

```
<?xml version='1.0'?>
<BATCHLIST version="1.0">
    <BATCH name="special">
```

```
        <TITLE>Run checkElig &amp; checkDemo</TITLE>
        <DESC>Among other things these edit checks test
        that the subject&apos;s age is &gt;= 20 and &lt;= 50.
        </DESC>
        <!-- note that &, <, >, ', and " can appear inside
        comments because comments are not parsed -->
        ...
    </BATCH>
</BATCHLIST>
```

6.3.1.2. Record selection criteria

Record selection criteria are similar to those found in the **By Data Fields** retrieval option of **DFexplore**. Retrieval criteria for records are by: site ID, subject ID (not subject alias), visit, plate, level, status, creation date, modification date. These map respectively to the elements: `SITE`, `ID`, `VISIT`, `PLATE`, `LEVEL`, `STATUS`, `CREATE`, `MODIFY`. These criteria are specified as nested elements of the `CRITERIA` element. If any element is omitted (or empty), the records to be selected are not constrained by this element. For example, if `PLATE` is omitted (or empty), there is no restriction on plate and hence all plates are retrieved, subject to the other criteria. Retrieval by center and pattern are currently excluded. Where multiple elements are given as criteria, the selected records must satisfy the inclusion criteria of each element, that is, the selected records are the intersection set of the sets of selected records satisfying each element individually.

Each element is expected to appear at most once. If an element (accidentally) does appear more than once, the last element overrides any previous occurrences.

Each criterion allows a value, range, and/or lists of both. These are expressed as the value of the `include` attribute as in:

```
include="val,min-max,val2"
```

Example 6.7. Selection criteria for all final records of visits 1 through 5, 10, and 20 through 29 inclusive

```
<CRITERIA>
    <STATUS include="final"/>
    <VISIT include="1-5,10,20-29"/>
</CRITERIA>
```

The `CRITERIA` element accepts one optional attribute, `sort`. The value of the attribute determines what sort order, if any, is applied before processing to records that meet the selection criteria. The value is constructed from one or more sort keys (precedence for multiple leys is left to right) from the list: `id`, `visit`, `plate` where multiple keys are separated by `;` and each key is preceded by either + to indicate that the key is sorted in ascending order, or `-` to indicate that the key is sorted in descending order.

Example 6.8. Use of the `sort` attribute to sort selected records on ascending id, then descending visit, and then descending plate

```
<CRITERIA sort="+id;-visit;-plate">
....
</CRITERIA>
```

It is also possible to select records by an existing DFdiscover Retrieval File (DRF). This is specified with the `IDRF` empty element and the `file` attribute as in:

Example 6.9. Select records specified by `IDRF`

```
<IDRF file="test.drf" />
```

The element instructs **DFbatch** that the records to be processed in the batch can be found in a file named `test.drf` located in the study `/drf` directory.

Example 6.10. Select records specified by `IDRF` in a sub-folder using relative pathname

```
<IDRF file="sub_folder/test.drf" />
```

Example 6.11. Select records specified by `IDRF` in a sub-folder using absolute pathname

```
<IDRF file="/STUDY_DIR/drf/test.drf" />
```

In the above two examples, the element instructs **DFbatch** that the records to be processed in the batch can be found in a file named `test.drf` located in the study `/drf` directory.

The use of `IDRF` is mutually exclusive of the other selection criteria and it is an error for the two to appear together in one batch's `CRITERIA`. Additionally, records selected by the `IDRF` element are processed in the order that they appear in the file, ignoring any value assigned to the `file` attribute of the parent `CRITERIA`.

6.3.1.3. Edit check selection

By default, all of the edit checks that are referenced by data fields on the records selected by the criteria, are executed.

Procedure 6.1. For each selected record, DFbatch performs the following steps

1. The data fields of the record are traversed in the normal order (typically plate top to plate bottom), executing any *plate enter* edit checks that are defined at each field. A plate enter edit check may change the traversal order as the result of a `dfmoveto()` call.

2. Starting at the first data field, the data fields are traversed in order. At each field any *field enter* edit checks, and then any *field exit* edit checks are executed. A field exit edit check may change the traversal order as the result of a `dfmoveto()` call.

3. The data fields of the record are again traversed in the normal traversal order, executing any *plate exit* edit checks that are defined at each field. Note that a `dfmoveto()` call always returns 0 in a plate exit edit check.

It is possible to include only certain edit checks to be executed by naming them in `EDIT` elements within the `CRITERIA` element. Records and fields are still traversed in the same manner but only those edit checks that match one of the included names are executed. This can be useful, for example, when a new edit check is introduced and requires testing.

Example 6.12. Execute only the aeCoding edit check on plate 5 records

```
<CRITERIA>
    <PLATE include="5" />
    <EDIT>aeCoding</EDIT>
</CRITERIA>
```

The `EDIT` element is the only element that is allowed to repeat within `CRITERIA`. A single `EDIT` element may also list multiple comma or space separated edit checks by name in the element body.

Example 6.13. Equivalent specifications for multiple edit checks

```
<CRITERIA>
    <EDIT>aeCoding</EDIT>
```

```
    <EDIT>checkInit</EDIT>
    <EDIT>sigLookup</EDIT>
</CRITERIA>
```

is equivalent to

```
<CRITERIA>
    <EDIT>aeCoding,checkInit,sigLookup</EDIT>
</CRITERIA>
```

When `EDIT` elements appear in the criteria, **DFbatch** optimizes the retrieval by automatically excluding from selection those plates that contain no variables which reference any of the named edit checks. For example, if the edit check named `checkElig` is referenced only by variables on plate 2, only records from plate 2 are selected even if `PLATE` does not appear in the criteria. However, if the `PLATE` element is present and includes a plate other than 2, the resulting set of selected records will be empty as there can be no records that reference both the `checkElig` edit check and are from a plate other than 2.

6.3.1.4. Processing actions

Edit checks are capable of changing (or assigning) data field values, adding queries to fields, adding and deleting missing page queries for records other than the current record, and generating information, warning, and error messages. This leads to three important categories:

- data - changes that are made to data field values
- qc - addition/modification of queries to data fields by `dfaddqc()` and `dfeditqc` or missing page query operations by `dfaddmpqc()` and `dfdelmpqc()`
- msg - messages that are generated by `dfmessage()`, `dfwarning()`, and `dferror()`

In an interactive environment, the user has the ability to visually review and confirm or cancel each of these actions. In **DFbatch** this is not possible. Instead the batch control file must carefully state which actions will be allowed to proceed unattended and which ones will be canceled. This is specified in the `ACTION` element and its `APPLY`, `LOG`, and `ODRF` child elements.

Figure 6.2. The descendants of `ACTION` and their attributes

```
<ACTION>
  <APPLY when="changes|all" level="1|2|3|4|5|6|7"
  which="none msg data qc"/>
  <LOG when="changes|all" which="none msg data qc" file="logfile_out.xml"
  mode="create|write" share="yes|no" history="yes|no" />
  <ODRF when="changes|all" which="none msg data qc" file="outfile.drf"
  mode="create|write" share="yes|no"/>
</ACTION>
```

6.3.1.4.1. The APPLY element

This element controls what categories of actions are applied back to the database.

> **Use with care**
>
> This is the only element that controls whether or not **DFbatch** can request irreversible database changes to be made and hence it must be used with care. If you are uncertain about the behavior of a batch control file or the edit checks that it may execute, use `<APPLY which="none"/>`.

The attributes of APPLY have the following semantics:

- **when.** This attribute must have a value of `all` or `changes`. If the value is `all`, every selected record is sent back to the database as an update, even if the record contains no differences from its previous state. If the value is `changes`, only those records that contain changes are sent back to the database for update.
- **level.** This attribute must be a single integer in the range of legal validation levels, 1 through 7 inclusive. It indicates the validation level to assign to records when they are sent back to the database for update. This causes **DFbatch** to behave in a manner equivalent to **Validate** mode in **DFexplore**. If this attribute is not specified, the validation level of any record sent back for update is not changed. This is equivalent to **Edit** mode in **DFexplore**.
- **which.** This attribute has a value that is one or more space delimited categorical keywords from the list: `none`, `data`, `msg`, `qc`. `data` indicates that all records with changed data fields should be updated back to the database. `qc` indicates that all queries added via `dfaddqc()` or `dfaddmpqc()`, modified by `dfeditqc()` or deleted via `dfdelmpqc()`, should update the database. `msg` is intended for logging purposes only and is present here for symmetry only. `none` indicates that no changes to data or queries should be updated back to the database. This is the recommended attribute value for this attribute in the context of APPLY.

6.3.1.4.2. The LOG element

This element controls what categories of actions are logged to file.

The attributes of LOG have the following semantics:

- **when.** This attribute must have a value of `all` or `changes`. If the value is `all`, every selected record, and every selected edit check, is logged to file, even if the edit check or record created no changes or messages. If the value is `changes`, only those records and edit checks that created a change or message are logged to file.
- **which.** This attribute has a value that is one or more space delimited categorical keywords from the list: `none`, `data`, `msg`, `qc`. `data` indicates that all records and edit checks which *would* change data fields should be logged to file. `qc` indicates that all queries that would be added via `dfaddqc()` or `dfaddmpqc()`, modified via `dfeditqc()` or deleted via `dfdelmpqc()`, should be logged. `msg` requests that all messages generated via `dferror()`, `dfwarning()`, and `dfmessage()` be logged. `none` indicates that no actions should be logged. The recommended value for this attribute in the context of LOG is `data msg qc`, as in `which="data msg qc"`.
- **file.** This attribute specifies the pathname of the file that will store the log information. The location of the batch control file (server-side or local) determines where the log file will be stored. The attribute is not required if no logging has been specified with `which="none"`.

  If the log file location is local and the pathname is given as a relative pathname, it is assumed to be **relative to the directory that contains the input file.** If a pathname is given, and the log file will be stored on the server, the pathname portion is discarded and only the filename portion will be used. If the attribute is missing but logging has been specified, **DFbatch** will construct a filename for the log as follows:

  1. The directory name of the input file is the base.
  2. Append the value of the batch's `name` attribute.
  3. Append the fixed suffix, `_out.xml`.

  It is also possible to include a sub-folder as part of filename specification. The location can start from either a relative or absolute path. The filename can be given as *`sub_folder`*`/xx_out.xml`, which is a relative path, or `STUDY_DIR/batch/sub_folder/xx_out.xml`, which is an absolute path. In both cases, the output file will be created in `STUDY_DIR/batch/sub-folder/xx_out.xml`. It is not possible to include `../` as a sub-folder: including `../` in any pathname will lead to an error.
- **mode.** This attribute specifies whether the log file should be created, `create`, or (over)written, `write`.

- **share.** This attribute specifies whether the log file is readable and writable by other members of the same group, yes, or by the creator only, no. This attribute is applicable only to locally stored log files.

- **history.** This attribute specifies whether **DFbatch** should distinguish between log entries that are new to this execution of the batch and entries that were present in previous executions, yes, or not, no.

  If history is requested, it is required that the file be created with mode="write" and that the name of the log file and the batch criteria not change between executions. That is, **DFbatch** must be able to read an existing log file to create a previous execution history and then overwrite that log file with the history and new entries.

  The purpose of this history mechanism is not to build a complete historical view containing all log entries ever generated. Instead it creates the log file containing only the entries from the current execution, flagging each of the entries to indicate whether this is the first time that it has appeared or whether it first appeared in a previous execution. Only those entries which are generated by the current execution are included when history is enabled.

  The entries in the batch output are the same whether history is checked or not. If history is yes, the entries are divided by date to show in which run the entry first appeared. If history is no, all entries are shown together.

6.3.1.4.3. The ODRF element

This element controls which records are written to a DFdiscover Retrieval File.

The attributes of ODRF have the following semantics:

- **when.** This attribute may have a value of all or changes. If the value is all, every selected record is written to the DRF, even if the record had no changes or messages. If the value is changes, only those records that had a change or message are written to the DRF.

- **which.** This attribute has a value that is one or more space-delimited categorical keywords from the list:

  - data: all records and edit checks which *would* change data fields should create a DRF record

  - qc: all queries that would be added via dfaddqc or dfaddmpqc, modified via dfeditqc or deleted via dfdelmpqc, should create a DRF record

  - msg: all records for which messages are generated via dferror dfwarning; and dfmessage; shall be written to the DRF.

  - none: no DRF should be created (this is equivalent to not specifying the ODRF element).

  The presence of a result DRF allows for the subsequent review of records that were (if changes were applied) or would have been (if changes were logged) processed by the batch.

- **file.** This attribute specifies the file that will receive the output DRF records. The attribute is not required if ODRF has been specified with which="none".

  Output DRF files are written to the *study /drf directory*, and must have the .drf suffix, e.g. test.drf. If the attribute is missing but output DRF has been specified, **DFbatch** will construct a filename for the DRF.

  It is also possible to include a sub-folder as part of filename specification. The location can start from either relative or absolute path. The filename can be given as sub_folder/xx_out.xml, which is a relative path, or /STUDY_DIR/batch/sub_folder/xx_out.xml, which is an absolute path. In both ways, the output file should be found in /STUDY_DIR/batch/sub-folder/xx_out.xml. The filename cannot contain ../ or /.. to alter the file path. Doing this will lead to error.

- **mode.** This attribute specifies whether the DRF should be created, create, or (over)written, write.

- **share.** This attribute specifies whether the DRF is readable and writable by other members of the same group, yes, or by the creator only, no. This attribute is applicable only to locally stored DRF files.

6.3.1.5. Input File Extensibility

For the current implementation of **DFbatch**, the input file must contain only the elements and attributes that have been described and are valid for the document type definition. The presence of unknown elements or attributes will cause reading of the batch to fail, resulting in the batch not being processed. This will likely change in a future release.

6.3.1.6. Additional Reference Material

For additional descriptions of each element and the attributes (and their purpose) that are valid for each element, consult BATCHLIST Element Reference.

6.3.2. Invoking DFbatch

The simplest way to invoke **DFbatch** is from the command-line with the command

```
% DFbatch -S server -U username -C password -i control_file study#
```

where the -S, -U and -C options, -i *control_file* and *study#* arguments are all required, The command line options `-S`, `-U` and `-C` may be used to supply user credentials for authentication, although a much better approach is to use **DFpass** as described in Section 3.2, “User Credentials” and DFpass. The control_file can be located locally if the infile contains a path, or it can exist on your server, in the 'STUDY_DIR/batch' directory.

This **DFbatch** command processes, in document order and in the context of the selected study, all of the `BATCH` elements that appear in *control_file*.

Example 6.14. Executing DFbatch on study 254 with the control file /opt/studies/val254/batch/test_in.xml

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd 254 -i test_in.xml
```

DFbatch accepts several other command-line options:

-b *batchnames*	permits batches to be selected by name from the control file, or re-ordered within the control file.
-O *outhtml_dir*	will make a default output HTML file in your local outhtml_dir for each batch. The default output file name will be 'outhtml_dir' + 'batch_name' + '_out.html'.
-o *outhtml_file*	output html file name is local and must include the full path. If '-o outhtml_file' is specified and there is more than one batch within a control file, only the last log will be saved to the given name. Consider using `-O` *out_dir_name* instead.
-O *out_dir_name*	use the specified directory for the log file of each batch
-x *xlsx_file*	XLSX file name is local and must include the full path. If '-x xlsx_file' is specified and there is more than one batch within a control file, only the last Excel output will be saved to the given name. Consider using `-X` *out_dir_name* instead.
-X *out_dir_name*	use the specified directory for the Excel output of each batch
-e *error_log*	will write any errors to the full pathname of error_log. By default, errors are written to stderr.

6.3.2.1. Scheduled, unattended invocation

DFbatch is ideally a batch process, run during off-hours. In the UNIX environment this is easily accomplished with the **cron** program. To use **cron**, simple include the needed **DFbatch** command-line equivalents in the `crontab` file. For additional information on using **cron**, refer to the UNIX man pages.

Example 6.15. Using cron to run DFbatch at scheduled times

```
0 23 * * * /opt/dfdiscover/bin/DFbatch -S idemo44.datafax.com -U datafax -C passwd 254 -i
 test_in.xml
```

Remember that the environment and path variables defined by your login are not available to **cron**, and hence /opt/dfdiscover must be set explicitly.

> ### DFbatch exit status
>
> When executing **DFbatch** several times with a sequence of control files (as might be done in a shell script), it is recommended to check the exit status of each execution before continuing with the next. Refer to DFbatch exit status.

6.3.2.2. Processing subsets of batches

Recall that the root document element, `BATCHLIST`, can contain one or more nested `BATCH` elements. The option `-b` *`batchname(s)`* can be used to select for processing specific batches by their name. For example, the command:

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd -b simple 254 -i test_in.xml
```

processes only the batch named `simple` from the control file, independent of how many other batches are defined. If the control file defines only the batch named `simple` then execution of **DFbatch** with and without `-b simple` are equivalent. However, if the control file defines three batches named `simple`, `hard`, and, `difficult`, it would be possible to process only a subset of the defined batches with a command like

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd -b "simple difficult" 254 -i
 another_in.xml
```

which would process the two batches `simple` and `difficult` while skipping the batch named `hard`.

6.3.2.3. Re-ordering batches for processing

When multiple batches appear in the control file, and multiple batches are processed, default ordering specifies that the batches be processed in the order that they appear in the file. Using `-b` it is possible to alter the processing order at invocation time without altering the control file.

Consider the following skeleton of a control file.

```
<?xml version="1.0"?>
<BATCHLIST>
        <BATCH name="b1">
                ...
        </BATCH>
        <BATCH name="b2">
                ...
        </BATCH>
        <BATCH name="b3">
                ...
        </BATCH>
</BATCHLIST>
```

Invoked in the default fashion,

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd 254 -i simple_in.xml
```

DFbatch will process batches `b1`, then `b2`, and finally `b3`. Order of processing can be altered on an ad-hoc basis through use of `-b`, as in the following example that processes batch `b3` first, and then `b1`, skipping `b2`:

Example 6.16. Process batches named b3 and b1

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd -b "b3 b1" 254 -i simple_in.xml
```

> **Note**
>
> If non-default ordering is commonly achieved with this method, it is recommended that the control file be edited to permanently re-order the batches.

6.3.2.4. Post-processing batch log files

The log information recorded by a batch execution is also in XML format. This makes it amenable to further processing, filtering, or transformation (also called *styling*). Of course, post-processing is only meaningful if the control file uses a `LOG` element and the value of the `which` attribute is not `none`; otherwise, there is no log information available to post-process.

For this release, the only post-processing that is supported by **DFbatch** is transformation of the log output via XSL. This is accomplished with one or more XSL style sheets that are able to transform the log information into HTML without affecting the log file itself. HTML is the most common output format but is certainly not the only one. An XSL transformation could just as easily create another XML file, plain text output, or even PDF. The simplest method for specifying post-processing is at **DFbatch** execution time with the command:

```
% DFbatch -p xsl study control_file > htmlfile
```

This command processes, in the same manner as already described, the batch in *`control_file`* in the context of study *`study`*. When the processing completes the log information is immediately post-processed with the default XSL transformation to create an HTML view of the log information that is stored to *`htmlfile`*. Note that the log file is not changed which allows post-processing to re-occur at a future time with the same XSL transformation, or a different XSL transformation to achieve different views of the same log. This post-processing of XML via XSL (or other) transformation is the key ingredient that allows **DFbatch** to separate content creation from presentation.

DFbatch comes with a default file for XSL transformation that is stored in /opt/dfdiscover`/lib/xsl/batchlog.xsl` and is referenced by the file /opt/dfdiscover`/lib/stylesheets.xml`. It is possible to create other XSL transformations (and future versions of **DFbatch** will be available with more) and incorporate them into /opt/dfdiscover`/lib/stylesheets.xml`. In such a case, it is possible to post-process the log information with an alternate, non-default, XSL transformation using the command:

```
% DFbatch -p XSL=name study control_file > htmlfile
```

which applies the XSL transformation named *`name`* to the log file, instead of the default transformation. Note that the case of the option is important: `-p xsl` requests the default transformation, `-p XSL=`*`name`* requests a specific transformation.

So far, we have only seen how to post-process a log file at the time of **DFbatch** execution. This unfortunately does not de-couple log creation from presentation as **DFbatch** must be run again to re-do the post-processing. De-coupling log creation from presentation requires an additional program, **DFstyle**.

6.3.2.5. Re-styling log files independent of their creation

The **DFstyle** program can be invoked at any time to apply a transformation to an XML file (not just a batch log file). **DFstyle** is invoked with either:

```
% DFstyle -p xsl XML file > htmlfile
```

which applies the default transformation, or

```
% DFstyle -p XSL=name XML file > htmlfile
```

which applies the transformation named by *name*. Notice that *XML file* can be any XML file, although in the context of **DFbatch**, it is an existing log file (not control file) from a previous execution. Also notice that the study number is not supplied to **DFstyle** - it does need the context of the study number to transform the log file.

Using **DFstyle** in conjunction with **DFbatch**, it is now possible to independently execute a batch to create a log, and then transform that log information into another format for viewing, thus achieving the de-coupling of content creation from presentation.

Example 6.17. Complimentary uses of DFbatch and DFstyle

Remember that **DFstyle** can transform a log file independent of when the log file was created. As a result the following two scenarios produce the identical HTML file.

The first scenario performs the post-processing at **DFbatch** execution time,

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd -p xsl 254 -i /opt/studies/val254/
batch/example_in.xml \
-o /opt/studies/val254/batch/htmlfile
```

while the second uses **DFstyle** to perform the post-processing at some, potentially much, later point in time:

```
% DFbatch -S idemo44.datafax.com -U username -C passwd 254 -i /opt/studies/val254/batch/
example_in.xml
% DFstyle -p xsl example_out.xml > htmlfile
```

If multiple XSL transformations are defined, it also possible to create multiple presentations of the same log file.

Example 6.18. Creating multiple presentations

```
% DFbatch -S idemo44.datafax.com -U datafax -C passwd -p xsl 254 -i /opt/studies/val254/
batch/example_in.xml \
-o /opt/studies/val254/batch/htmlfile1           ❶
% DFstyle -p XSL=secondtransform example_out.xml > htmlfile2 ❷
% DFstyle -p XSL=thirdtransform example_out.xml > htmlfile3  ❸
```

❶ The first presentation is an HTML file created with the default transformation.
❷ The second presentation is a second HTML file created with the named transformation `secondtransform`.
❸ The third presentation is a third HTML file created with the named transformation `thirdtransform`.

The challenge in using **DFstyle** to transform a log file is to know the name of the log file that was created by a batch control file. Consistent naming between batches and input/log files simplifies this challenge.

6.3.3. Strategies for using DFbatch

Keep the following issues in mind as you learn about and begin to use batch edit checks.

- **Decide on file naming conventions and stick to them.** There are potentially many input control files and output log and drf files that can be created and naming conventions will help you to keep them straight. Minimally, try using suffixes to distinguish between file types, something like this:
  - `_in.xml` - input control file
  - `_out.xml` - output log file

- `.drf` - output DRF

If possible, define only one `BATCH` per input control file. Use the name of the batch as the base name of the input file.

- **Use the `APPLY` element sparingly.** Instead, use `LOG` and `ODRF` as often as possible. Remember that the `APPLY` element will cause actual, irreversible changes to be made to the database. There is no rollback feature in **DFbatch**.

  Further remember that the owner of created queries and the last modifier of changed data becomes the person that executed **DFbatch**. This implies that different batches should be run by different people, likely at different validation levels, just as if the edit checks were being tripped by individuals during interactive validation. Certain batches will lend themselves to being run by first level data entry, at validation level 1, while others will lend themselves, such as adverse event and medication coding, to being run by subsequent reviewers at higher validation levels. Alternatively, you may decide to make one person responsible for running all batch edit checks. **DFbatch** does not require or restrict either implementation method.

- **Perform extensive testing of edit check logic in DFexplore.** Test all edit checks extensively in **DFexplore** before using them in **DFbatch**. In the 10-20 seconds required to validate a record interactively, **DFbatch** will process hundreds of records. It is much easier to deal with a single edit check error than potentially hundreds of the same error.

- **Re-usability of batches versus specificity.** Do certain types of batch control files lend themselves to being generic while others are study specific? Where multiple batches need to be defined, is it better to define them in one `BATCHLIST` with multiple `BATCH`es, or in multiple `BATCHLIST`s with one (or a few) `BATCH`es per.

  One reason to place multiple `BATCH`es in one `BATCHLIST` is that the order of execution of the each `BATCH` is executed in the order that is in encountered in the file, reading the file from top to bottom.

- **Executing DFbatch from cron.** What timing issues need to be considered before running **DFbatch** from the UNIX cron?

- **Try to limit how much a batch does.** Avoid input control files that execute all edit checks on all records. This can lead to very large log files that are difficult to post-process and subsequently apply history to. Experience to date has shown that log files larger than 5MB in size cannot really be post-processed efficiently.

- **Primary records only.** Remember that only primary records are processed in batch.

- **Consider dedicating a validation level to DFbatch.** If **DFbatch** is being used to make changes to database records and add/delete queries, consider using one of the validation levels only for the purpose of marking records that have been through batch processing. For example, assume that all data records go through two levels of review by data clerks (first review moves record from level 0 to 1, and second review moves record from level 1 to 2) resulting in database records (hopefully final) at level 2. If the next step in the data review process required application of all edit checks to all level 2 records, level 3 could be used as an indication of records that had been through batch processing. The input control file would look something like:

```
<?xml version="1.0"?>
<BATCHLIST version="1.0">
    <BATCH name="level2">
        <TITLE>Process all level 2, primary records</TITLE>
        <DESC>This batch processes all level 2, primary
        data records, moving them to level 3 after they
        are processed.</DESC>
        <ACTION>
            <APPLY when="all" which="data msg qc" level="3"/>  ❶
            <LOG when="changes" which="data msg qc"            ❷
            history="no"/>
        </ACTION>
```

```
        <CRITERIA sort="+id;+visit;+plate">
            <STATUS include="primary"/>
            <LEVEL include="2"/>                                    ❸
        </CRITERIA>
    </BATCH>
</BATCHLIST>
```

❶ Apply all actions (data, msg, and qc) and assign all records (not just changed records) a validation level of 3. Specifying `when="changes"` would only change the validation level of those records that were updated by the batch processing, leaving the unchanged records at their current validation level. In some scenarios, this may be desired, but not in this one.

❷ Log only the changes (this is not required, but does reduce the amount of log information recorded when edit checks do nothing and records are not changed).

Also, turn off history. Because of the way that this control file is designed, this attribute setting really makes no difference. Since level 2 records are always promoted to level 3, it will never occur that the same log entries repeat, because the selected set of records will always be different.

❸ Select only the records that are at level 2.

6.4. Limitations

This section describes the behavior of interactive edit check functions in the non-interactive environment of **DFbatch**, and lists items that cannot and should not be done with **DFbatch**.

6.4.1. Default actions for interactive functions

Certain features of the edit checks language are intrinsically interactive, for example, the `dfask()` function. When these features are encountered in **DFbatch**, they must be handled intelligently and consistently. The following describes the behavior of edit check functions when executed in **DFbatch**. Functions that are not listed behave identically in both environments.

- `dfask( query, dflt, accept, cancel )` always returns *`dflt`*.
- `dflookup( table, var, dflt, method )` always returns *`dflt`* when *`method`* has any value other than *`-1`*. If *`method=-1`*, `dflookup` behaves the same in both environments, returning the result element from *`table`* if an exact match can be made, *`dflt`* otherwise.

> **Warning**
>
> Improper coding of `dflookup` without consideration to this behavior in **DFbatch** can lead to unexpected results. In particular, previously coded fields can be replaced with the default.

Example 6.19. Improper usage

The following use of `dflookup` would *always* replace the value in the current variable with the default parameter, `""` in this case.

```
string s;

s = dflookup( "TABLE", @(T-1), "", -1 );
if ( s != "" )
    @T = s;
else
    @T = dflookup( "TABLE", @(T-1), "", 0 );
```

The intention of the edit check appears to be a good one: store an exact match if it can be found, otherwise display the table and store the selected result. In **DFexplore**, this works fine. However, in **DFbatch**, the second invocation of `dflookup()` will never display the table and will always return `""`, which after the assignment, effectively erases any previous value in `@T`.

An example of a general implementation strategy for `dflookup` that considers the behavior in **DFbatch** is given below.

Example 6.20. Implementation strategy for `dflookup`

```
# Look-up the value in @(T-1) and store the result in @T

if ( dfbatch() ) {
    # Use the result only if an exact match is available and then
    # only if the field is not already coded
    result = dflookup( "TABLE", @(T-1), "", -1 );
    if ( result == "" )
        return;
    if ( dfblank( @T ) )
        @T = result;
    else if ( result != @T )
        dferror( "Previously coded value of ", @T, " and new result ",
        result, " do not match." );
} else {
    # insert existing dflookup code here
}
```

- `dfillegal()` always returns `0`. Setting the field color to the illegal value color is only meaningful in **DFexplore**.
- `dfbatch()` always returns `1` in **DFbatch** and `0` in **DFexplore**.
- The behavior of `dfaddqc()`, `dfeditqc()`, `dfaddmpqc()`, and `dfdelmpqc()` is controlled by the `which` attribute of the `APPLY` element. If `APPLY` contains the attribute `which="qc"`, the behavior of these functions is equivalent to the user interactively always choosing OK, that is, the queries are always added/deleted. If the value for `which` does not contain `qc`, the behavior of these functions is equivalent to the interactive user who always chooses Cancel, that is, the query operations are always canceled.
- The behavior of `dfmessage()`, `dfwarning()`, and `dferror()` is controlled by the `which` attribute of the `APPLY` or `LOG` elements.
- All other errors that would cause a dialog to appear in interactive edit checks cause a log message to be written to the batch log file, if there is one, or standard error, otherwise. For example, if the referenced lookup table is not a plain ASCII file, an error message will appear on the command line when the batch is initialized.

6.4.2. Not possible with DFbatch

The following actions are not possible with **DFbatch**.

- It is not possible to change the status of a record. This means that a final record must remain final - it is not possible to assign an illegal or missing required value to a data field on a final record.

  There are exceptions to this rule. **DFbatch** will change the status of a final record to incomplete if one or more queries are added to data fields of the record. **DFbatch** will change the status of a final record to incomplete if an illegal value is assigned to a field on a final record.
- It is not possible to change the status of any primary record to secondary in batch.

- It is not possible to change the value of any key field of a record. This means that the plate, visit, and ID numbers may not be changed, regardless of whether or not those fields are barcoded. This limits the usefulness, in batch, of edit checks that calculate and assign the visit number of a CRF.
- It is not possible to apply batch edit checks to new (validation level 0) records, or records with status `missed`.
- It is not possible to to assign a validation level that is greater than the maximum permitted to the user by their DFdiscover permissions.
- It is not possible to query or interact with the user when something unexpected happens. Most unexpected events in **DFbatch** result in the writing of a message to the log file followed by immediate termination of the batch execution.

6.4.3. Not recommended with DFbatch

The FDA's *Guidance for Industry: Computerized Systems Used in Clinical Trials* explicitly states

> Features that automatically enter data into a field when that field is bypassed should not be used.

Although not stated, the spirit of the guidance relates to reported values. Calculated or derived values that are not part of the source record should be exempt from this guidance.

To be safe, however, we do not encourage creating or processing edit checks that blindly assign values to data fields. A preferred alternative is to compute what the expected value of a field is and then compare it against the recorded value, signaling an error when the two do not match.

Example 6.21. Comparing calculated and reported values

Rather than simply replacing reported values, edit checks should be written to compare calculated and reported values, issuing an error message when the two do not match.

```
# s contains the calculated value for what should be in @T
s = "some calculated value";
if ( s != @T )
    dferror( "The expected value, ", s,
    ", and the reported value, ", @T,
    ", do not match." );
```

Should it be necessary to add or change data values using edit checks, DFdiscover will by default, automatically create a reason indicating that the change was made by an edit check rather than manually. These reasons have this standard format:

```
Set by edit check ECname
```

6.5. Example Control Files

Going with the old saying that “a picture is worth a thousand words”, this section is a collection of example control files.

Example 6.22. Execute all edit checks on all records, logging their actions without actually applying them

```
<BATCHLIST>
<BATCH name="batch1">
   <TITLE>All edit checks on all records</TITLE>
   <ACTION>
        <!-- this APPLY statement isn't actually needed as the
        default is to apply none, but being explicit about it
```

```
        never hurts -->
        <APPLY which="none" />
        <LOG which="data msg qc" file="batch1_out.xml" mode="write"/>
   </ACTION>
        <CRITERIA>
        </CRITERIA>
</BATCH>
</BATCHLIST>
```

Example 6.23. Execute all edit checks on all incomplete, level 1 records for plates 1 through 5, applying no changes, and logging only the messages generated

```
<BATCHLIST>
<BATCH name="batch2">
   <ACTION>
        <APPLY which="none" />
        <LOG which="msg" file="batch2_out.xml" mode="write"/>
   </ACTION>
        <CRITERIA>
            <STATUS include="incomplete" />
            <LEVEL include="1" />
            <PLATE include="1-5" />
        </CRITERIA>
</BATCH>
</BATCHLIST>
```

Example 6.24. Perform AE coding on all level 4 records, assigning the records to level 5 when coding is complete

```
<BATCHLIST>
<BATCH name="batch3">
   <ACTION>
        <APPLY which="data" level="5" />
        <LOG which="data" file="batch3_out.xml" mode="write"/>
   </ACTION>
        <CRITERIA>
            <LEVEL include="4" />
            <PLATE include="12" />
            <EDIT>aeCoding</EDIT>
        </CRITERIA>
</BATCH>
</BATCHLIST>
```

Notice the statement:

```
<APPLY which="data" level="5" />
```

requests **DFbatch** to make changes to the processed records and change their validation level to 5. Before including this statement in the batch control file, you should thoroughly test that the `aeCoding()` is performing as expected.

Example 6.25. Execute the echoWho edit check on all level 1 and 2 records, processing records in the specified order

```
<BATCHLIST>
```

```
<BATCH name="batch4">
   <ACTION>
        <APPLY which="none" />
        <LOG which="data msg qc" file="batch4_out.xml" mode="write"/>
   </ACTION>
        <CRITERIA sort="-id;+visit;+plate;-img">
            <LEVEL include="1-2" />
            <EDIT>echoWho</EDIT>
        </CRITERIA>
</BATCH>
</BATCHLIST>
```

Example 6.26. Execute the `missingAEreport()` edit check on all plate 15 records, adding and logging only queries

```
<BATCHLIST>
<BATCH name="batch5">
   <ACTION>
        <APPLY which="qc" />
        <LOG which="qc" file="batch5_out.xml" mode="write"/>
   </ACTION>
        <CRITERIA>
            <PLATE include="15" />
            <EDIT>missingAEreport</EDIT>
        </CRITERIA>
</BATCH>
</BATCHLIST>
```

This would be a beneficial edit check in a scenario where plate 15 contains a question like: “Did the subject experience an adverse event? If yes, please submit adverse event report.”. The assumption is that the `missingAEreport()` edit check tests the condition and adds a missing page query if the condition is true. Interactively, we don't know if the missing adverse event report is possibly the next page in the fax, so this makes more sense to do in batch.

6.6. Common Pitfalls and System Messages

6.6.1. Common Pitfalls

Experience has demonstrated that the following areas of **DFbatch** are known to be problematic and may result in confusion at the end-user level:

- The control file lists both plate and edit checks selection criteria. The plate list that results from the intersection of these two criteria is the empty set. The result is that **DFbatch** executes without error but no records are processed.
- Edit checks that assign the sequence number based upon fields after the sequence number and then dfmoveto() back to the sequence number. This can lead to a loop condition because the attempt to assign the sequence number will always fail.

6.6.2. System Messages

At runtime, the interpreter may detect errors that generate messages. Error messages from **DFbatch** appear either on the command-line (or the shell from which **DFbatch** was started via cron) or in the `BATCHLOG` file as a `M` element with a `type` of `s` (short for *system*).

Even though these system messages appear as `M` elements, it is not possible to filter them by excluding `msg` from the `which` attribute of either the `APPLY` or `LOG` elements. They will *always* appear in the output log file. While it is possible to subsequently filter out these messages with an alternate style sheet, this practice is not recommended.

Messages that appear on the command-line have the following format:

```
ERROR[batchname,type]: message
      ❶        ❷   ❸
```

❶ The name of the batch in which the error was detected. A batch name of * indicates that no batch was active at the time, because the error was detected during the initial parse step.
❷ The severity of the error detected from the list:

- **aa.** abort all - processing of the current batch and any subsequent batch is halted
- **ab.** abort batch - processing of the current batch is halted but processing resumes with the next batch, if any
- **w.** warning - processing of the current batch continues and is followed by processing of any subsequent batches

❸ The text of the reported message.

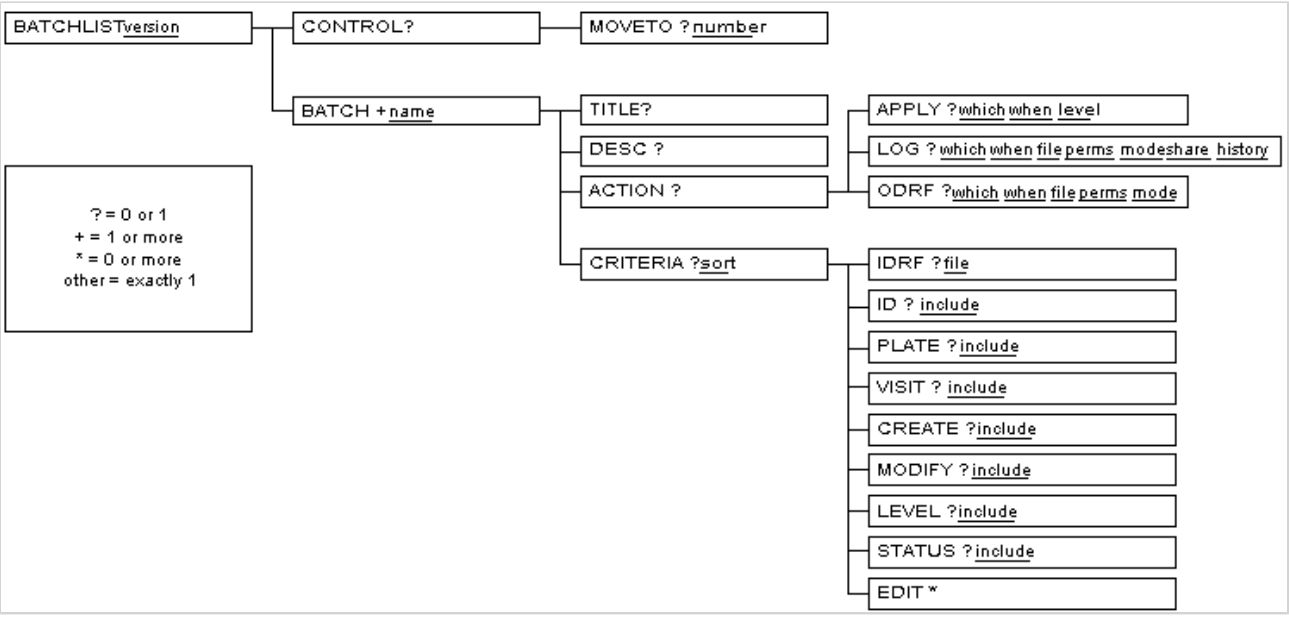
6.7. BATCHLIST Element Reference

This section describes every element in the BATCHLIST document type definition. The description is offered in two complimentary views. The first view is a tree diagram illustrating the relationships between the elements. The second view is a reference where the meaning and use of every element is described.

6.7.1. BATCHLIST Document Type Definition

A Document Type Definition (DTD) defines the set of elements and their attributes that are valid within a document, how many occurrences of each are allowed, and in what order they are allowed. The batch edit checks input control file has its own DTD that is listed here.

The root element of the input control file is `BATCHLIST`.



The tree structure of the DFbatch input control file, starting at the root, BATCHLIST.

6.7.2. Organization of Reference Pages

The description of each element in this reference is divided into sections.

6.7.2.1. Synopsis

Provides a quick synopsis of the element. The content of the synopsis varies according to the nature of the element, but may include any or all of the following sections:

- **Content model.** This is a concise description of the elements that it can contain. This description is in DTD "content model" syntax which describes the name, number, and order of elements that may be used inside an element. The syntax contains: element names, keywords, repetitions, sequences, alternatives, and groups.
  - **Element names.** An element name in a content model indicates that an element of that type may (or must) occur at that position.
  - **Keywords.** A content model that consists of the single keyword `EMPTY` identifies an element as the empty element. Empty elements are not allowed to have any content. The `#PCDATA` keyword indicates that text may occur at that position. The text may consist of any characters that are legal in the document character set.
  - **Repetitions.** Repetition of an element is accomplished by following the element name with one of the following characters: * for zero or more times, + for one or more times, or ? for exactly zero or one time. If no character follows the element name, then it must appear exactly once at that position.
  - **Sequences.** If element names in a content model are separated by commas, then they must appear in sequence.
  - **Alternatives.** If element names in a content model are separated by vertical bars, then they are alternatives, requiring the selection of one or another element.
  - **Groups.** Parenthesis may be used around part of a content model to form a group. A group formed this way can have repetition characters and may occur as part of a sequence.

  Note that at this time, there is no element that allows a mixed content model, that is, an element that accepts both text and sub-elements.
- **Attributes.** Provides a synopsis of the attributes on the element.

6.7.2.2. Description

Describes the semantics of the element in detail. Typically contains the following sub-sections:

- **Processing Expectations.** Summarizes specific processing expectations of the element. Many processing expectations are influenced by attribute values. Be sure to consult the description of element attributes as well.
- **Parents.** Lists the elements that are valid parent elements.
- **Children.** Lists the elements that are valid child elements.

6.7.2.3. Examples

Provides examples of proper usage for the element.

6.7.3. Reference Pages

Name

ACTION — processing directives for the current batch

Synopsis

Content model

```
ACTION ::=
(APPLY?, LOG?, ODRF?)
```

Attributes

None.
Description

Parents

These elements contain ACTION: BATCH
Children

The following elements occur in ACTION: APPLY , LOG , ODRF .
Examples

Example 6.27. Processing action that applies all records with new queries to the database and logs all activity

```
<ACTION>
        <APPLY which="qc" when="changes" />
        <LOG which="data msg qc" when="all" />
</ACTION>
```

Name

APPLY — which actions are applied to database, when, and at what validation level

Synopsis

Content model

```
APPLY ::=
EMPTY
```

Attributes

Name	Type	Default	Description

which	*Enumeration:*
	
	none
	data
	msg
	qc
		none	The value for this attribute is one or more (space-delimited) words from the enumerated list. Inclusion of a word in the attribute value indicates that the batch is interested in the action of this operation.
			
			Edit checks operate in three distinct areas:
			
			• data - changes that are made to data field values
			
			• qc - addition/modification of queries to data fields by `dfaddqc()` and `dfeditqc` or missing page query operations by `dfaddmpqc()` and `dfdelmpqc()`
			
			• msg - messages that are generated by `dfmessage()`, `dfwarning()`, and `dferror()`
			
			`none` is beneficial only when used on its own. Specifying another word in addition to `none` is the same as not specifying `none` at all. For example,
			
			`which="none msg"`
			
			is equal to
			
			`which="msg"`

when	*Enumeration:* all changes	*None*	If the value is `all`, every record, or edit check (in the case of `LOG`), every action is taken. If the value is `changes`, only those records which are changed, or edit checks (in the case of `LOG`) that cause a change, are actioned.
level	*Enumeration:* 1, 2, 3, 4, 5, 6, 7	*None*	Level specifies the validation level that should be assigned to processed records when they are written back to the database [a]. The level may never be greater than the maximum validation level permitted to the user. If the level is not specified, the validation level of the record is not changed. This is equivalent to working in **Edit** mode in **DFexplore**.

[a] A processed record (a data record) will be written back to the database when:

- the data record has been changed by one or more edit checks and `which="data"` has been specified, or
- the data record has not been changed, `which="data"` and `when="all"` have been specified, and the record's current validation level does not match the level specified in `level="#"`, or

- a query has been added or changed, `which="qc"` has been specified (so the query is written), and the record's current validation level does not match the level specified in `level="#"`.

Description

Parents

These elements contain APPLY: ACTION.
Children

The following elements occur in APPLY: None.
Examples

Example 6.28. Apply no changes to the database - this is the recommended usage for this element

```
<APPLY which="none"/>
```

Example 6.29. Apply all records to the database that have had data fields modified, qc notes added or deleted, or messages generated and assign those records a validation level of 2

```
<APPLY
        when="all"
        which="data msg qc"
        level="2"
/>
```

Name

BATCH — a named set of processing actions and record retrieval set

Synopsis

Content model

```
BATCH ::=
(TITLE?, DESC?, ACTION?, CRITERIA?)
```

Attributes

Name	Type	Default	Description
name	CDATA		The name of the batch. The name must be unique within the enclosing BATCHLIST.

Description

Parents

These elements contain BATCH: BATCHLIST
Children

The following elements occur in BATCH: TITLE , DESC , ACTION , CRITERIA .
Examples

Example 6.30. A simple BATCH that logs all messages generated by the msgIllegalBP edit check when applied to level 1, plate 2 records

```
<BATCH name="checkBP">
    <TITLE>Check systolic and diastolic blood pressure readings</TITLE>
    <ACTION><LOG which="msg" /></APPLY>
    <CRITERIA>
        <EDIT>msgIllegalBP</EDIT>
        <LEVEL include="1" />
        <PLATE include="2" />
    </CRITERIA>
</BATCH>
```

Name

BATCHLIST — root element of input control file

Synopsis

Content model

```
BATCHLIST ::=
(CONTROL?, BATCH+)
```

Attributes

Name	Type	Default	Description
version	NUMBER	1.0	The version of the BATCHLIST language. If subsequent versions of the language are developed, the version number will change. The number to the left of the . is the major version number and the number to the right is the minor version number. Note that this version number is in no way related to the version number of the XML language that appears at the head of each input file in the processing instruction <?xml version="1.0"?>

Description

A BATCHLIST is simply a container element for one or more BATCH elements. The BATCHLIST is the root element of the input control file.

Processing Expectations

When multiple BATCH elements appear in a BATCHLIST, they are, by default, processed in the order that they are defined in the BATCHLIST. The processing order can however be altered at runtime through the -b option.

The BATCHLIST root element must be present even if only one BATCH is defined. It must appear exactly once in the file.

It is an error for any characters to appear after the </BATCHLIST> end tag.

Parents

These elements contain BATCHLIST: None.

Children

The following elements occur in BATCHLIST: CONTROL, BATCH.

Examples

Example 6.31. A BATCHLIST containing two BATCHes, named first and example

```
<?xml version="1.0"?>
<BATCHLIST version="1.0">
    <BATCH name="first">
        <CRITERIA>
```

```
            <PLATE include="1-10" />
            <EDIT>codeAE</EDIT>
        </CRITERIA>
    </BATCH>
    <BATCH name="example">
        <ACTION>
            <APPLY which="data msg qc" level="2" when="changes" />
        </ACTION>
        <CRITERIA>
            <LEVEL include="1" />
        </CRITERIA>
    </BATCH>
</BATCHLIST>
```

Name

CONTROL — grouping element for batch edit checks processing options

Synopsis

Content model

```
CONTROL ::=
(MOVETO?, REASON?)
```

Attributes

None.

Description

Certain elements of the control input file language may themselves be present to provide end-user control over the actions and behavior of the batch edit checks program itself. These elements are defined within a `CONTROL` or `REASON` element.

The `CONTROL` and `REASON` elements apply to all `BATCH` elements within the input control file and hence is defined once before any `BATCH` definition.

Parents

These elements contain CONTROL: BATCHLIST.

Children

The following elements occur in CONTROL: MOVETO, REASON.

Examples

Example 6.32. Specify that the looping limit is 30 consecutive `dfmoveto()` invocations and a non-default reason for data changes

```
<CONTROL>
    <MOVETO number="30" />
    <REASON>converting all responses to 2 decimals of precision</REASON>
</CONTROL>
```

Name

CREATE — select records for inclusion by the record creation date

Synopsis

Content model

```
CREATE ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) date values, one or more ranges of date values, or any combination of both.

Description

Records are selected by creation date with this element. If the creation date of a record is in the range of included creation dates (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion independent of the creation date. This is equivalent to not specifying a `CREATE` element.

The date notation for expressing constant date values is the standard DFdiscover notation, `yy/mm/dd`, which means two-digit year of century, two-digit month of year, and two-digit day of month. The word `today` may appear in the selection criteria, and has the effect of selecting records created with todays date.

Parents

These elements contain CREATE: CRITERIA

Children

The following elements occur in CREATE: None.

Examples

Example 6.33. Select records that were created on or after January 1, 2000

```
<CREATE include="00/01/01-today" />
```

Name

CRITERIA — record selection criteria for the batch

Synopsis

Content model

```
CRITERIA ::=
((IDRF| (ID | PLATE | VISIT | CREATE | MODIFY | LEVEL | STATUS)*), EDIT*)
```

Attributes

Name	Type	Default	Description
sort	CDATA	*None*	The sort method to be applied to the selected records before processing the edit checks. *This attribute is ignored when the selection criteria are by DRF. For other selection criteria, by default, no sorting is performed.* The value for the attribute contains one or more (semi-colon delimited) words from the list: `id`, `visit`, `plate`, `img`, and each word allows an optional leading + or - symbol. Each word indicates what key the sort is on, the first word has the highest priority, the last word has the lowest, and the optional symbol indicates ascending sort order (+) or descending sort order (-). If a sort key is omitted, the sort order on that key in the selection set of records is arbitrary. **Example 6.34. Use of the sort attribute** Sort by ascending subject ID, and then descending visit identifier within subject. `sort="+id;-visit"`

Description

The `CRITERIA` specifies the record selection criteria for the current batch. Records can be selected by:

- a previously created DRF file using the `IDRF` child element,
- key fields using the `ID`, `VISIT`, `PLATE`, `CREATE`, `MODIFY`, `LEVEL`, and `STATUS` child elements,
- edit checks that they reference using the `EDIT` child element,
- a combination of DRF and edit check names, or
- a combination of key fields and edit check names.

Parents

These elements contain CRITERIA: BATCH

Children

The following elements occur in CRITERIA: IDRF , ID , PLATE , VISIT , CREATE , MODIFY , LEVEL , STATUS , EDIT .

Examples

Example 6.35. Select records from plate 5, modified on or after January 1, 2000, at validation level 3, for subjects 1000 to 4999 inclusive, and for visits 1 through 10, inclusive, and 14

```
<CRITERIA>
        <PLATE include="5" />
        <MODIFY include="00/01/01-today" />
        <LEVEL include="3" />
        <ID include="1000-4999" />
        <VISIT include="1-10,14" />
</CRITERIA>
```

Name

DESC — verbose description for the batch purpose

Synopsis

Content model

```
DESC ::=
#PCDATA
```

Attributes

None.

Description

This optional description is for documentation purposes only. The contents are not read nor understood by **DFbatch**.

Parents

These elements contain DESC: BATCH.

Children

The following elements occur in DESC: None.

Examples

Example 6.36. Description of a batch

```
<DESC>This batch executes edit checks
needsAE and findAEreport on all records that
are currently at level 1.
</DESC>
```

Name

EDIT — select records for inclusion by the edit checks that reference them

Synopsis

Content model

```
EDIT ::=
#PCDATA
```

Attributes

None.

Description

This element selects the edit checks to execute by their name. `EDIT` is the only element that is permitted to repeat with `CRITERIA`.

The body text of the element is a single edit check name, or a comma-delimited or space-delimited list of edit check names.

Parents

These elements contain EDIT: CRITERIA

Children

The following elements occur in EDIT: None.

Examples

Example 6.37. Select records that reference the edit checks medHx or codeAE

```
<EDIT>medHx</EDIT>
<EDIT>codeAE</EDIT>
```

An alternative and equivalent selection of records that reference the edit checks medHx or codeAE is:

```
<EDIT>medHx,codeAE</EDIT>
```

Name

ID — select records for inclusion by the subject ID

Synopsis

Content model

```
ID ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) numeric values, one or more ranges of numeric values, or any combination of both.

Description

Records are selected by subject ID with this element. If the subject ID of a record is in the range of included subject IDs (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion independent of the subject ID. This is equivalent to not specifying an `ID` element.

Parents

These elements contain ID: CRITERIA

Children

The following elements occur in ID: None.

Examples

Example 6.38. Select records for subject IDs 1000 through 4999 inclusive, 10000 through 14999 inclusive, and 99999

```
<ID include="1000-4999, 10000-14999, 99999" />
```

Name

IDRF — DFdiscover Retrieval File of keys for records to be selected

Synopsis

Content model

```
IDRF ::=
EMPTY
```

Attributes

Name	Type	Default	Description
file	CDATA	*None*	A relative or absolute pathname. For relative pathnames, the base directory is the `$STUDY_DIR/drf` directory of the study. The pathname must be specified using UNIX file and directory naming semantics. If the pathname is not given, the processing system will create a pathname from: 1. the base directory of `$STUDY_DIR/drf`of the study followed by 2. the name of the batch, and terminated with 3. the fixed suffix, `.drf` The pathname specification can also include a sub-folder, the basic rule is, `/STUDY_DIR/drf/sub-folder/xx_out.drf`, which starts from absolute path, or `sub-folder/xx_out.drf`, which is a relative path. In both ways, the output file should be found in `/STUDY_DIR/drf/sub-folder/xx_out.drf`. The filename cannot contain ../ or /.. to alter the file path. Doing this will lead to error.

Description

Records can be selected by a previously created DRF. Each record in the DRF is retrieved and processed with the exception of any secondary records which are omitted. Secondary records are only used to link images to data records and can not be processed in batch.

Parents

These elements contain IDRF: CRITERIA

Children

The following elements occur in IDRF: None.

Examples

Example 6.39. Select records from the DRF named `/opt/studies/val254/drf/needcoding.drf`

```
<IDRF file="/opt/studies/val254/drf/needcoding.drf" />
```

If the study `drf` directory is `/opt/studies/val254/drf`, the following statement has equivalent meaning.

```
<IDRF file="needcoding.drf" />
```

Name

LEVEL — select records for inclusion by the validation level

Synopsis

Content model

```
LEVEL ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) numeric values, one or more ranges of numeric values, or any combination of both.

Description

Records are selected by validation level with this element. If the current validation level of a record (not of the user performing the batch) is in the range of included validation levels (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion from the minimum validation level, 1, up to and including either:

- the level specified by the `level` attribute of the APPLY element, if it is specified explicitly, or
- the maximum validation level permitted to the user executing the batch

This is equivalent to not specifying a LEVEL element.

Permissible validation levels are in the range 1 through 7 inclusive.
Parents

These elements contain LEVEL: CRITERIA
Children

The following elements occur in LEVEL: None.
Examples

Example 6.40. Select records that are at validation level 2 or 3

```
<LEVEL include="2,3" />
```

Name

LOG — which actions are logged to an external file and when

Synopsis

Content model

```
LOG ::=
EMPTY
```

Attributes

Name	Type	Default	Description

which	*Enumeration:*
	
	none
	data
	msg
	qc
		none	The value for this attribute is one or more (space-delimited) words from the enumerated list. Inclusion of a word in the attribute value indicates that the batch is interested in the action of this operation.
			
			Edit checks operate in three distinct areas:
			
			• data - changes that are made to data field values
			
			• qc - addition/modification of queries to data fields by `dfaddqc()` and `dfeditqc` or missing page query operations by `dfaddmpqc()` and `dfdelmpqc()`
			
			• msg - messages that are generated by `dfmessage()`, `dfwarning()`, and `dferror()`
			
			`none` is beneficial only when used on its own. Specifying another word in addition to `none` is the same as not specifying `none` at all. For example,
			
			`which="none msg"`
			
			is equal to
			
			`which="msg"`

when	*Enumeration:* all changes summary	*None*	If the value is `all`, every record, or edit check (in the case of `LOG`), every action is taken. If the value is `changes`, only those records which are changed, or edit checks (in the case of `LOG`) that cause a change, are actioned. *summary is not implemented yet.*
file	CDATA	*None*	A relative or absolute pathname. For relative pathnames, the base directory is the same as the base directory of the input file. The pathname must be specified using UNIX file and directory naming semantics. If the pathname is not given, the processing system with create a pathname from: 1. the base directory of the input file followed by 2. the name of the batch, and terminated with 3. the fixed suffix, `_out.xml`

Name	Type	Default	Description
			The pathname specification can also include a sub-folder, the basic rule is, `/STUDY_DIR/batch/sub-folder/xx_out.xml`, which starts from absolute path, or `sub-folder/xx_out.xml`, which is a relative path. In both ways, the output file should be found in `/STUDY_DIR/batch/sub-folder/xx_out.xml`. The filename cannot contain ../ or /.. to alter the file path. Doing this will lead to error.
share	*Enumeration:* yes no	*None*	Is this file sharable (meaning readable and writable) with other members of the same group? If the attribute value is `no`, the file can be read and written by the creator only. If the attribute value is `yes`, the file can be read and written by the creator and others in the same group as the creator. If the attribute is not specified, the sharing is inherited from the user's environment. In UNIX, this is defined by the **umask** command.
mode	*Enumeration:* create write	write	should the file be created, (`create`), or (over)written, (`write`)? Generally, files will be created with `write` so that they can be subsequently overwritten when the batch is re-run. However, if a batch is only intended to be run once or you would like to ensure that the log file does not accidentally overwrite a log file from another batch that might have the same name, use `create`. **Note** The combination of attributes `mode="create"` and `history="yes"` has no semantic meaning as it will never be possible to preserve the history of a log file that can only be created once.
history	*Enumeration:* yes no	*None*	Should the log file mark those entries that were generated by a previous execution, `yes`, or should all entries be marked equally, `no`, as though they were all created by the current execution.

Description

Parents

These elements contain LOG: ACTION.
Children

The following elements occur in LOG: None.
Examples

Example 6.41. Log all records that have had data values changed, messages generated, or queries added or deleted

```
<LOG
        when="all"
        which="data msg qc"
/>
```

Example 6.42. Log records which have had data values changed or messages generated to an output file in a subfolder

```
<LOG
        when="all"
        which="data msg"
    file="test/example_out.xml"
/>
```

or

```
<LOG
        when="all"
        which="data msg"
    file="/STUDY_DIR/batch/test/example_out.xml"
/>
```

The output file should be found in `/STUDY_DIR/batch/test/example_out.xml`

Name

MODIFY — select records for inclusion by the record modification date

Synopsis

Content model

```
MODIFY ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) date values, one or more ranges of date values, or any combination of both.

Description

Records are selected by last modification date with this element. If the plate identifier of a record is in the range of included modification dates (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion independent of the modification date. This is equivalent to not specifying an `MODIFY` element.

The date notation for expressing constant date values is the standard DFdiscover notation, `yy/mm/dd`, which means two-digit year of century, two-digit month of year, and two-digit day of month. The word `today` may appear in the selection criteria, and has the effect of selecting records last modified on todays date.
Parents

These elements contain MODIFY: CRITERIA
Children

The following elements occur in MODIFY: None.
Examples

Example 6.43. Select all records that were modified today

```
<MODIFY include="today" />
```

Name

MOVETO — define limit on number of consecutive `dfmoveto()` calls

Synopsis

Content model

```
MOVETO ::=
EMPTY
```

Attributes

Name	Type	Default	Description
number	NUMBER	20	The maximum number of consecutive `dfmoveto()` calls that is allowed before the edit check(s) are declared a loop.

Description

During processing of an edit check, it is possible for one edit check or a combination of edit checks to create a loop. Specifically, a loop can occur when:

- two edit checks, on two different fields, each execute the `dfmoveto()` statement, resulting in a move to the other field
- or execution of the `dfmoveto()` statement in a single edit check can move the focus back to a previous field allowing subsequent traversal to move the focus back to the current field and triggering the same edit check

A loop is detected after a number of consecutive `dfmoveto()` invocations. By default this number is 20. When a loop is detected, edit checks processing halts. In an interactive environment, a warning dialog is displayed and the user has the option of aborting the current edit check or allowing it to continue, presumably resulting in another loop shortly thereafter. In batch edit checks, the current edit check is always aborted.

It is possible, although highly unlikely, for a particularly complex combination of edit checks to invoke `dfmoveto()` more than the default number of times, 20, without a loop existing. In this case, the limit on the loop can be raised by setting the `number` attribute of the `MOVETO` element to a higher value.

This element applies to all of the `BATCH` elements in the current `BATCHLIST`.
Parents

These elements contain MOVETO: CONTROL.
Children

The following elements occur in MOVETO: None.
Examples

Example 6.44. Increase the looping limit to 25 consecutive `dfmoveto()` invocations

```
<MOVETO number="25" />
```

Name

ODRF — which records are logged to an external DFdiscover Retrieval File (DRF) and when

Synopsis

Content model

```
ODRF ::=
EMPTY
```

Attributes

Name	Type	Default	Description

which	*Enumeration:*
	
	none
	data
	msg
	qc
		none	The value for this attribute is one or more (space-delimited) words from the enumerated list. Inclusion of a word in the attribute value indicates that the batch is interested in the action of this operation.
			
			Edit checks operate in three distinct areas:
			
			• data - changes that are made to data field values
			
			• qc - addition/modification of queries to data fields by `dfaddqc()` and `dfeditqc` or missing page query operations by `dfaddmpqc()` and `dfdelmpqc()`
			
			• msg - messages that are generated by `dfmessage()`, `dfwarning()`, and `dferror()`
			
			`none` is beneficial only when used on its own. Specifying another word in addition to `none` is the same as not specifying `none` at all. For example,
			
			`which="none msg"`
			
			is equal to
			
			`which="msg"`

when	*Enumeration:* all changes	*None*	If the value is `all`, every record, or edit check (in the case of `LOG`), every action is taken. If the value is `changes`, only those records which are changed, or edit checks (in the case of `LOG`) that cause a change, are actioned.
file	CDATA	*None*	A relative or absolute pathname. For relative pathnames, the base directory is the `$STUDY_DIR/drf` directory of the study. The pathname must be specified using UNIX file and directory naming semantics. If the pathname is not given, the processing system will create a pathname from: 1. the base directory of `$STUDY_DIR/drf`of the study followed by 2. the name of the batch, and terminated with 3. the fixed suffix, `.drf`

Name	Type	Default	Description
			The pathname specification can also include a sub-folder, the basic rule is, `/STUDY_DIR/drf/sub-folder/xx_out.drf`, which starts from absolute path, or `sub-folder/xx_out.drf`, which is a relative path. In both ways, the output file should be found in `/STUDY_DIR/drf/sub-folder/xx_out.drf`. The filename cannot contain ../ or /.. to alter the file path. Doing this will lead to error.
share	*Enumeration:* yes no	*None*	Is this file sharable (meaning readable and writable) with other members of the same group? If the attribute value is `no`, the file can be read and written by the creator only. If the attribute value is `yes`, the file can be read and written by the creator and others in the same group as the creator. If the attribute is not specified, the sharing is inherited from the user's environment. In UNIX, this is defined by the **umask** command.
mode	*Enumeration:* create write	write	should the file be created, (`create`), or (over)written, (`write`)? Generally, files will be created with `write` so that they can be subsequently overwritten when the batch is re-run. However, if a batch is only intended to be run once or you would like to ensure that the log file does not accidentally overwrite a log file from another batch that might have the same name, use `create`. **Note** The combination of attributes `mode="create"` and `history="yes"` has no semantic meaning as it will never be possible to preserve the history of a log file that can only be created once.

Description

Parents

These elements contain ODRF: ACTION.
Children

The following elements occur in ODRF: None.
Examples

Example 6.45. Write all records that have had messages generated to the DRF named `/opt/studies/254/batch/outputs/sample1.drf` and enable file sharing

```
<ODRF
        when="all"
        which="msg"
        file="/opt/studies/254/batch/outputs/sample1.drf"
        share="yes"
        mode="write"
/>
```

Example 6.46. Write records which have had data value changed or messages generated to the DRF in a sub-folder

```
<ODRF
```

```
        when="all"
        which="data msg"
        file="test/sample1.drf"
/>
```

or

```
<ODRF
        when="all"
        which="data msg"
        file="/STUDY_DIR/drf/test/sample1.drf"
/>
```

The output file should be found in `/STUDY_DIR/drf/test/sample1.drf`

Name

PLATE — select records for inclusion by the plate identifier

Synopsis

Content model

```
PLATE ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) numeric values, one or more ranges of numeric values, or any combination of both.

Description

Records are selected by plate identifier with this element. If the plate identifier of a record is in the range of included plate identifiers (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion independent of the plate identifier. This is equivalent to not specifying a PLATE element.

Parents

These elements contain PLATE: CRITERIA

Children

The following elements occur in PLATE: None.

Examples

Example 6.47. Select all records for plates 21 through 29 inclusive

```
<PLATE include="21-29" />
```

Name

REASON — define the text that will be inserted into reason for data change records for each data value that is changed and applied to the database

Synopsis

Content model

```
REASON ::=
#PCDATA
```

Attributes

None.

Description

During processing of an edit check, a data value may be changed. Further, that data value may have been defined in the study setup so that it has a minimum reason level after which all data value changes require reasons. If the changed data value is applied to the database, and the record's validation level is at or above the minimum reason level, then a reason is required. The text of this element is used as the reason.

If, in the batch definition, this element is not present or is invalid (i.e. contains '|' or control characters, or consists entirely of an empty string) and a reason is required for a data value change that is to be applied to the database, then the system creates a reason text that is the concatenation of the fixed string `DFbatch` and the current batch's name.

This element applies to all of the `BATCH` elements in the current `BATCHLIST`.

Parents

These elements contain REASON: CONTROL.

Children

The following elements occur in REASON: None.

Examples

Example 6.48. Indicate the the reason for all of these changes is the installation of a new lookup table

```
<REASON>applying coding from new lookup table</REASON>
```

Name

STATUS — select records for inclusion by the record status

Synopsis

Content model

```
STATUS ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) string values from the list `final`, `incomplete`, `pending`, `missed`, `all`.

Description

Records are selected by status with this element. If the status of a record is in the range of included statuses (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion independent of the status. This is equivalent to not specifying a STATUS element.

Permissible status values must be chosen from the list: `final`, `incomplete`, `pending`, `missed`, `all`.
Parents

These elements contain STATUS: CRITERIA
Children

The following elements occur in STATUS: None.
Examples

Example 6.49. Select all final and incomplete records

```
<STATUS include="final,incomplete" />
```

Name

TITLE — brief title for the batch

Synopsis

Content model

```
TITLE ::=
#PCDATA
```

Attributes

None.

Description

The body text of this optional element is a descriptive title for the batch.

Parents

These elements contain TITLE: BATCH.

Children

The following elements occur in TITLE: None.

Examples

Example 6.50. Batch title

```
<TITLE>Locate Missing Adverse Event Reports</TITLE>
```

Name

VISIT — select records for inclusion by the visit identifier

Synopsis

Content model

```
VISIT ::=
EMPTY
```

Attributes

Name	Type	Default	Description
include	CDATA	*None*	One or more (comma or space delimited) numeric values, one or more ranges of numeric values, or any combination of both.

Description

Records are selected by visit identifier with this element. If the visit identifier of a record is in the range of included visit identifiers (specified by the value of the `include` attribute), the record becomes part of the set of records to be processed.

If no inclusion criteria are specified, records are selected for inclusion independent of the visit identifier. This is equivalent to not specifying a `VISIT` element.

Parents

These elements contain VISIT: CRITERIA

Children

The following elements occur in VISIT: None.

Examples

Example 6.51. Select all records with a visit identifier of 10

```
<VISIT include="10" />
```

6.8. BATCHLOG Element Reference

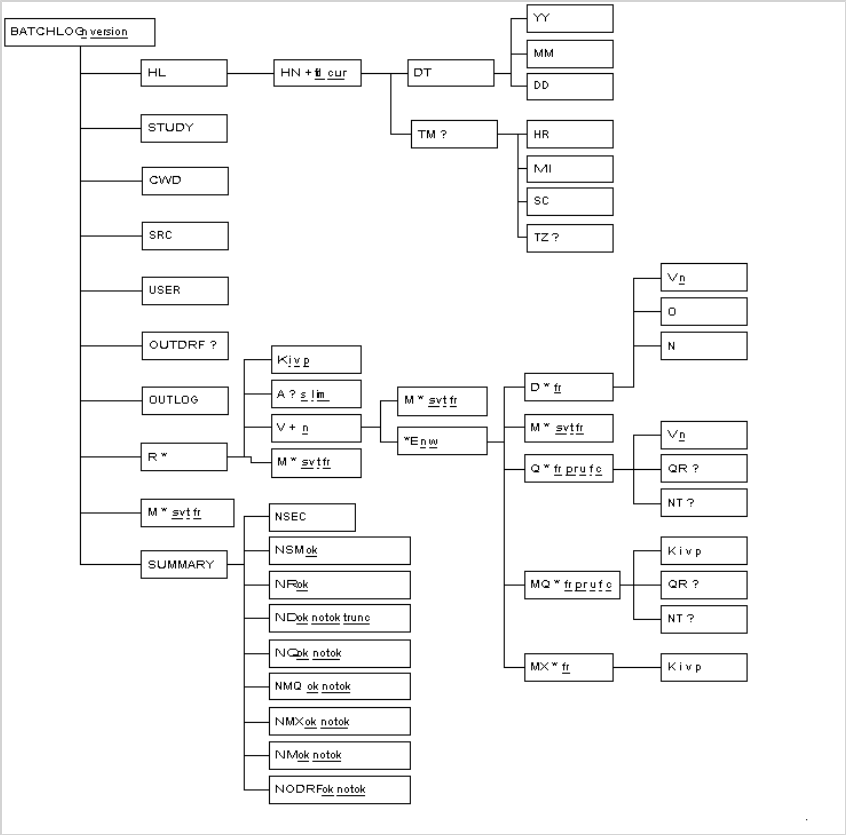
This section describes every element in the BATCHLOG document type definition. The description is offered in two complimentary views. The first view is a tree diagram of the document type definition. The second view is a reference where the meaning and use of every element is described.

6.8.1. BATCHLOG Document Type Definition

A Document Type Definition (DTD) defines the set of elements and their attributes that are valid within a document, how many occurrences of each are allowed, and in what order they are allowed. The batch edit checks input control file has its own DTD that is outlined in Figure 6.3, “The BATCHLOG DTD”.

Figure 6.3. The BATCHLOG DTD

The root element of the input control file is BATCHLOG.



6.8.2. Element Reference

This reference describes every element in the BATCHLOG document type declaration. The organization of the reference is identical to that for the BATCHLIST document type and can be reviewed at Organization of Reference Pages.

6.8.2.1. Reference Pages

Name

A — meta information, including record status, validation level, and CRF image name, for the context record

Synopsis

Content model

```
A ::=
EMPTY
```

Attributes

Name	Type	Default	Description
s	*Enumeration:* `1=final`, `2=incomplete`, `3=pending`, `4=FINAL`, `5=INCOMPLETE`, `6=PENDING`, `0=missed`.	*None*	A numeric code, from the enumerated list, equivalent to the record status.
l	*Enumeration:* 1, 2, 3, 4, 5, 6, 7.	*None*	The validation level of the context record.
im	CDATA	*None*	The unique CRF image name of the context record. The name may be used to locate a physical file containing the image, or it may simply be a sequencing number in the case of records that have no CRF image.

Description

A A contains meta information for the context record. The meta information includes the record status, validation level, and the CRF image name.
Processing Expectations

The CRF image name is guaranteed by DFdiscover to be unique across an entire installation. Therefore, it can be used as a key in implementing relationships across documents.
Parents

These elements contain A: R
Children

The following elements occur in A: None.
Examples

Example 6.52. Meta information for the context record indicating a record status of `final`, validation level of 5, and CRF image name of `0022/0001001`

```
<A s='1' l='5' im='0022/0001001'/>
```

Name

BATCHLOG — container element of batch output log file

Content model

```
BATCHLOG ::=
(HL, STUDY, CWD, SRC, USER, OUTDRF?, OUTLOG, (R | M)*, SUMMARY)
```

Attributes

Name	Type	Default	Description
n	CDATA		The name of the BATCH that generated this output. The value of this attribute must match the value of the BATCH name in the source file identified by the value of the SRC element.
version	NUMBER	1.0	The version of the BATCHLOG language. If subsequent versions of the language are developed, the version number will change. The number to the left of the . is the major version number and the number to the right is the minor version number. Note that this version number is in no way related to the version number of the XML language that appears at the head of each input file in the processing instruction `<?xml version="1.0"?>`

Description

The BATCHLOG is the root element of the output log file. A BATCHLOG is simply a container element for the output from one execution of a batch. If multiple batch outputs are to be recorded they must be written one batch output per log file.

Processing Expectations

It is an error for any characters to appear after the </BATCHLOG> end tag.

Parents

These elements contain BATCHLOG: None.

Children

The following elements occur in BATCHLOG: HL, STUDY, CWD, SRC, USER, OUTDRF, OUTLOG, R, M, SUMMARY.

Examples

Example 6.53. A BATCHLOG

```
<?xml version="1.0"?>
<BATCHLOG version="1.0" name="test1">
    output for this batchlog
</BATCHLOG>
```

Name

CWD — the current working directory in which **DFbatch** executed to create this log file

Synopsis

Content model

```
CWD ::=
EMPTY
```

Attributes

None.

Description

A `CWD` identifies the directory in which **DFbatch** was executed when this log file was created.

Processing Expectations

Any filenames in the output log that have values which are relative pathnames can be taken as relative to the value of this element.

Parents

These elements contain CWD: BATCHLOG

Children

The following elements occur in CWD: None.

Examples

Example 6.54. The current working directory `/opt/studies/val254/lib` and the source file `test_in.xml`

```
<CWD>/opt/studies/val254/lib</CWD>
<SRC>test_in.xml</SRC>
```

The combination of these elements indicates that the source file for the batch was in `/opt/studies/val254/lib/test_in.xml`.

Name

D — information about a change in a data value for a single variable

Synopsis

Content model

```
D ::=
(V, O, N)
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (HN) during which this item was recorded.
c	*Enumeration:* 0=fail 1=success 2=success, but value truncated	*None*	The completion status of the action, or function during which this item was recorded. The only time that a status of "failure" (code 0) is produced is when the database server is found to be unavailable. Otherwise, a status of success (codes 1 or 2) is produced.

Description

A D contains the information of a change in a data value that occurred when the edit check named in the parent element was executed. It identifies which variable (V) was changed, what the original value of the variable was (O), and what the new value is (N).

Processing Expectations

The V element identifies the variable for which the data value was changed. In this context, it is not expected to have any child elements.

The O element will always be present, even if the variable had no original value (was blank), and similarly the N element will always be present, even if the variable has no new value (becomes blank).

Parents

These elements contain D: E

Children

The following elements occur in D: V, O, N

Examples

Example 6.55. A data changed element

```
<D fr='1' c='1'><V n='othsp6'/><O></O><N>-</N></D>
```

This element indicates that the value of the variable `othsp6` was successfully changed from blank to `-`.

Name

DD — day of month information for a date stamp

Synopsis

Content model

```
DD ::=
#PCDATA
```

Attributes

None.

Description

A `DD` contains day of month information. The value will be numeric and in the range `01` and `31` inclusive. The value will always be leading zero-padded to two digits, if necessary.

Parents

These elements contain DD: DT

Children

The following elements occur in DD: None.

Examples

Example 6.56. The 25th day of the month

```
<DD>25</DD>
```

Name

DT — timestamp information for a single execution of **DFbatch**

Synopsis

Content model

```
DT ::=
(YY, MM, DD)
```

Attributes

None.

Description

A DT contains date information, specifically the year (YY), month (MM), and day (DD). This element appears as a child of an HN element and records the current date that the batch was run, or the historical date of a previous execution of the batch.

Processing Expectations

The content model does not allow for the representation of a partial date, and so each of YY, MM, and DD must be present as children.

Parents

These elements contain DT: HN

Children

The following elements occur in DT: YY, MM, DD.

Examples

Example 6.57. A date entry for October 19, 2000

```
<DT><YY>2000</YY><MM>10</MM><DD>19</DD></DT>
```

Name

E — container element for an edit check including its name and what actions occurred when the edit check was executed

Synopsis

Content model

```
E ::=
(D | M | Q | MQ | MX)*
```

Attributes

Name	Type	Default	Description
w	*Enumeration:* pn=plate enter px=plate exit fn=field enter fx=field exit	*None*	The time at which the edit check was executed.
n	CDATA	*None*	The name of the item.

Description

The execution of an edit check can cause no changes to occur, or changes to one or more data values, messages, queries, missing page queries, or deletions of missing page queries, to occur. This element identifies the edit check by name and when it was executed, and is the parent element for the changes, if any. The parent of this element is the variable that was current when the edit check was executed.

Processing Expectations

If the detail level (identified by the `when` attribute of the `LOG` or `APPLY` element in the input batch file) has a value of `changes`, then this element will never appear in the output as an empty element. It may only appear as an empty element when the attribute value is `all` in which the element identifies that the edit check was executed but no changes occurred.

Parents

These elements contain E: V

Children

The following elements occur in E: D, M, Q, MQ, MX.

Examples

Example 6.58. An edit check element and its children

```
<E w='pn' n='no_diabetes'><M fr='1' t='w'>Section 5.c questions should be blank
subject is not diabetic.
</M>
</E>
```

This fragment identifies that the edit check named `no_diabetes` was triggered at plate enter (`pn`) of the context variable and its execution caused the shown warning message.

Name

EQ — a query edited by the execution of `dfeditqc`

Synopsis

Content model

```
EQ ::=
(V?, QR?, QRPLY?, NT?)
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (HN) during which this item was recorded.
pr	*Enumeration:* 1=missing, 2=illegal, 3=inconsistent, 4=illegible, 5=fax noise, 6=other, 30-99=user-defined category	*None*	The category code identified by the query.
u	*Enumeration:* 1=external 2=internal	*None*	The usage type identified by the query.
f	*Enumeration:* 1=Q&A (Clarification) 2=Fax/Refax (Correction)	*None*	The response type identified by the query.
c	*Enumeration:* 0=fail 1=success 2=success, but value truncated	*None*	The completion status of the action, or function during which this item was recorded. The only time that a status of "failure" (code 0) is produced is when the database server is found to be unavailable. Otherwise, a status of success (codes 1 or 2) is produced.
prlbl	CDATA	*None*	The label of the query when a user-defined category type is used. When a default DFdiscover category type is used, this attribute is not included.

Description

Any queries edited by the `dfeditqc` function during the execution of an edit check are recorded in an EQ element.

The V element identifies the variable by name to which the query was edited, even if it is the current variable.

The query and note child elements appear only if their respective values have been set by the function. Note that the element values do not identify whether it has been changed from its previous value, simply that the value was specified as an argument in the function call.

An EQ element does not imply that changes to a query were added to the database, simply that they would have been added if the APPLY element had allowed queries to be added or changed.
Processing Expectations

The history element that records which batch execution generated this element can be determined by matching the values of the `fr` attribute and the `fd` attribute.
Parents

These elements contain EQ: E
Children

The following elements occur in EQ: V, QR, QRPLY, NT
Examples

Example 6.59. A query on the age variable was edited

```
<EQ fr='8' pr='3' u='1' f'=1' c='1'><V n='age'/>
<QR>The reported age is inconsistent with
the exam date and the subject's birth date</QR></Q>
```

Example 6.60. A user defined query added to the visitDate variable

```
<Q fr='9' pr='30' u='1' f'=1' c='1' prlbl="Requires Follow-Up"><V n='visitDate'/>
<QR>The reported visit date does not match up with the trial schedule and needs to be
 verified by the trial coordinator.</QR></Q>
```

Name

HL — container element for history elements

Synopsis

Content model

```
HL ::=
(HN+)
```

Attributes

None.

Description

A HL is simply a container element for one or more HN elements. A BATCHLOG always records at least the date and time of the current batch execution, and if history is enabled, additionally records the date and time of every previous execution.

Processing Expectations

The HN child elements can be ordered in reverse chronological order by descending sequence of fd. While the oldest HN element generally has a value of 1 for this attribute, this is not required. Similarly, it is not required that there are no gaps in the ascending sequence of fd attributes, but this is usually the case.

Parents

These elements contain HL: BATCHLOG

Children

The following elements occur in HL: HN.

Examples

Example 6.61. Two history elements

```
<HL>
<HN fd='1'>
<DT><YY>2000</YY><MM>10</MM><DD>19</DD></DT>
<TM><HR>09</HR><MI>01</MI><SC>40</SC></TM>
</HN>
<HN fd='2'>
<DT><YY>2000</YY><MM>10</MM><DD>20</DD></DT>
<TM><HR>00</HR><MI>10</MI><SC>03</SC></TM>
</HN>
</HL>
```

Name

HN — timestamp information for a single execution of **DFbatch**

Synopsis

Content model

```
HN ::=
(DT, TM)
```

Attributes

Name	Type	Default	Description
fd	CDATA	*None*	The id of a history element (HN). There is a one-to-many relationship between this attribute and the fr attribute of action elements.
cur	*Enumeration:* 0=no 1=yes	*0*	Is the current history entry for the current execution?

Description

A HN contains date and time information regarding a single execution of **DFbatch**.
Processing Expectations

If the element has a cur attribute with a value of 1, the element records the date and time of the current execution. Otherwise, it records the date and time of a previous execution.

Where multiple HN elements are present, they can be ordered chronologically by sorting their fr attributes in ascending order. The HN elements also appear within the parent HL element in chronological order, but this is not required.
Parents

These elements contain HN: HL
Children

The following elements occur in HN: DT, TM.
Examples

Example 6.62. A history entry

```
<HN fd='1'>
<DT><YY>2000</YY><MM>10</MM><DD>19</DD></DT>
<TM><HR>09</HR><MI>01</MI><SC>40</SC></TM>
</HN>
```

This is the entry for the oldest execution of the batch which took place on October 19, 2000 at 09:01:40. Because the element does not have a cur attribute, it is not the history element for the current (and only) execution.

Name

HR — hour information for a time stamp

Synopsis

Content model

```
HR ::=
#PCDATA
```

Attributes

None.

Description

A HR contains hour of day information in 24-hour notation. The value is numeric in the range 01 to 24, and is always zero-padded to two digits.

Parents

These elements contain HR: TM

Children

The following elements occur in HR: None.

Examples

Example 6.63. The 14th hour, commonly called 2pm

```
<HR>14</HR>
```

Name

K — container element for key identification of the parent element

Synopsis

Content model

```
K ::=
EMPTY
```

Attributes

Name	Type	Default	Description
i	CDATA	*None*	The subject ID of the context record.
v	CDATA	*None*	The visit or sequence number of the context record.
p	CDATA	*None*	The plate number of the context record.

Description

This element contains the key identifiers of the parent element, which can be a record, a new missing page query, or the deletion of an existing missing page query.
Processing Expectations

Parents

These elements contain K: R, MQ, MX
Children

The following elements occur in K: None.
Examples

Example 6.64. A key element that identifies subject ID 1, visit 10, and plate 9

```
<K i='1' v='10' p='9'/>
```

Name

M — the message generated by the execution of `dfmessage`, `dferror`, or `dfwarning`

Synopsis

Content model

```
M ::=
#PCDATA
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (`HN`) during which this item was recorded.
t	*Enumeration:* m=message e=error w=warning s=system	*None*	The type of message logged. This type maps directly to one of the edit check functions, `dfmessage`, `dferror`, or `dfwarning`. System messages are generated by the **DFbatch** system itself, not by a user-defined edit check.

Description

Any messages generated by the functions `dfmessage`, `dferror`, or `dfwarning` during the execution of an edit check are recorded in a `M` element.

Messages can also be generated by the **DFbatch** system during the execution. As a result, a `M` element can occur at almost any point in the `BATCHLOG` output.

Processing Expectations

The history element that records which batch execution generated this message can be determined by match the values of the `fr` attribute and the `fd` attribute.

Parents

These elements contain M: BATCHLOG, V, R

Children

The following elements occur in M: None.

Examples

Example 6.65. A message generated by `dfwarning`

```
<M fr='1' t='w'>Section 5.c questions should be blank
subject is not diabetic.
</M>
```

Name

MI — minute information for a time stamp

Synopsis

Content model

```
MI ::=
#PCDATA
```

Attributes

None.

Description

A `MI` contains minute of hour information. The value is numeric in the range 00 to 59, and is always zero-padded to two digits.

Parents

These elements contain MI: TM

Children

The following elements occur in MI: None.

Examples

Example 6.66. The 45th minute of the hour

```
<MI>45</MI>
```

Name

MM — month information for a date stamp

Synopsis

Content model

```
MM ::=
#PCDATA
```

Attributes

None.

Description

A `MM` contains month of year information. The value is numeric in the range 01 (January) to 12 (December), and is always zero-padded to two digits.

Parents

These elements contain MM: DT

Children

The following elements occur in MM: None.

Examples

Example 6.67. The month June

```
<MM>06</MM>
```

Name

MQ — a missing page query generated by the execution of `dfaddmpqc`

Synopsis

Content model

```
MQ ::=
(K, QR?, NT?)
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (HN) during which this item was recorded.
u	*Enumeration:* 1=external 2=internal	*None*	The usage type identified by the query.
f	*Enumeration:* 1=Q&A (Clarification) 2=Fax/Refax (Correction)	*None*	The response type identified by the query.
c	*Enumeration:* 0=fail 1=success 2=success, but value truncated	*None*	The completion status of the action, or function during which this item was recorded. The only time that a status of "failure" (code 0) is produced is when the database server is found to be unavailable. Otherwise, a status of success (codes 1 or 2) is produced.

Description

Any missing page queries generated by the `dfaddmpqc` function during the execution of an edit check are recorded in a `MQ` element.

Since missing page queries are never added to the current record, a `K` child element is needed to identify the keys that will get the missing page query. If query or note arguments were specified to `dfaddmpqc`, `QR` or `NT` child elements, respectively, will be present.

A `MQ` element does not imply that a missing page query was added to the database, simply that one would have been added if the `APPLY` element had allowed queries to be added.
Processing Expectations

The history element that records which batch execution generated this element can be determined by matching the values of the `fr` attribute and the `fd` attribute.
Parents

These elements contain MQ: E
Children

The following elements occur in MQ: K, QR, NT
Examples

Example 6.68. A missing page query added for subject 1001, visit 1, plate 5, with no additional query or note

```
<MQ fr='5' c='1'><K i='1001' v='1' p='5'/></MQ>
```

Name

MX — deletion of a missing page query generated by the execution of `dfdelmpqc`

Synopsis

Content model

```
MX ::=
(K)
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (HN) during which this item was recorded.

Description

Any missing page queries deleted by the `dfdelmpqc` function during the execution of an edit check are recorded in a `MX`.

Since missing page queries are never deleted from the current record, a `K` child element is needed to identify the keys from which the missing page query is deleted.

A `MX` element does not imply that a missing page query was deleted from the database, simply that one would have been deleted if the `APPLY` element had allowed query actions.
Processing Expectations

The history element that records which batch execution generated this element can be determined by matching the values of the `fr` attribute and the `fd` attribute.
Parents

These elements contain MX: E
Children

The following elements occur in MX: K
Examples

Example 6.69. A missing page query deleted for subject 99001, visit 2, and plate 4

```
<MX fr='4' c='1'><K i='99001' v='2' p='4'/></MX>
```

Name

N — the original value before a data change

Synopsis

Content model

```
N ::=
#PCDATA
```

Attributes

None.

Description

A N element records the new data value of a variable after it was changed by assignment.

If a field has a value assigned by an edit check, and the new value is identical to the original value, this is considered to be no change, and as a result is not recorded in the output log.

Processing Expectations

This element will be present, even if the new value is blank, in which case the element will be an empty element.

Parents

These elements contain N: V

Children

The following elements occur in N: None.

Examples

Example 6.70. A new value of 1

```
<N>1</N>
```

Name

ND — the number of data changes recorded

Synopsis

Content model

```
ND ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
notok	CDATA	*None*	The number of items of this type that were not successfully applied, or would not have been successfully applied if APPLY was enabled.
trunc	CDATA	*None*	The number of truncated data values that were successfully applied, applied, or would have been successfully applied if APPLY was enabled. This attribute counts the number of times that an assignment of a data value to a field resulted in the value being truncated to fit in the formatting of the field.
apply	CDATA	*None*	Set to "1" if APPLY was enabled when the batch file was run.

Description

The ND contains summary information including the number of data changes that were successful, the number that failed, and the number that were successful but required truncation of the data value. attributes.
Processing Expectations

By counting the number of D elements present in the output log and grouping them by the value of their c attribute, a stylesheet can tabulate the same numbers as reported by the attributes of this element.
Parents

These elements contain ND: SUMMARY
Children

The following elements occur in ND: None.
Examples

Example 6.71. Summary information of 1 successful data change, no failed changes, and no successful but truncated changes, applied to the database

```
<ND ok='1' notok='0' trunc='0' apply='1'/>
```

Name

NEQ — the number of times queries were edited

Synopsis

Content model

```
NEQ ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
notok	CDATA	*None*	The number of items of this type that were not successfully applied, or would not have been successfully applied if APPLY was enabled.
apply	CDATA	*None*	Set to "1" if APPLY was enabled when the batch file was run.

Description

The NEQ element contains summary information including the number of times `dfeditqc` was called.
Processing Expectations

By counting the number of EQ elements present in the output log and grouping them by the value of their c attribute, a stylesheet can tabulate the same numbers as reported by the attributes of this element.
Parents

These elements contain NEQ: SUMMARY
Children

The following elements occur in NEQ: None.
Examples

Example 6.72. `dfeditqc` called 4 times successfully, 1 time with a failure, APPLY set for queries

```
<NEQ apply='1' ok='4' notok='1'/>
```

Name

NM — the number of messages recorded

Synopsis

Content model

```
NM ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
apply	CDATA	*None*	Set to "1" if APPLY was enabled when the batch file was run.

Description

The NM contains summary information including the number of messages that were successful - it is not possible for message creation to fail.

> ## Note
>
> If NM indicates that messages were successful but the records to be processed by **DFbatch** are locked and unavailable, the output log will also indicate this by an entry such as
>
> ```
> <NR ok='0'/>
> ```
>
> (number of selected records is 0). Be aware that edit check execution will not have been applied to the selected records in this case.

Processing Expectations

By counting the number of M elements present in the output log, a stylesheet can tabulate the same numbers as reported by the attribute of this element.

Parents

These elements contain NM: SUMMARY

Children

The following elements occur in NM: None.

Examples

Example 6.73. Summary information of 210 messages generated, APPLYset for messages

```
<NM apply='1' ok='210'/>
```

Name

NMQ — the number of missing page queries added

Synopsis

Content model

```
NMQ ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
notok	CDATA	*None*	The number of items of this type that were not successfully applied, or would not have been successfully applied if APPLY was enabled.
apply	CDATA	*None*	Set to "1" if APPLY was enabled when the batch file was run.

Description

The NMQ element contains summary information including the number of missing page queries added successfully, and the number that failed.

Processing Expectations

By counting the number of MQ elements present in the output log and grouping them by the value of their c attribute, a stylesheet can tabulate the same numbers as reported by the attributes of this element.

Parents

These elements contain NMQ: SUMMARY

Children

The following elements occur in NMQ: None.

Examples

Example 6.74. Summary information of 1 failed missing page query addition, APPLY element set.

```
<NMQ ok='0' notok='1' apply='1'/>
```

Name

NMX — the number of missing page queries deleted

Synopsis

Content model

```
NMX ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
notok	CDATA	*None*	The number of items of this type that were not successfully applied, or would not have been successfully applied if APPLY was enabled.
apply	CDATA	*None*	Set to "1" if APPLY was enabled when the batch file was run.

Description

The NMX element contains summary information including the number of missing page queries deleted successfully, and the number that failed.
Processing Expectations

By counting the number of MX elements present in the output log and grouping them by the value of their c attribute, a stylesheet can tabulate the same numbers as reported by the attributes of this element.
Parents

These elements contain NMX: SUMMARY
Children

The following elements occur in NMX: None.
Examples

Example 6.75. Summary information of 4 successfully deleted missing page queries and 2 that failed, APPLY set.

```
<NMX ok='4' notok='2' apply='1'/>
```

Name

NODRF — the number of DRF records written

Synopsis

Content model

```
NODRF ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
notok	CDATA	*None*	The number of items of this type that were not successfully applied, or would not have been successfully applied if APPLY was enabled.

Description

The NODRF element contains summary information including the number of DRF records written successfully, and the number that failed.

The DRF records are written to the file identified bu the value of the `file` attribute of the ODRF element in the input file.

Parents

These elements contain NODRF: SUMMARY

Children

The following elements occur in NODRF: None.

Examples

Example 6.76. 210 DRF records successfully written

```
<NODRF ok='210' notok='0'/>
```

Name

NQ — the number of queries added

Synopsis

Content model

```
NQ ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.
notok	CDATA	*None*	The number of items of this type that were not successfully applied, or would not have been successfully applied if APPLY was enabled.
apply	CDATA	*None*	Set to "1" if APPLY was enabled when the batch file was run.

Description

The NQ element contains summary information including the number of queries added successfully, and the number that failed.

Processing Expectations

By counting the number of Q elements present in the output log and grouping them by the value of their c attribute, a stylesheet can tabulate the same numbers as reported by the attributes of this element.

Parents

These elements contain NQ: SUMMARY

Children

The following elements occur in NQ: None.

Examples

Example 6.77. 4 queries successfully added and 1 failure, APPLY set for queries

```
<NQ apply='1' ok='4' notok='1'/>
```

Name

NR — the number of records selected by the criteria

Synopsis

Content model

```
NR ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.

Description

The NR element contains summary information including the number of records selected by the criteria.

Parents

These elements contain NR: SUMMARY

Children

The following elements occur in NR: None.

Examples

Example 6.78. 2365 records selected

```
<NR ok='2365'/>
```

Name

NT — an additional note added to a query or missing page query

Synopsis

Content model

```
NT ::=
#PCDATA
```

Attributes

None.

Description

The `NT` element contains the additional note, if any, supplied by the `dfaddqc` or `dfaddmpqc` edit check functions.

Processing Expectations

If the text of the note contains an embedded newline, the newline should cause a line break in the presentation of the note.

Parents

These elements contain NT: Q, MQ

Children

The following elements occur in NT: None.

Examples

Example 6.79. An additional note added to a query

```
<NT>This page should have been received over 4 weeks ago</NT>
```

Name

NSEC — the total number of seconds elapsed for the execution of the batch

Synopsis

Content model

```
NSEC ::=
#PCDATA
```

Attributes

None.
Description

The NSEC element contains a numeric value that is the number of seconds elapsed in the execution of the batch. The value is reported without any fractional seconds and so it is possible for the number of seconds elapsed to be 0. attributes.

The number of seconds elapsed does not include the time spent, if any, styling the resulting output file for presentation.
Processing Expectations

The end time of the batch execution can be calculated by adding the number of seconds to the timestamp of the current HN element.
Parents

These elements contain NSEC: SUMMARY
Children

The following elements occur in NSEC: None.
Examples

Example 6.80. A batch that executed in 12 seconds

```
<NSEC>12</NSEC>
```

Name

NSM — the number of system messages recorded

Synopsis

Content model

```
NSM ::=
EMPTY
```

Attributes

Name	Type	Default	Description
ok	CDATA	*None*	The number of items of this type that were successfully applied, or would have been successfully applied if APPLY was enabled.

Description

The NSM element records the number of system messages recorded during the execution of the batch. System messages are generated by the edit checks interpreter or database server and do not include any messages generated by the dfmessage, dferror, or dfwarning functions.
Processing Expectations

By counting the number of M elements with a t attribute of s, a stylesheet can tabulate the same numbers as reported by the attributes of this element.
Parents

These elements contain NSM: SUMMARY
Children

The following elements occur in NSM: None.
Examples

Example 6.81. Good news, no system messages

```
<NSM ok='0'/>
```

Name

O — the original value before a data change

Synopsis

Content model

```
O ::=
#PCDATA
```

Attributes

None.

Description

A O element records the original data value of a variable before it was changed by assignment of a new value.

If a field has a value assigned by an edit check, and the new value is identical to the original value, this is considered to be no change, and as a result is not recorded in the output log.

Processing Expectations

This element will be present, even if the original value was blank, in which case the element will be an empty element.

Parents

These elements contain O: V

Children

The following elements occur in O: None.

Examples

Example 6.82. An original value of 56.6

```
<O>56.6</O>
```

Name

OUTDRF — the filename of the output DRF

Synopsis

Content model

```
OUTDRF ::=
#PCDATA
```

Attributes

None.

Description

The value of the OUTDRF element is the filename to which output DRF records were written. If output DRF records were not selected, this element will not be present.

Processing Expectations

If the filename does not begin with /, then it is assumed to a relative filename from which the absolute pathname can be derived by prepending the value with the value of the CWD element.

Parents

These elements contain OUTDRF: BATCHLOG

Children

The following elements occur in OUTDRF: None.

Examples

Example 6.83. The DRF /opt/studies/val254/drf/example.drf

```
<OUTDRF>/opt/studies/val254/drf/example.drf</OUTDRF>
```

Name

OUTLOG — the filename of the output log, namely this file

Synopsis

Content model

```
OUTLOG ::=
#PCDATA
```

Attributes

None.

Description

The value of the `OUTLOG` element is the filename to which output log information was written. The value is self-referential naming the file that contains the element.

Processing Expectations

If the filename does not begin with `/`, then it is assumed to a relative filename from which the absolute pathname can be derived by prepending the value with the value of the `CWD` element.

Parents

These elements contain OUTLOG: BATCHLOG

Children

The following elements occur in OUTLOG: None.

Examples

Example 6.84. The log file `/opt/studies/val254/lib/example_out.xml`

```
<OUTLOG>/opt/studies/val254/lib/example_out.xml</OUTLOG>
```

Name

Q — a query generated by the execution of `dfaddqc`

Synopsis

Content model

```
Q ::=
(V?, QR?, NT?)
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (HN) during which this item was recorded.
pr	*Enumeration:* 1=missing, 2=illegal, 3=inconsistent, 4=illegible, 5=fax noise, 6=other, 30-99=user-defined category	*None*	The category code identified by the query.
u	*Enumeration:* 1=external 2=internal	*None*	The usage type identified by the query.
f	*Enumeration:* 1=Q&A (Clarification) 2=Fax/Refax (Correction)	*None*	The response type identified by the query.
c	*Enumeration:* 0=fail 1=success 2=success, but value truncated	*None*	The completion status of the action, or function during which this item was recorded. The only time that a status of "failure" (code 0) is produced is when the database server is found to be unavailable. Otherwise, a status of success (codes 1 or 2) is produced.
prlbl	CDATA	*None*	The label of the query when a user-defined category type is used. When a default DFdiscover category type is used, this attribute is not included.

Description

Any queries generated by the `dfaddqc` function during the execution of an edit check are recorded in a Q element.

The V element identifies the variable by name to which the query was added, even if it is the current variable.

A Q element does not imply that a query was added to the database, simply that one would have been added if the APPLY element had allowed queries to be added.

Processing Expectations

The history element that records which batch execution generated this element can be determined by matching the values of the `fr` attribute and the `fd` attribute.

Parents

These elements contain Q: E

Children

The following elements occur in Q: V, QR, NT
Examples

Example 6.85. A query added to the age variable

```
<Q fr='8' pr='3' u='1' f'=1' c='1'><V n='age'/>
<QR>The reported age is inconsistent with
the exam date and the subject's birth date</QR></Q>
```

Example 6.86. A user defined query added to the `visitDate` variable

```
<Q fr='9' pr='30' u='1' f'=1' c='1' prlbl="Requires Follow-Up"><V n='visitDate'/>
<QR>The reported visit date does not match up with the trial schedule and needs to be
 verified by the trial coordinator.</QR></Q>
```

Name

QR — an additional question asked in a query or a missing page query

Synopsis

Content model

```
QR ::=
#PCDATA
```

Attributes

None.

Description

The QR element contains the additional query, if any, supplied by the dfaddqc or dfaddmpqc edit check functions.

Processing Expectations

If the text of the query contains an embedded newline, the newline should cause a line break in the presentation of the query.

Parents

These elements contain QR: Q, MQ

Children

The following elements occur in QR: None.

Examples

Example 6.87. The query added to a query

```
<QR>Please identify the correct response by initialing and dating
it</QR>
```

Name

QRPLY — the reply field of a query

Synopsis

Content model

```
QRPLY ::=
#PCDATA
```

Attributes

None.

Description

The QRPLY element contains the reply to a query, if any, supplied by the dfeditqc edit check function.

Processing Expectations

If the reply to the query contains an embedded newline, the newline should cause a line break in the presentation of the query.

Parents

These elements contain QR: EQ

Children

The following elements occur in QRPLY: None.

Examples

Example 6.88. The reply to a query

```
<QRPLY>This was a clerical error</QRPLY>
```

Name

R — a container element for all of the processing associated with a single record

Synopsis

Content model

```
R ::=
(K, A?, V*, M*)
```

Attributes

None.

Description

Each record that is processed by **DFbatch** is identified in the log by a R element. The children of this element record the actions that occurred during the processing of the record. The record that is being processed is identified by the key fields which are recorded in the K element.

Processing Expectations

If the detail level of logging is `all`, R elements may appear in the output with no child elements other than the required K element, indicating that the identified record met the record selection criteria but then executed no edit checks, or no edit checks that recorded changes.

It is possible for a system message to be reported at the record level.

Parents

These elements contain R: BATCHLOG

Children

The following elements occur in R: K, A, V, M.

Examples

Example 6.89. A record element and its children

```
<R>
<K i='1' v='10' p='9'/>
<A s='1' l='5' im='9949/0017009'/>
<V n='id9'><E w='pn' n='no_diabetes'><M fr='1' t='w'>Section 5.c questions should be blank
subject is not diabetic.
</M>
</E></V>
</R>
```

Name

S — a reason for data change generated by the execution of `dfaddreason`

Synopsis

Content model

```
S ::=
(V?, T?)
```

Attributes

Name	Type	Default	Description
fr	CDATA	*None*	The id of the unique history element (HN) during which this item was recorded.
c	*Enumeration:* 0=fail 1=success 2=success, but value truncated	*None*	The completion status of the action, or function during which this item was recorded. The only time that a status of "failure" (code 0) is produced is when the database server is found to be unavailable. Otherwise, a status of success (codes 1 or 2) is produced.

Description

Any reasons for data change generated by the `dfaddreason` function during the execution of an edit check are recorded in a S element.

The V element identifies the variable by name to which the reason for data change was added, even if it is the current variable. The T element contains the text of the reason for data change. This text matches the input reason text supplied by the programmer in the `dfaddreason` function call.

A S element does not imply that a reason for data change was added to the database, simply that one would have been added if the APPLY element had allowed data changes.
Processing Expectations

The history element that records which batch execution generated this element can be determined by matching the values of the `fr` attribute and the `fd` attribute.
Parents

These elements contain S: E
Children

The following elements occur in S: V, T
Examples

Example 6.90. A reason for data change added to the RACE variable

```
<S fr='1' c='1'><V n='RACE'/>
<T>previous response was obscured on the sent CRF</T></S>
```

Name

SC — second information for a time stamp

Synopsis

Content model

```
SC ::=
#PCDATA
```

Attributes

None.

Description

A SC contains second of minute information. The value is numeric in the range 00 to 59, and is always zero-padded to two digits.

Processing Expectations

None.

Parents

These elements contain SC: TM

Children

The following elements occur in SC: None.

Examples

Example 6.91. The 30th second of the minute

```
<SC>30</SC>
```

Name

SRC — the name of the input file whose execution created this batch log

Synopsis

Content model

```
SRC ::=
#PCDATA
```

Attributes

None.

Description

A SRC identifies the filename that contains the input BATCH whose execution created this batch log.

Processing Expectations

If the filename does not begin with /, then it is assumed to a relative filename from which the absolute pathname can be derived by prepending the value with the value of the CWD element.

Parents

These elements contain SRC: BATCHLOG

Children

The following elements occur in SRC: None.

Examples

Example 6.92. The batch input file `example_in.xml`, from the same directory as the current working directory

```
<SRC>example_in.xml</SRC>
```

Name

STUDY — the DFdiscover study number

Synopsis

Content model

```
STUDY ::=
#PCDATA
```

Attributes

None.

Description

A STUDY identifies the study number to which the batch and the results apply.

Processing Expectations

Parents

These elements contain STUDY: BATCHLOG

Children

The following elements occur in STUDY: None.

Examples

Example 6.93. Study 254

```
<STUDY>254</STUDY>
```

Name

SUMMARY — container element for summary information elements

Synopsis

Content model

```
SUMMARY ::=
(NSEC, NSM, NR, ND, NQ, NEQ, NMQ, NMX, NM, NODRF)
```

Attributes

None.

Description

A SUMMARY is simply a container element for other elements containing specific summary information about the most recent execution of the batch.

Parents

These elements contain SUMMARY: BATCHLOG

Children

The following elements occur in SUMMARY: NSEC, NSM, NR, ND, NQ, NEQ, NMQ, NMX, NM, NODRF.

Examples

Example 6.94. The summary element and its children

```
<SUMMARY>
<NSEC>12</NSEC>
<NSM ok='0'/>
<NR ok='2365'/>
<ND apply='0' ok='1' notok='0' trunc='0'/>
<NQ apply='0' ok='0' notok='0'/>
<NEQ apply='0' ok='0' notok='0'/>
<NMQ apply='0' ok='0' notok='0'/>
<NMX apply='0' ok='0' notok='0'/>
<NM apply='0' ok='210'/>
<NODRF ok='210'/>
</SUMMARY>
```

Name

T — the text reason accompanying a data change

Synopsis

Content model

```
T ::=
#PCDATA
```

Attributes

None.

Description

A T element records the reason for change text supplied as an argument during the execution of the `dfaddreason` function. If the execution of `dfaddreason` returns an empty string, then **DFbatch** records any empty string for the T element. When **DFbatch** has finished processing the record and required reasons are still missing, the system inserts a default reason constructed from the batch name.

Processing Expectations

None.

Parents

These elements contain T: S

Children

The following elements occur in T: None.

Examples

Example 6.95. Reason for change text

```
<T>data entry error made during first entry</T>
```

Name

TM — timestamp information for a single execution of **DFbatch**

Synopsis

Content model

```
TM ::=
(HR, MI, SC)
```

Attributes

None.

Description

A TM contains time information. It is contained in a HN element that identifies the execution of the batch that this time applies to.

Processing Expectations

All timestamps are reported by hours, minutes, and seconds.

Parents

These elements contain TM: HN

Children

The following elements occur in TM: HR, MI, SC.

Examples

Example 6.96. A time entry for 10 minutes, 3 seconds after midnight

```
<TM><HR>00</HR><MI>10</MI><SC>03</SC></TM>
```

Name

USER — the login name of the user that executed the batch

Synopsis

Content model

```
USER ::=
#PCDATA
```

Attributes

None.

Description

A USER identifies the login name of the user that executed the batch creating the results which the element is a part of.

Processing Expectations

Parents

These elements contain USER: BATCHLOG

Children

The following elements occur in USER: None.

Examples

Example 6.97. Identification of the batch executed by user `eric`

```
<USER>user1</USER>
```

Name

V — variable identification

Synopsis

Content model

```
V ::=
(E | M)*
```

Attributes

None.

Description

A V element identifies the variable containing the edit checks to be executed, or the variable to which a query is being added.

Processing Expectations

If the element appears as a child of a Q element, it may not have any further descendants.

Parents

These elements contain V: BATCHLOG, D

Children

The following elements occur in V: E, M.

Examples

Example 6.98. A variable element for `id9` and its children

```
<V n='id9'><E w='pn' n='no_diabetes'><M fr='1' t='w'>Section 5.c questions should be blank
subject is not diabetic.
</M>
</E></V>
```

Name

YY — year information for a date stamp

Synopsis

Content model

```
YY ::=
#PCDATA
```

Attributes

None.
Description

A YY contains year information. The value is numeric and is always reported in 4 digit format that includes the century.
Processing Expectations

None.
Parents

These elements contain YY: DT
Children

The following elements occur in YY: None.
Examples

Example 6.99. The year 2000

```
<YY>2000</YY>
```

6.9. XML Language Basics

XML is really a meta language - a language for creating new languages. The syntactic rules for each language are the same, but the vocabulary and semantics of each language can be quite different. In the case of **DFbatch**, we used XML to create two new languages: the input control file language, rooted at `BATCHLIST`, and the output log file language, rooted at `BATCHLOG`.

XML was chosen as the input and output language format for a variety of reasons, a few of which are listed below:

1. It is supported by community standards. It is an entirely vendor neutral way of describing data and the structure of data.
2. It is self-describing. You can read an XML document and understand what it is saying without being aware of specialized formats or processing instructions.
3. It is extensible (hence the X in XML). If you need another element or attribute, you can add it.
4. XML is easy to format for a variety of different uses and audiences.
5. There are many publicly available tools for manipulating XML with many more to come. This will allow you to do numerous things with XML data that are independent of DFdiscover.

It is not coincidental that XML is so easy to use - it was designed this way. There are very few rules to live by when using XML. This makes it easy to implement lightweight programs (typically parsers) that enforce those rules. The programs never have to worry about exceptions to the rules - if there is an exception, it is no longer XML - it's as simple as that.

6.9.1. The Rules of XML

The following rules define what is and what is not an XML document:

- An XML document is constructed from elements and attributes. Elements are delimited by tags, a start-tag and a matching end-tag. The content for the element, which may be character data, other elements, or a combination, is between the tags.
- The value of an attribute must be enclosed in matching quotes, either single quotes, '', or double quotes, "".
- An XML document must have exactly one root element.
- An XML document must be well-formed. Each starting tag must be balanced by a closing tag, and pairs of tags must be nested properly.

Example 6.100. Improperly nested tags

```
<bold>This text is bold and <italic>this is bold-italic
</bold>, but what is this?</italic>
```

- The following reserved characters may not appear directly in an XML document: &, <, >, ", and '.
- Comments are denoted in the SGML notation.

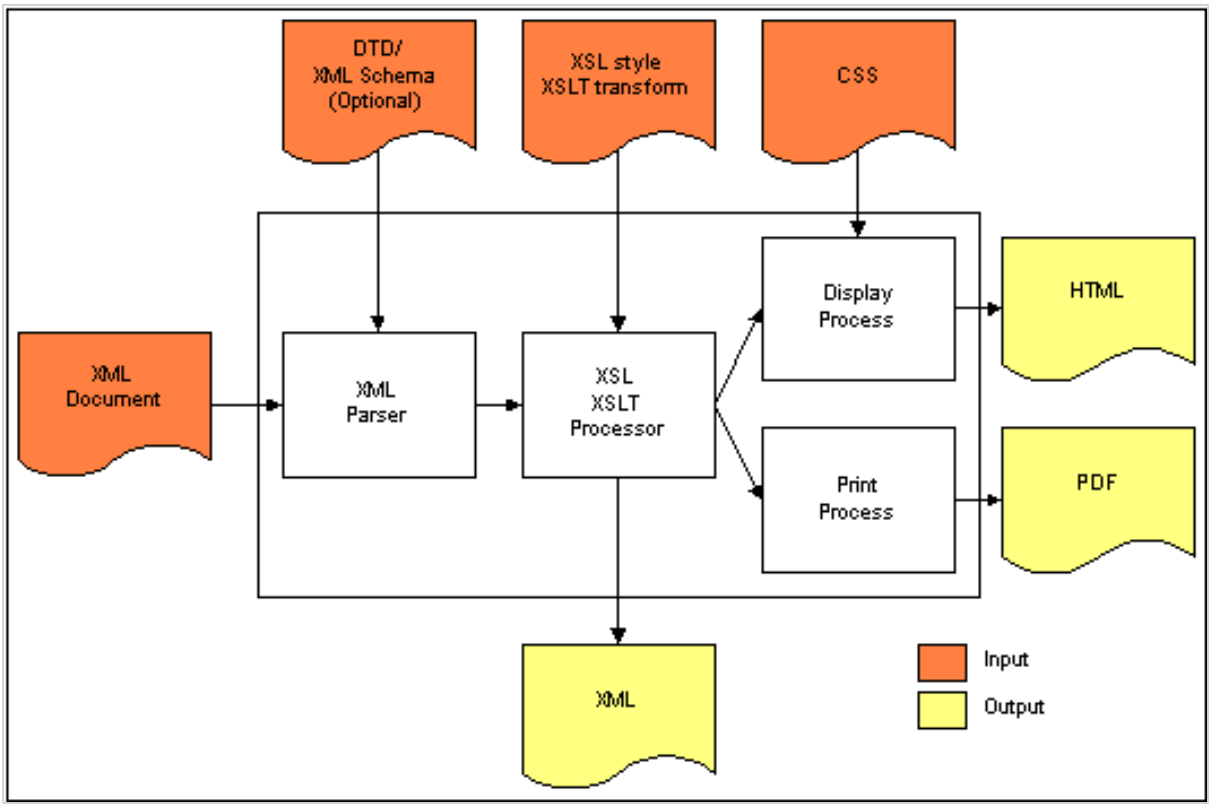
Example 6.101. Comments

```
<!-- this is a comment -->
```

- XML documents may optionally also be *valid*. A valid XML document, in addition to being well-formed, also adheres to the structure of a Document Type Definition (DTD).

6.9.2. Companions to XML

XML has many companion technologies, some that apply business rules, and others that define schemas. By far though, most of the additional technologies are focused on transformation (converting one XML document into another XML document, or filtering parts of an XML document) and formatting (converting an XML document to HTML or PDF, for example). The following illustration is a simple view of how XML fits in with these other technologies.



Companions to XML

6.9.3. Recommended Reading

If you would like to learn more about XML, we recommend the following starting points for additional reading:

- The XML Cover Pages
- Cafe con Leche XML News and Resources
- XML.ORG - The XML Industry Portal, hosted by OASIS

Chapter 7. Writing Your Own Reports

DFdiscover comes with approximately 40 standard reports that are useful for most clinical trials. There will always be the need for custom reports for almost every trial. You can create reports using any of the programming tools that you are familiar with (e.g SAS®, a database report tool, UNIX shell scripts, etc.) and then install them in DFdiscover so that your DFdiscover users can execute them via Reports View in **DFexplore**. Also, don't hesitate to take a look at the standard DFdiscover reports included in your DFdiscover installation reports directory. Most are UNIX shell scripts, which can serve as models for creating your own study specific reports.

7.1. General Guidelines

- After a report has been created the easiest way to make it available to study staff is through **DFexplore**'s Reports View. It can then be executed by permitted users by simply clicking the report name.
- If reports are to be executed from **DFexplore** they must be installed in the study reports directory and have execute permissions for at least owner and group.
- When you install a new report in the study reports directory, be sure to update the `.info` file kept in that same directory with a complete description of how the report works, including what options it accepts and what output it generates. Take a look at the existing `.info` file in your DFdiscover reports directory for examples of how on-line documentation should be formatted. However, make sure you don't include your own documentation in this file, as it will be replaced with each new DFdiscover release, as new standard reports are added.
- Reports executed from **DFexplore** are always provided with the study number as an argument, plus the options that the user has provided in **DFexplore**'s `Options` field. Within a Bourne shell script, for example, the study number is always $1, so you can do things like:

  ```
  study=$1
  ```

- Use the shell level program **DFgetparam.rpc** to obtain the values of configuration parameters from the study server rather than trying to parse the configuration file yourself, or even worse, hard coding in the values of study directories, etc. The following Bourne shell example shows how to use **DFgetparam.rpc** to get the study database directory, where the study number has already been set to $study:

  ```
  db=`/opt/dfdiscover/bin/DFgetparam.rpc -s $study DATABASE_DIR`
  ```

- Temporary files created by your report should be written to the study work directory. Using **DFgetparam.rpc** you can evaluate the value of the work directory as follows:

  ```
  work=`/opt/dfdiscover/bin/DFgetparam.rpc -s $study WORKING_DIR`
  ```

  and then use the temporary file in one of these ways:

  ```
  $work/tmp
  $work/$$tmp
  ```

- HTML markup can be used to format report output directed to the reports view in **DFexplore**. HTML reports must start with one of the following tags: <HTML>,<!DOC>,<!doc>,<TABLE>,<table>,<P>,<p>. Note: If **DFexplore** is run using the web-based DFnavigator, links are disabled. Page breaks are output when printing or saving report output to PDF.

7.2. Installing Your Reports

Many study reports are re-executed at regular intervals throughout the trial. Such routine reports can be created by putting all of the computational steps (data retrieval, analysis and report creation) into a UNIX shell script. This script can then be

documented and installed in the study reports directory. Once this is done, and tested, it can then be executed by anyone with access to the reports tool, the study, and privileges for the particular report. Of course some analyses must be performed by a skilled statistician each time they are done, but most of the summary reports created for trial and database management purposes are routine tables and graphs. In such cases setting up a shell script, which includes all of the steps needed to create the report, can relieve programmers and data analysts from those tasks which are simple, repetitive and time consuming and allow them to concentrate on those analyses which require more attention and skill.

7.3. Input Data Files

DFdiscover Study Files describes the location and format of all study files including: the data files created from the study CRFs, the quality control data base, the journal files used to record every transaction written to the study database, and all study configuration files. Any of these files might be needed as input to a study report program.

7.4. Programming Tools

DFdiscover includes several shell level programs which are described in Shell Level Programs. These programs can be used to export and reformat data, and read study configuration parameters. Any number of other programming tools might also be incorporated into shell scripts to create study specific report programs. These might include other DFdiscover programs (e.g. **DFsas**), UNIX commands (e.g. awk, grep, sed, sort), third party packages (e.g. SAS), report generators (e.g. perl) or even low-level programming languages.

With these tools, programmers can extract the data they need from the study database, and then analyze and summarize it using whatever programming tools they are familiar with or think most suitable to the task at hand.

7.5. An Example

The following shows a simple example of a UNIX shell script that reports subject entry by site for the past 9 months, as well as the total to date, for an example study.

The basic outline of this program is documented with comments (which begin with the # symbol). This hopefully is enough to give you an idea of the level of effort required to produce simple study specific reports. For those unfamiliar with UNIX shell programming, this may whet your appetite for an exploration of the many useful tools built into the UNIX operating system. You can accomplish a great deal without invoking big systems like SAS, and it's really not that hard, honest!

```
#!/bin/sh
# RANDOMIZATIONS BY SITE FOR PAST 9 MONTHS AND TOTAL TO DATE
# $1 is study number.
# yy = current year
# mm = current month
# hx = number of months to be printed
yy=`date +"%y"`
mm=`date +"%m"`
hx=9
# Export all primary randomization records (plate 1) received to date
# and use field 13 as the visit date. Site number is assumed to be pid/1000
/opt/dfdiscover/bin/DFexport.rpc -s primary $1 1 - | nawk -F\| '
BEGIN { YY="'$yy'"+0; m=MM="'$mm'"+0; HX="'$hx'"+0
    # determine which months are to be printed
    if(m >= HX) {
       for(i=HX;i>=1;i--) {k[i]=YY*100+m;--m}
    } else {
       jn = HX - MM
```

```
       jm = 13 - jn
       jy = YY - 1
       for(i=1 ;i<=jn;i++) {k[i]=jy*100+jm; ++jm}
       for(jm=1;i<=HX;i++) {k[i]=YY*100+jm; ++jm}
    }
}
{ # Read each exported record and count cases by month and center
    mon=substr($13,4,2); yr=substr($13,7,2)
    center=int($7/1000); yymm= yr*100 + mon
    n[yymm,center] +=1
    mtot[yymm] +=1
    ctot[center] +=1
}
END{ # Print Report
    printf"RECENT AND TOTAL RANDOMIZATIONS BY SITE\n"
    printf"SITE "
    for(i=1;i<=HX;i++) printf"%6d",k[i]
    printf" TOTAL\n\n"
    for(i=1;i<=200;i++) { # center number range is 1~200
        if( ctot[i]>0 ) {
           printf"%5d: ",i
           for(j=1;j<=HX;j++)
               if (n[k[j],i] > 0) printf"%6d",n[k[j],i];
               else printf "      ";
           printf" :%6d\n", ctot[i]
           SUM += ctot[i]
       }
    }
    printf"\nTOTAL: "
    for(j=1;j<=HX;j++)
        if (mtot[k[j]] > 0) printf "%6d",mtot[k[j]];
        else printf "      ";
    printf" : %5d\n", SUM
}'
```

When this UNIX shell script is installed in the study reports directory, and given execute permissions for the permitted members of the study group, it can be executed.

7.6. Writing Documentation for Study Specific Reports

The documentation for study specific reports must be kept in a separate file from the documentation for all standard DFdiscover reports. Specifically, it must be kept in the `.info` file in the study `reports` directory.

Report titles appear in the scrolling list of reports in the order in which they are defined in the file. Any reports not defined in this file will appear in alphabetical order at the end of the list of reports that have been defined.

The general layout of the file is repeating blocks, of the following structure, where each block contains the documentation for one report:

```
.BEGIN report_name       ❶
.TITLE report_title      ❷
.OPTION first_option     ❸
```

```
.OPTION next_option       ❹
documentation text        ❺
.END                      ❻
```

❶ The keyword `.BEGIN` indicates the beginning of the documentation for the report whose unique name is *`report_name`*. The name must exactly match the name of the report as it is located in the study `reports` directory.
❷ A descriptive title for the report.
❸❹ The `.OPTION` lines appear in the pop-up options menu when Options is selected.
❺ This text appears in the reports output window when Explain is clicked.
❻ This marker indicates where the end of the documentation for the report is.

Chapter 8. DFsas: DFdiscover to SAS®

DFsas is an intermediary between DFdiscover and SAS®. It can be used to extract summary data files from the study database and to create the corresponding SAS® job file for subsequent processing by SAS®.

> **SAS® version 7 assumed**
>
> Unless otherwise stated, the SAS® functionality described herein is based upon version 7.

8.1. An Example

DFsas reads specifications from a **DFsas** job file. As an introduction to **DFsas** consider the following example **DFsas** job file.

Example 8.1. Typical DFsas job file

```
# GLOBAL SPECIFICATIONS
DFNUM 248
SASDIR /studies/df248/sas
SASJOB test
SASVERSION 7
CHECK labels
CHOICE codes
VLABEL yes
BLANK all asis
RETAIN QUOTES no
MISSING all asis
MISSING missed .L
NOVISIT .
RECSTATUS final incomplete missed
RECLEVEL all
MERGE yes

# DATA RETRIEVALS
# variables from plate 001, seq 001
RECORD 1
9 race labels
10~31
# variables from plate 002, seq 000 to 005
RECORD 2 0~5
9 vdate
11 SBP
12 DBP

# SAS PROCS
SAS
proc print;
```

Executing **DFsas** with the example job file results in the creation of 3 files: `test.sas` (the SAS® job file), and `test.d01` and `test.d02` (two data files, one for each of the 2 record types specified in the **DFsas** job file). The SAS® job and data files created by **DFsas** are plain ASCII files, which can be moved to any platform capable of running SAS®.

From the above example, one can see that a **DFsas** job file has three parts:

- global specifications
- data retrievals
- SAS® procedures

8.1.1. Global Specifications

The global specifications identify the study database, SAS® job name, and those specifications that are to be applied to all data fields. The global statements in Example 8.1, "Typical **DFsas** job file" include the following:

- The `DFNUM` statement identifies the DFdiscover study number (248 in this example) for which the SAS® job is to be created.
- The `SASDIR` statement identifies the full path name of the directory where the **DFsas** job file can be found and where the output SAS® job and data files are to be written.
- The `SASJOB` statement identifies the name of the **DFsas** job file. This file includes all of the specifications needed to create the SAS® job and data files. This name also serves as the root name of the SAS® files to be created. In the example, `test.sas` will become the name of the SAS® job file, and `test.d01` and `test.d02` will become the names of the SAS® input data files.
- The `SASVERSION` statement specifies the version of SAS® to be used with the SAS® job file created by **DFsas**. This statement is created by specifying the `-SAS #` option when generating the **DFsas** job file. If this option is not specified, the default of SAS® version 7 is used.
- The `CHECK` statement is used to specify the desired output for check fields (i.e. those data fields defined by a single box which is either checked or not). In our example we are requesting that the labels specified in the study schema be written to the data files for all check fields (instead of the numeric codes, `0` and `1`). All check fields must have labels defined in the study schema [1]. Note that local specification of `codes` at the variable level overrides specification of `labels` at the global level.

  If labels are to be written, **DFsas** encloses the label in double quotes and removes any double quotes present in the label's text. Single quotes present in the label text are preserved.
- The `CHOICE` statement is used to specify the desired output for choice fields (i.e. those fields like race, for which there are 2 or more response options). As with `CHECK`, the options are `codes` or `labels`. In the example, codes have been requested. If labels are requested **DFsas** will read them from the study schema. **DFsas** will enclose the label in double quotes and remove any double quotes present in the label's text. Single quotes present in the label text are preserved. If no labels are found, **DFsas** will default to the numeric codes. Note that local specification of `codes` at the variable level overrides specification of `labels` at the global level.
- The `VLABEL` statement, followed by `yes` indicates that SAS® variable labels are to be written to the SAS® job file. These labels are read from the description of each field found in the study schema.

  When writing variable labels, **DFsas** encloses the label in double quotes and removes any double quotes present in the variable description text. Single quotes present in the variable label are preserved.
- The `BLANK` statement is used to identify how blank fields are to be written to the data files. In the example, all blank fields will be written as they are (i.e. they will remain blank).
- The `RETAIN QUOTES no` statement instructs SAS to discard any quotation marks when reading string fields from the input data files. If no is changed to yes, quotation marks are preserved.

[1] If a label is not provided in **DFsetup** by the user, **DFsetup** writes out the code as the label.

- The `MISSING` statement is used to identify how fields that contain a DFdiscover missing code, are to be written to the data files. In the example `MISSING all asis` specifies that all missing codes are to be output as they are, (i.e. without any re-coding). The `MISSING missed .L` statement specifies that the missing value code `.L` is to be output in fields exported from missed data records.

- The `NOVISIT` statement is used to specify a value to be used for all variables for visits that do not exist in the database for a subject, when constructing data records containing variables that are repeated across visits. The SAS® `.` (dot) missing value code has been used in the example.

- The `RECSTATUS` command is used to select data records by record status. The default is to export all final, incomplete and missed data records.

- The `RECLEVEL` command is used to select tdata records by workflow level. The default is to export records at all levels. Levels can be specified using a list of values and ranges, as in: RECLEVEL 3-5,7.

- The `MERGE` statement followed by 'yes' specifies that the merge command needed to combine all of the data files into a single SAS® data set, should be included at the end of the SAS® job file. In cases where a more detailed merge command is needed, use `MERGE no`, and include a new merge specification at the top of the SAS® procedures section.

8.1.2. Data Retrieval Specifications

This section identifies the data fields to be extracted from the study database. The `RECORD` statement identifies the plate from which data fields are to be extracted. The plate number may be followed by a visit or sequence number or range, to identify the repetitions of the plate which are to be included. If there is only one possible sequence number for a particular plate, the sequence number need not be specified.

In the example, for each primary data record in the database with plate number 1, a summary data record will be written to `test.d01`. Each summary data record automatically includes the subject ID as the first data field. In the example, the subject ID is followed by data fields 9 through 31. The field numbers correspond to the numbering used in the study schema. The SAS® job file will automatically include the variable name ID for the subject ID. The variable name `race` will be used in the SAS® job file for field 9. Since variable names are not specified for fields 10 through 31, variable names for these fields will be taken from the study schema. If a variable's field name has been specified it will be used; otherwise the appropriate number of leading characters of the variable's alias will be used.

The variable `race` (a choice field) is also followed by the keyword `labels`. The result will be to output value labels (e.g. Caucasian, Asian, etc.) instead of codes for this particular choice field, thus overriding the global `CHOICE codes` specification. **DFsas** will enclose the labels in double quotes and remove any double quotes present in the text of the label. Single quotes present in the label's text will be preserved.

The retrieval specified for plate 2 will be written to file `test.d02`. It is similar, except that a range of visit numbers has been specified. One summary data record will be created for each subject who has at least one record in the specified set (i.e. plate 2, visit numbers 0 through 5 inclusive). In each summary data record, separate data fields are created for each of the specified sequence numbers. In retrievals of this type the sequence number is appended to each variable name when the SAS® job file is created. Thus the variable names written to the SAS® job file in the example will be: `ID`, `vdate0`, `SBP0`, `DBP0`, `vdate1`, `SBP1`, `DBP1`, etc. When variable names are not specified they will be taken from the study schema, and if a sequence number range is specified, the sequence number will be appended to each variable name. It is therefore important when specifying the variable field names to allow for the sequence number that will be appended when this type of retrieval is specified.

It is also possible to create a separate data record for each visit (or sequence) number that appears in the database. To do this, specify the plate number alone, without any qualifying visit or sequence numbers.

DFsas also includes the ability to create normalized records for adverse events, medications, medical history items, etc. This is not shown in the preceding example but is illustrated later in this chapter.

8.1.3. SAS® Procedures

DFsas will automatically write the commands required to merge the summary data files on subject ID to the SAS® job file (unless `MERGE no` is specified in the global specifications section). In addition, all lines at the end of a **DFsas** job file, following the SAS® statement, are written to the end of the SAS® job file. In the example, after the data is merged into a SAS® data set it will be printed using the SAS® print procedure.

8.1.4. Running DFsas

After

```
% DFsas test
```

is executed to create the SAS® job file, `test.sas`, and the data files, `test.d01` and `test.d02`, the job can be submitted to SAS®. If SAS® is installed on the same machine being used to run **DFsas**, SAS® can be run directly with the command:

```
% sas test.sas
```

SAS® will put the output from the print command in file `test.lst`, and will write job control and messages to file `test.log`.

8.2. Creating a DFsas job file

A **DFsas** job file can be created manually by using a text editor (e.g. vi) and following the syntax described in detail later in this chapter. But a quicker method is to first use the **DFsas** job creation option to build an initial **DFsas** job file for all variables in the database or all variables on specified plates, and then use an editor to make any desired modifications. Modifications might include:

- changing global statement options
- removing specifications for variables that are not required
- changing variable names or labels
- specifying the desired sequence number range for specified plates, or
- indicating how a normalized data set is to be created

8.2.1. Impact of SAS® limits

SAS® imposes various limits, those limits vary with SAS® version and those limits have an impact upon the behavior of **DFsas**. Specifically, there are character limits on variable name, variable description and maximum length of text/string value. **DFsas** enforces the following maximums:

- for SAS® version 6, and older:
  - variable name length = 8 characters
  - variable description length = 40 characters
  - text/string length = 200 characters
- for SAS® version 7, and newer:

- variable name length = 32 characters
- variable description length = 256 characters
- text/string length = 32767 characters

8.2.2. Creating an initial DFsas job file

An initial **DFsas** job file is created by using the `-c` (or `-C`) option. Option `-C` includes all variables while `-c` includes all variables except for the following meta variables:

- `DFRASTER` (the DFdiscover CRF page identifier)
- `DFSTUDY` (the DFdiscover study number)
- `DFPLATE` (the DFdiscover plate number)
- `DFCREATE` (the record creation date/time field)
- `DFMODIFY` (the last date/time the record was modified)
- `DFSCREEN` (screen value of the record status)

These fields are infrequently used in a SAS® analysis and can thus generally be omitted by using `-c` instead of `-C` when creating a **DFsas** job file.

Example 8.2. Build a DFsas job file named `job1` for all variables on all plates for study number 7.

```
% DFsas job1 -C 7 -p all
```

The **DFsas** job file created by this command contains the field number, name and description of all data fields described in the study schema for all user defined study plates in the range 1-500, plus DFdiscover plates 510 (reasons) and 511 (queries). Users can then scan the list of variables and remove any that are not required.

To create a **DFsas** job file for specified plates, replace the keyword `all` with a list of the desired plate numbers, as in:

```
% DFsas job1 -c 7 -p 1~3 6 10~12 33
```

8.2.3. String splitting

To split long string fields into a number of smaller fields use `-s` like this:

```
% DFsas job1 -C 7 -p all -s 200
```

This example splits all string fields that are defined with a maximum length greater than 200 characters into multiple fields of 200 characters each. For example a 500 character comment field named `COMMENT` would be split on word boundaries into 3 fields named `COMMENT1`, `COMMENT2` and `COMMENT3`, each with a maximum of 200 characters. If `-s` is specified, **DFsas** uses the SAS® version number to decide how long it can make the new variable names that it needs to create. **DFsas** creates a new variable for each substring by using the variable name as a base and adding a number (1, 2, 3, etc.). If SAS® version 6 or earlier is being used and the variable name is already 8 characters long, **DFsas** will reduce it as needed to keep the resulting variable names within the 8-character limit. For example, splitting a field named `LONGNAME` produces fields named `LONGNAM1`, `LONGNAM2`, etc. If SAS® version 7 is specified, a limit of 32 characters will be imposed when creating new variable names for each substring.

Warning for shortened names

A warning message is printed whenever **DFsas** has to shorten an existing variable name.

String splitting may be needed for versions of SAS® 6 and older, as they will not read string fields that are longer than 200 characters. As described later, a **DFsas** job file may include instructions to split specified string fields into 1 or more shorter fields. When creating a default **DFsas** job file, using `-c` or `-C`, one can instruct **DFsas** to automatically include the specifications needed to split all string fields that are longer than a specified maximum length by also specifying `-s`.

Warning for long fields

A warning message is printed if the **DFsas** job file specifies string fields longer than the SAS® maximum and that have not been split into smaller strings. This is merely a warning as **DFsas** can be used to assemble data sets for purposes other than SAS®.

8.2.4. String truncation

To truncate long string fields, use `-t` as in:

```
% DFsas job1 -C 7 -p all -t 200
```

which truncates all string fields to a maximum of 200 characters.

Use `-t` to truncate string fields to a specified maximum character length. Truncation occurs at exactly the specified number of characters, even if this truncates the string in the middle of a word. Strings that are shorter are not affected.

8.2.5. Date exporting

To export dates in calendar, string, original or julian formats use the `-d` option. As described in Section 8.4.2, “Qualified Dates”, **DFsas** can export each date field in one or more of 4 different formats. When creating a default **DFsas** job file, using `-c` or `-C`, you can automatically generate the specifications needed to have all dates formatted in one or more of these formats by using `-d` followed by one or more of the single letters (date qualifiers) `csoj` to specify the desired date formats.

For example, the following command will generate the **DFsas** specifications needed to convert all dates on plates 1-3 to both c (calendar) and s (string) formats.

```
% DFsas job1 -C 7 -p 1~3 -d cs
```

This results in creation of 2 output fields for each date field. These fields are named by appending 1,2,3 etc. to the original field name. **DFsas** uses the SAS® version number to determine the maximum length allowed for these variable names (see Impact of SAS® limits). If the base name is too long to generate a legal SAS® name by appending a number (1-4 in the case of qualified dates), then the base name is shortened and a warning message is printed similar to the following: `WARNING: date datename -> datenam1 to datenam4 (SAS 8 char names)`

8.2.6. A sampling of other options

To select subjects use `-I` as in:

```
% DFsas job1 -C 7 -p all -I 1001~1999,3001~3999,5066
```

Use `-I` to specify a list of subject IDs to be included in the SAS® data sets. In the above example, 2 subject ID ranges and one single value have been specified. If this option is not used all subjects with primary records for the specified plates will be included. Note that the specified ID string must not contain spaces.

To select data records having a specified list of visit numbers, use `-v` as in:

```
% DFsas job3 -C 254 -p all -v 0~99
```

In the above example, a range of visit numbers (0-99) has been specified. If this option is not used, **DFsas** will create **DFsas** job files for all visits.

To suppress warning messages, use `-w` as in:

```
% DFsas job2 -C 254 -p all -w
```

8.3. Creating SAS® job and data files

After you have setup a **DFsas** job file, you can execute **DFsas** again, this time with no options, to create the SAS® job file and assemble the required summary data files. Variable name and label lengths created in the data files will be determined by the SAS® version number specified in the global SASVERSION statement in the **DFsas** job file (see Impact of SAS® limits).

Example 8.3. Create SAS® job file and data files for DFsas job file `job1`

```
% DFsas job1
```

DFsas creates the SAS® job file (`job1.sas`) and the required data files (`job1.d01`, `job1.d02`, `job1.d03`, etc.). These are plain ASCII files that can be copied to the computer used to run SAS® and submitted for execution.

DFsas displays the number of subjects and number of records written to each data file, as it proceeds to build the data files.

```
1. RECORD 1    Subjects = 172    Records = 172
2. RECORD 2    Subjects = 154    Records = 154
3. RECORD 3    Subjects = 152    Records = 152
```

8.3.1. Force Option

If a **DFsas** job file requests data from a plate that contains no data, **DFsas** will not create an output data file or SAS® input statements for that plate, unless the force option is used. The force option is invoked by including `-f` on the command line after the **DFsas** job file name.

```
% DFsas job1 -f
```

8.3.2. Export Script Option

By default, the data export script created when building a **DFsas** job file is removed after it is executed. Including `-dbx` as a command line option preserves the data export script.

```
% DFsas job1 -f -dbx -c 7 -p all
```

This script may be useful for debugging purposes but is not required for proper operation of **DFsas** or SAS®.

8.3.3. Use Field Alias Option

The default behavior of using field names will not create a valid SAS job file when used on a study that has more than one instance of a module, whether on the same or on different plates. Including `-a` in the command line creates job files using the field alias and will work as expected provided all field aliases are unique for all fields.

```
% DFsas job1 -a
```

8.3.4. Syntax Checks

DFsas performs limited checks on the integrity of the **DFsas** job file before proceeding to create the SAS® job file and data files. In general it is up to the user to make sure that SAS® rules for variable names, labels, missing value codes, etc. are followed. **DFsas** checks the following:

- **`DFNUM`.** Has a legal DFdiscover study number been specified?
- **`SASDIR`.** Does the SAS® directory exist?
- **`SASJOB`.** Has a SAS® job name been specified?
- **Reserved character, `|`.** Has the field delimiter been used inappropriately? **DFsas** checks for illegal use of `|` in the specification of fixed fields, default labels for check fields and recoded values for blanks and missing value codes.
- **Plate and variable numbers.** Have legal values been specified? **DFsas** checks the specified plates to verify that they have been defined for the study, and also verifies that the specified field numbers have been defined for each plate.
- Field numbers do not contain extraneous characters (e.g. `12-`, `12.`, `12a`, `a12`, etc).
- Field number ranges are legal (e.g. `12~55`, and not: `55~12`, `12~15~55`, etc.)
- If a string split is specified, is the field a string?
- No more than one field qualifier is used on any field.
- If a date qualifier is specified, is the field a date?
- **Variable name and label length.** **DFsas** checks the length of all variable names and labels in the **DFsas** job file and prints error messages and stops if there are any which exceed the limits of the specified SAS® version.

  If the **DFsas** job contains a request to split a specified data field, **DFsas** uses the `SASVERSION` statement to determine the maximum length allowed for the variable names that it creates (see Impact of SAS® limits).

8.4. Date Fields

Dates are governed by the global statements `IMPUTE`, `INFORMAT` and `OPTIONS` and by the date field qualifiers, `jocs`.

8.4.1. Global Statements

The `IMPUTE` statement controls how date values for SAS® are imputed from DFdiscover partial dates.

- **`IMPUTE no`.** Date fields are exported exactly as they appear in the database, regardless of what imputation method has been defined.
- **`IMPUTE yes`.** All 2-digit years are converted to 4 digit years using the pivot year defined for each date. In addition the imputation method defined in the study schema for each date field is used to convert missing days and/or months to legal values. If the imputation method is set to none only 2 digit to 4 digit year conversions are performed. When imputing dates, any nonsensical dates, i.e. dates with impossible values for day, month or year, are converted to the default DFdiscover missing code, `*`. If other missing value codes have been defined for the study, any dates that use them will retain their original missing value code.

The `INFORMAT` statement controls the type of SAS® `informat` statements **DFsas** generates.

- **`INFORMAT dates.`** Create SAS® `informat` statements for date fields that SAS® recognizes. DFdiscover allows some date formats that SAS® does not recognize as dates, (e.g. Jan 25, 2001). When this global statement is used, date fields with formats that SAS® does not allow are converted to string fields and a corresponding character `informat` statement is created.
- **`INFORMAT all.`** Convert all fields to type character, including dates.
- **`INFORMAT all dates.`** Use date formats for all date fields and convert all other fields to type character.

Finally, 4-digit year imputation from 2-digit years can be achieved through the SAS® `OPTIONS YEARCUTOFF` statement. The **DFsas** global statement:

```
OPTIONS YEARCUTOFF=yyyy
```

instructs **DFsas** to add a SAS® `YEARCUTOFF` statement to the job file, such that *yyyy* defines the beginning of a 100 year period for imputing the century in 2 digit dates.

Example 8.4. Using `OPTIONS YEARCUTOFF`

With the following **DFsas** global statement,

```
OPTIONS YEARCUTOFF=1940
```

years 40 to 99 will be interpreted as 1940 to 1999, and years 00 to 39 will be interpreted as 2000 to 2039.

> **One YEARCUTOFF statement per SAS® job file**
>
> SAS® only allows one `YEARCUTOFF` statement per job file that can be a problem when trying to allow for both a birth date and a recent follow-up visit date. In such situations it may be preferable to let DFdiscover do the imputation by using the global **DFsas** statement `IMPUTE yes`.

8.4.2. Qualified Dates

The global statements already described set the desired format for all dates. This can be overridden at the individual field level by using one of the date qualifiers, *`jocs`*, after the date's field number, as in:

```
12:c
```

which will output field 12 as a calendar date. Qualified dates will be written with an `INFORMAT` statement appropriate to the qualified date format, and will override the global statement `INFORMAT all`, if present.

The date qualifiers are:

- **`:j` - julian value.** This option converts the date to a number representing the number of days since a date in 4712 BC. No informat statement is written to the SAS® job file as this is treated by SAS® as a number.
- **`:o` - original value.** This option turns off imputation to yield the value exactly as it appears in the database, overriding any global specification `IMPUTE yes`.

  With this date qualifier a date informat statement is written to the SAS® job file using the original date format specified in the study schema. This option should only be used for fields that cannot contain a partial date. Otherwise SAS® will complain.
- **`:c` - calendar value.** This option converts 2 digit years to 4 digit years and performs imputation as specified in the study schema. If imputation leads to a nonsensical date it is converted to `*`, the DFdiscover default missing value code. When `:c` is specified the appropriate date informat statement is written to the SAS® job file overriding any global `INFORMAT` statement.

- **`:s` - string value.** Like the `:o` option, `:s` also turns off imputation to yield the value exactly as it appears in the database, but the field is considered to be a string and thus a character (not date) informat statement is written to the SAS® job file. This option allows one to output partial dates exactly as they appear in the database with a character informat that SAS® will accept.

8.4.3. Time Qualifiers

In addition, to date qualifiers, **DFsas** includes time qualifiers that cause **DFsas** to generate appropriate SAS® time types. Time variables in DFdiscover are handled correctly automatically, however this qualifier must be applied manually to numeric or string fields that have the format `nn:nn` or `nn:nn:nn`.

- **`:t5` - SAS time type `TIME5`.** This option indicates that the field is to be identified as the SAS® time type, `TIME5`, represented as `HH:MM` The appropriate SAS® informat statement is written to the SAS® job file for any fields so qualified.
- **`:t8` - SAS time type `TIME8`.** This option indicates that such fields are to be identified as SAS time type `TIME8`, represented by `HH:MM:SS`. The appropriate SAS® informat statement is written to the SAS® job file for any fields so qualified.

8.4.4. Default Actions Performed When Creating a DFsas Job File

When creating a default **DFsas** job file, with `-c` or `-C`, the following rules are applied:

- The global statement `INFORMAT dates` is written to the **DFsas** job file.
- If all dates in the study schema use the same pivot year, **DFsas** creates the following global statements:

```
OPTIONS YEARCUTOFF=yyyy     ❶
IMPUTE no
```

❶ where *yyyy* is set to the common pivot year

- If all dates do not use the same pivot year a `YEARCUTOFF` statement cannot be generated because SAS® only allows one such statement. Instead, **DFsas** converts all dates to 4 digit years using the global statement `IMPUTE yes`.
- If more than one output format is requested for date fields using the `-d` *`csoj`* option, **DFsas** creates a unique variable name for each of the output date variables by appending 1, 2, 3, 4 to the variable name. **DFsas** uses the SAS® version number to determine the maximum length allowed for these variable names.

8.5. String Fields

This section includes a description of how global statements can be manipulated for string fields.

8.5.1. String Splitting

SAS® cannot input a string field that is longer than 200 characters. DFdiscover allows much longer string fields. Thus when preparing string fields for SAS® it is necessary to either truncate strings that are longer than 200 characters or split them into multiple shorter fields. This can be done within a **DFsas** job file using the same string splitting syntax used by **DFexport.rpc**.

Example 8.5. String splitting

Field 44, a 500-character field named `comment`, is split into 5 fields of up to 100 characters each. The `w` qualifier specifies that splitting is to occur on word boundaries. The field names are created by appending 1,2,3, etc. to the root name provided in the **DFsas** job file. The resulting 5 fields are named `comment1`, `comment2`, `comment3`, `comment4` and `comment5`.

DFsas uses the SASVERSION statement in the **DFsas** job file to determine the maximum lengths allowed for the variable names it creates.

```
44:5x100w   comment   "Physician comment field"
```

It is also possible to split string fields on exact character boundaries, by using the c qualifier.

```
44:5x100c   comment   "Physician comment field"
```

String fields may be truncated by specifying a split that does not add up to the original field length, as in:

```
44:2x200w
```

This creates 2 fields of not more than 200 characters each, with the division occurring on word boundaries. If it is necessary to truncate the second field, truncation will occur on a word boundary.

Similarly,

```
44:1x200c
```

truncates field 44 to not more than 200 characters. In this case truncation will occur on a character boundary and thus may occur in the middle of a word.

When creating a normalized data set, field names are specified after the NORMALIZE key word. A separate name must be specified for each of the string fields that result from any string field splitting that is specified in the data record creation section that appears after the RECORDS keyword, as in this example:

```
NORMALIZE if(length(drug) > 0)
drug "Drug name"
why1 "Drug indication - part 1"
why2 "Drug indication - part 2"

RECORDS 200
20,25:2x200w
30,35:2x200w
40,45:2x200w
```

8.5.2. Extracting Sub-Strings

New fields can be created consisting of substrings of database fields. The specification is: field number : start_character x number_of_characters. Substrings can be extracted from any field type: strings, dates, or numbers. But substrings are extracted from the string value of the field. So be careful with numeric fields; unless they are zero padded you may not get the results you want. In the following example variable sitenum is created from the 1st 3 digits of the subject ID field. This will give the desired results provided all IDs are zero padded, e.g. 001001 not 1001, for subject 1 at site 1.

```
7:1x3 sitenum "site number - 1st 3 digits of subject ID"
```

8.5.3. Retaining Quotes in String Fields

When SAS reads string fields from an input data file it normally removes any quotation marks it finds. This can be prevented by tagging string field names with ~$ instead of $ in SAS input statements. (Aside: per communication from SAS support, his trick only works when the DSD option is used in the INFILE statement; but this has been standard practice for reading the pipe delimited output files created by **DFsas** from the beginning.)

By default **DFsas** tags string fields with $ and thus quotes are removed. You can instruct **DFsas** to tag string fields with ~$ and thus retain input quotes, in 2 ways: by including the global statement

```
RETAIN QUOTES yes
```

which is applied to all string fields, or by using the `:q` field level qualifier on those fields for which quotes are to be retained, as illustrated in the following example.

```
RECORD 1
8 PINIT Subject Initials
9 AGE Age
10 SEX Sex
10:q PCOMP Subject complaint
```

There is one limitation. It is not possible to use more than one field level qualifier at a time. Thus you cannot instruct **DFsas** to both split a string field and retain quotes using field level qualifiers. The only way this can be accomplished is by using the global statement `RETAIN QUOTES yes` in combination with field level string splitting specifications. However, note that there is no guarantee that matching quotes will appear in each of the split string fields.

8.6. DFsas Job File Syntax

This section includes a detailed description of all **DFsas** commands. Each **DFsas** job file has three parts. Global specifications come first, followed by instructions for each of the summary data files to be created, and ending with any SAS® command lines you want to include in the SAS job file.

DFsas job files are constructed from records, where each record is composed of a keyword followed by value specifications for the keyword. Keywords and options must be typed exactly as illustrated in the examples. All keywords are in uppercase. Blank lines and extra spaces may be inserted anywhere to aid readability. Comments can be added on lines by starting them with a single octothorpe, `#`, followed by at least one space and then your comment.

8.6.1. Global Specifications

The global specifications, located at the top of each **DFsas** job file, apply to all of the subsequent data retrieval specifications in the job file. They include the following:

- **DFNUM.** This keyword is followed by the DFdiscover study number of the database from which you plan to export a SAS® data set. For example:

  ```
  DFNUM 248
  ```

- **SASJOB.** The file name specified after this keyword is the name of the **DFsas** job file and is also the root name for the SAS® job and summary data files created by **DFsas**.

  The following sets the **DFsas** job name to `job1`:

  ```
  SASJOB job1
  ```

  The SAS® job file name is constructed by appending `.sas` to the specified job name, constructing a filename similar to `job1.sas`. A separate data file is created for each set of retrieval specifications introduced by the keyword `RECORD` or `NORMALIZE`. These summary data files are named by appending `.d##` (where ## is in the range 01 to 99, inclusive) to the job name (e.g. `job1.d01`, `job1.d02`). Summary data files are numbered in the order in which they appear in the **DFsas** job file.

- **SASVERSION.** When using the `-C` or `-c` option to create a default **DFsas** job file, the target SAS® version can be specified on the command line using the `-SAS #` option. SAS® version 7 is the default if the `-SAS #` is not specified. Each **DFsas** job file contains a `SASVERSION` statement regardless of whether or not the `-SAS #` is explicitly specified on the command line.

```
SASVERSION 7
```

- **SASDIR.** The SAS® job file and summary data files created by **DFsas** are written to the directory specified by the value of this keyword. A full path name must be given.

```
SASDIR /studies/mystudy/sas/baseline
```

- **RUNDIR.** If you plan to move the SAS® job and data files created by **DFsas** to another platform, such that the files will be processed by SAS® from a different file location than they were created by **DFsas**, use this keyword and specify the location where you intend to install the files. If a RUNDIR statement is present, **DFsas** will use this directory when creating filename statements in the SAS® job file. Without the RUNDIR statement **DFsas** uses SASDIR when creating filename statements. A full path name must be given.

```
RUNDIR C:\studies\mystudy\sas\baseline
```

- **LIBNAME.** **DFsas** includes support for SAS® libraries, and also allows users to create their own data set names for both the individual data files corresponding to DFdiscover plates, and for the merged data set that currently has the default name `final`. SAS® libraries are used to save a SAS® data set created during a SAS® run, and to use a previously saved SAS® data set. When libraries are not used, the SAS® data sets created during a SAS® run are temporary, and are removed when the run is completed.

  SAS® libraries may be used by specifying the `LIBNAME` statement in the global specifications section of a **DFsas** job file as per the following example.

Example 8.6. SAS® data sets `mylib1` and `mylib2` are created by specifying the previously saved SAS® data sets of `baselib` and `aelib`, respectively, in a `LIBNAME` statement in the global section of a DFsas job file.

```
LIBNAME mylib1 `C:\studies\study254\sas\baselib'
LIBNAME mylib2 `C:\studies\study254\sas\aelib'
```

> **Note**
>
> **DFsas** will not create the `LIBNAME` if it does not exist. The user must do this.

Data set names may be specified for each input data file by including a `DATA` statement immediately following the `RECORD` statement used to introduce data set specifications for a plate in a **DFsas** job file, or immediately below a normalized data set.

Example 8.7. The data set name `mylib1.vitals` is specified using a `DATA` statement following the `RECORD` statement for plate 5.

```
RECORD 5
DATA mylib1.vitals
```

Example 8.8. The data set name `mylib2.meds` is specified using a `DATA` statement following the `NORMALIZE` statement for normalized data set specifications.

```
NORMALIZE if( length(medname)>0 )
DATA mylib2.meds
```

To change the name of the final merged data set, from the current default value of `final`, add the desired name of the merged data set to the global `MERGE` statement.

Example 8.9. The name `mylib1.baseline` replaces the default name of `final` using the `MERGE` statement in the global specifications section of a DFsas job file.

```
MERGE yes mylib1.baseline
```

- **OPTIONS.** A **DFsas** job file may include one or more OPTIONS statement to define SAS® options. For example,

```
OPTIONS YEARCUTOFF=1940
OPTIONS PAGESIZE=60 LINESIZE=72 NOCENTER
```

- **IDNAME.** When **DFsas** is used to create a **DFsas** job file it determines the field variable name assigned to the subject ID field from the first plate in the schema and writes this out as the global IDNAME statement. The variable name can be changed to any desired value, keeping in mind the SAS® restrictions on variable names. If the IDNAME statement does not appear in a **DFsas** job file, **DFsas** uses the name ID.

- **SUBJECTS.** This statement can be used to specify a list of subject IDs and ID ranges to be included in the SAS® data sets. The default setting is

```
SUBJECTS all
```

  which includes all subjects who have a primary data record in at least one of the plates being extracted from the study database.

Example 8.10. Select a subset of subjects

The following statement selects subject IDs in the range 1001 to 1999, 3001 to 3999, and values 5501 and 6002. The order in which the values are specified is not important.

```
SUBJECTS 1001~1999,3001~3999,5501,6002
```

- **VISITS.** This option can be specified on the command line during SAS® job creation by using the option **`-v`** ***`visit#_list`*** or added to the global specifications section by editing the **DFsas** job file. If this option is not specified, **DFsas** will create **DFsas** job files containing the global statement `VISITS all`. For backwards compatibility, **DFsas** will assume `VISITS all` if the `VISITS` global statement is missing from a **DFsas** job file.

  This option is similar to the existing `SUBJECTS` option in that both are applied during data export. Since data export occurs before data record processing, this option takes precedence over the visit specification on the `RECORD` statement. Thus, for example, specifying `RECORDS 12 20`, which indicates the creation of a data file for plate 12, visit 20, would produce no output at all if the global `VISITS` statement was not set to `all` or did not include `20`. Also, if the global `VISITS` statement has already been used to select visit `20`, the `RECORDS` statement would not need to include the visit specification. For example, `RECORDS 12` would be adequate to produce the desired data file.

  The specified visit number list is applied to all of the specified plates. It is not necessary that all visits be relevant for all plates.

  > **Note**
  >
  > The `VISITS` option does not allow the specification of different visit numbers for different plates.

- **SUBJECTALIAS.** Specifying

```
SUBJECTALIAS yes
```

  instructs **DFsas** to export the subject alias as the identifier in place of the traditional subject ID. It is possible to include both subject ID and subject alias by specifiying

```
SUBJECTALIAS yes
```

and also requesting field 7 in the list of fields to be exported.

- **CHECK.** Check fields are data fields that are entered using a single box which is either checked or left blank. An example might be a question that asks the investigator “Check all of the symptoms that apply to this subject from the following list”. Each of the symptoms will have a check box with only 2 possible values, for example, 1 if the box was checked and 0 if it was left blank.

  This keyword is used to control the output for all data fields of this type. You may either print the codes (e.g. 0,1) or replace them with the labels specified in the study schema.

  The 2 possibilities are specified as follows:

  ```
  CHECK codes
  ```

  which outputs the codes (e.g. 0, 1) for all check fields and creates a proc format statement for the value labels, and

  ```
  CHECK labels
  ```

  which outputs the schema labels (e.g. no for 0, yes for 1).

  When using the labels option, missing value codes are preserved. If you request labels for all check fields, but have not specified any labels for a particular check field in the study schema, **DFsas** will use the codes.

  The default for this global specification is `CHECK codes`, meaning that the numeric codes found in the database will be output to the SAS® data file if this statement does not appear in your **DFsas** job file.

  You can override the global specification of labels or codes at the individual field level as described in Data Retrieval Specifications.

- **CHOICE.** Choice fields consist of a question followed by 2 or more mutually exclusive response options. Examples include: race, yes/no questions, severity mild/moderate/severe, etc. As for check fields, choice fields can be output as either codes or labels,

  ```
  CHOICE codes
  CHOICE labels
  ```

  When codes are output to the data file, **DFsas** creates a proc format statement for value labels and writes it to the SAS job file.

  Because the choice data type will apply to fields having many different response options it doesn't make sense to have default labels. Thus if you request labels and **DFsas** cannot find them in the study schema it will simply output the codes. As for check fields, **DFsas** will first check for missing value codes before substituting value labels for the codes stored in the database.

  The default for this global specification is `CHOICE codes`, meaning that the numeric codes found in the database will be output to the SAS® data file if this statement does not appear in your **DFsas** job file.

  You can over-ride the global specification of labels or codes at the individual field level as described in Data Retrieval Specifications.

- **IMPUTE.** Dates which use 2 digit years can be converted to 4 digit years and missing day and/or month values can be imputed with this statement, such that

  ```
  IMPUTE no
  ```

disables imputation and outputs dates as they appear in the database and

```
IMPUTE yes
```

enables imputation and imputes the day and month in partial dates and convert 2 digit years to 4 digits.

Imputation of day and month, and conversion of 2 digit years to 4 digit years is performed using the imputation method and pivot year set in the study schema.

If a date variables has its imputation method set to `never`, imputation by **DFsas** will only result in conversion of 2 digit years to 4 digit years.

If a date is nonsensical, (i.e. does not yield a true date even after application of the imputation method, if any) imputation will output the DFdiscover default missing value code, `*`.

If a date field is blank or contains a missing value code, as defined in the study missing values map, imputation has no effect, i.e. the field will be output as is, with a blank or missing value code.

> ## IMPUTE and RECODE
>
> The use of imputation in a **DFsas** job file (via any of the ways that it can be done) has the potential of creating missing value codes and thus the `RECODE` statement should be used to change the DFdiscover `*` to either the SAS® `.` or some other user-defined missing value code that SAS® will accept. If the user has defined a missing map which only contains legal SAS® missing value codes, then the `RECODE` statement could still be used for dates. For example,
>
> ```
> RECODE date *
> ```

- **NUMBER.** Numeric fields may be defined with labels, just like choice and check fields. In such cases you have the option of outputting the numeric values, as in

  ```
  NUMBER codes
  ```

  or, the labels defined for the values, as in

  ```
  NUMBER labels
  ```

- **STRING.** It is rare to put value labels on string fields but DFdiscover does allow it. For example single letter entries in a string field may be used as codes for longer descriptions that are defined in value labels. In such cases you have the option of outputting the string values,

  ```
  STRING codes
  ```

  or the labels, as in:

  ```
  STRING labels
  ```

  If string splitting is used in conjunction with a request for labels and the resulting split string values are coded with labels, the labels will be output.

Example 8.11. STRING coding and string splitting

Suppose you have a string field where you enter codes for problems that have occurred

A = "lost to follow-up"
B = "temporary withdrawal from treatment"

...
Z = "zero interest in this study"
Further, the user enters any combination of the letters A-Z into the string field in the database. To export the labels, one could then include

```
22:12x1c prob labels
```

in a record specification, such that the string field is field 22 and has a maximum length of 12 characters. The record specification would produce 12 fields named prob1 to prob12, each containing the label corresponding to the letter, or the letter itself if no label is defined.

- **RETAIN QUOTES.** This statement determines how SAS input statements are written for string fields. If

```
RETAIN QUOTES no
```

is specified (which is also the default setting), string field names are followed by a $ sign, and SAS will remove any quotation marks found in these fields when the input data files are read. If

```
RETAIN QUOTES yes
```

is specified, string field names are followed by ~$, which instructs SAS to retain quotation marks.

- **VLABEL.** Specifying

```
VLABEL yes
```

instructs **DFsas** to include variable labels in the SAS® job file. Variable labels are copied from the field descriptions included in the study schema file, with the exception that any double-quote characters appearing in the field description are removed from the variable label.

- **VALFMT.** If `VALFMT yes` is specified, equivalent `proc format` value label statements will be written to the SAS® job file for each variable that has code labels defined in it's style or variable definition in the study schema. With value formats defined in the SAS® job file, users can elect to use the data values as in the SAS® statement `proc print`, or use the value labels as in the SAS® statement `proc print label`.

  DFsas creates value formats for all variables that have code labels, whether they are defined in the style or at the variable level. If code labels are defined in the style, the style name is used as the value format name in the SAS® job file, unless the style name would be an illegal SAS® name, in which case **DFsas** makes up a legal SAS® name. The style name must meet the SAS® restriction that it be no longer than 8 characters, start with a letter or underscore, thereafter contain characters that are letters, digits, or an underscore, and not end with a digit. If the code labels are defined at the variable level (instead of in a style), **DFsas** makes up a new SAS® value format name.

  When **DFsas** creates a value format name, it does not check to see if the variable codes and labels exactly match another value format already in use. Thus if coding and labels are not defined in the style, it is possible that **DFsas** may create and use more value formats than are really required. If the same code labels are used by more than one variable, it is recommended that the codes and labels be defined in a style which the variables then use.

  When creating new value format names, **DFsas** uses F####v where #### starts at 0001 and is incremented for each new value format name that **DFsas** creates as it reads through the list of study styles stored in the file `DFschema.stl`. `v` is the visit number which is appended to the variable's field name. There is one exception. For DFSTATUS and DFSCREEN variables, which are DFdiscover protected fields appearing on every plate, **DFsas** uses value format names `DFSTATv` and `DFSCRNv` respectively. Thus these 2 names should not be used for user-defined styles with code and label definitions of their own.

  For normalized records **DFsas** creates SAS® value formats based on the code labels defined in the study schema for the first data record defined in the block of normalized records. Typically all records in the normalized block have the

same variables with the same codes (which is why they are being normalized) but **DFsas** does not check to make sure that this is the case.

Value format and variable names

SAS® requires that value format names be different from variable names. DFdiscover does not impose this restriction and currently **DFsas** does not check for this possible SAS® error.

- **BLANK.** Data fields which are blank (i.e. empty) in the database can be output as they are or can be recoded to some other value (e.g. the SAS® `.` missing code). Since check and choice fields contain a numeric code when no box has been selected, check and choice fields are never blank. Consequently the `BLANK` global specification only applies to string, date and numeric fields.

  The `BLANK` keyword is followed by either the keyword `all` or by the data type from the list `string`, `date`, or `int`, which is to be recoded. This is then followed by either the keyword `asis` or by the value to be inserted for blank fields. For example,

  ```
  BLANK all asis
  ```

  outputs all blank fields without any recoding.

  ```
  BLANK all .
  ```

  recodes all blank fields to a period.

  ```
  BLANK all blank
  ```

  recodes all blank fields to the word `blank`.

  ```
  BLANK string .
  ```

  recodes blank string fields to a period.

  ```
  BLANK int 0
  ```

  recodes blank int fields to 0.

  It is legal to include more than one `BLANK` specification, to specify different recoding instructions for string, date and int data types. Any such field type specifications will take precedence over a `BLANK all` specification.

- **RECODE.** A `RECODE` statement can be used to recode all data fields of a given type. Since SAS® provides extensive recode capabilities, only minimal recoding has been implemented in **DFsas**. **DFsas** only allows one `RECODE` statement per data type and only allows for the replacement of one data value by another.

  The `RECODE` keyword is followed by the data type, from the list `check choice string date int`, which is to be recoded. This is followed by the value to be recoded and then the new value to be written to the SAS® data input files. For example:

  ```
  RECODE choice 0 .
  ```

  recodes 0 to a period in all choice fields, and

  ```
  RECODE check 0 9
  ```

  recodes 0 to 9 in all check fields

> **Note**
>
> If you request output labels instead of codes for check and/or choice fields, and a label has been specified for zero for some or all check and/or choice fields, then the label will appear in the data field, and the above recode specification will have no effect. The desired recode can however be obtained when outputting labels, by specifying the label that is to be recoded instead of the numeric value (see Recode Processing Order).

- **MISSING.** Data fields that contain a missing value code in the database can be output as they are or can be recoded to some other value. For example, while several different missing value codes may be used in a DFdiscover study, you might want to change all missing value codes to the SAS® `.` missing code for a particular SAS® analysis.

  The `MISSING` keyword is followed by either the keyword `all` or by the data type, from the list `check`, `choice`, `string`, `date`, or `int`, which is to be recoded. This is followed by either the keyword `asis` or by the value to be used in place of all missing codes. For example:

  ```
  MISSING all asis
  ```

  outputs all missing codes without any recoding,

  ```
  MISSING all .
  ```

  recodes all missing codes for all fields to a dot,

  ```
  MISSING all NA
  ```

  recodes all missing codes for all fields to "NA", and

  ```
  MISSING string .
  ```

  recodes all missing codes in string fields to a dot.

  It is legal to include more than one `MISSING` specification, to specify different recoding instructions for choice, check, string, date and int data types. However, if the `all` specification appears it takes precedence over all other specifications.

  When creating new SAS® job files, a second `MISSING` statement is included by default. This statement `MISSING missed` allows you to specify the missing value code to be used in data fields for missed records. The keyword `missed` can be followed by a user-defined missing value code that will be inserted into each data field after field 7 (Subject ID) in each missed data record. If the global statement `MISSING missed` exists with no missing value code specification, all data fields following field 7 are left blank for missed records.

  It is important to note that the `MISSING all` global statement described above will not insert missing value codes into fields of missed records. A separate `MISSING missed` statement must be specified in order to do this. However, if the `MISSING missed` statement specifies the DFdiscover missing value code (*) and a `MISSING all code` statement is used to recode DFdiscover missing value codes, then the `MISSING all code` takes precedence and this statement will apply to missed records as well.

  > **Note**
  >
  > The `MISSING missed` global statement will have no effect on the output unless missed records are requested by the `RECSTATUS` global statement (See RECSTATUS). By default, the `RECSTATUS` statement includes final, incomplete and missed records. If missed records are requested but a `MISSING missed` statement has not been included, or has been included but with no missing value code specification (i.e. literally as `MISSING missed`), all data fields following field 7 will be left blank for missed records.

The `MISSING` statement can also be used to specify that a SAS® `MISSING` statement is to be included in the SAS® job file created by **DFsas**. A SAS® `MISSING` value statement is generated if the **DFsas** job file contains the following:

```
MISSING SAS missing_value_list_from_study_missing_value_map
```

For example the global statement:

```
MISSING SAS A B C
```

will generate the SAS® `MISSING` statement:

```
MISSING A B C;
```

to indicate that the values A, B and C represent missing values.

> ## Note
>
> A `MISSING SAS` statement is generated automatically when **DFsas** is executed with `-c` or `-C`, regardless of whether or not `DFmissing_map` contains legal SAS® missing value codes. If only legal SAS® codes have been used the `MISSING SAS` statement should be removed, as SAS® expects this statement only for non-standard codes. The SAS® missing value statement is written at the top of each data step rather than just once at the top of the entire SAS® job file.

Example 8.12. Generate a SAS® job file called `testjob` for plate 5 of study #254, view the global `MISSING` statements, and recode all illegal SAS® missing value codes.

```
% DFsas testjob -c 254 -P 5
```

After executing the above command, we see that the SAS® job file `testjob` contains the following `MISSING` statements.

```
MISSING all asis
MISSING SAS * _A _U _N
```

We see that * is used as a missing value code in DFdiscover. This is not legal in SAS® and thus needs to be changed. An appropriate change might be to modify the `MISSING` statements in the job file to appear as follows:

```
MISSING recode * _D
MISSING SAS _D _A _U _N
```

- **F.** In addition to extracting data from the DFdiscover database you might also want to include fixed fields, i.e. data fields that contain the same value for all cases. An example might be a study protocol number or a study name that you want to be able to include in data listings. Another possibility is that you might plan to merge data sets from different studies at some point and want to have the protocol number included in the data set for subjects from each study.

  Fixed fields can be defined globally (in which case they are added to all data records from all plates) or they may be included in the variable list following the `RECORD` statement used to begin data retrieval from a specified plate (as described in Data Retrieval Specifications). Fixed fields can be defined for both normalized or non-normalized data sets.

  A fixed field is defined using a statement in the following format:

```
F fixed_value variable_name variable_label
❶                          ❷
```

  ❶ If the *`fixed_value`* includes spaces it must be enclosed in double or single quotes. If the fixed field contains non-numeric characters (i.e. characters other than 0-9 or `.`), or if the fixed field is enclosed in quotes it is treated as a

string field, otherwise it is considered to be of type int. A fixed field can not contain quotes within the string and the `:q` qualifier can not be used.

❷ Quotes may also be used around the *`variable_label`* but are not required.

Example 8.13. Common uses of fixed fields

```
F 18345 SNUM "Study Number"
F 44.171 PNUMBER "Protocol Number"
F "Study 44-171" PNAME "Protocol Name"
F 09/15/97 STARTDT "Study Start Date"
F "150mg" STDOSE "Study Treatment Dose"
```

The first example is interpreted as an int field and the last 4 examples are all string (character) fields.

Exactly the same format is used to specify fixed fields, whether defining them in the global statements section of the **DFsas** job, or locally in the variable list following a `RECORD` statement for a particular plate. The only difference is that globally defined fixed fields are inserted at the beginning of each data record immediately after the subject ID, while locally defined fixed fields are inserted in the position in which they are defined within the variable list. A **DFsas** job may include both globally and locally defined fixed fields.

There are 3 restrictions on fixed fields:

1. they can not contain single or double quotes
2. they can not contain the `|` or `-` characters,
3. and they can not begin with a minus/dash (`-`).

- **NOVISIT.** By specifying visit numbers after the RECORD statement, it is possible to construct data records in which the data for repeating visits are laid out on a single summary data record for each subject (e.g. ID dbp0 dbp1 dbp2 dbp3 etc.). The NOVISIT keyword is used to specify a value to be inserted for variables that don't exist in the database for a subject, because that visit has not been completed, or received. Whatever follows the NOVISIT keyword will be used, exactly as typed. Do not include quotes or the quotes will also be inserted. The only exception is the word blank, which is interpreted as requesting that the fields be left blank. A few examples follow.

```
NOVISIT .
```

Inserts the SAS® missing value code, i.e. the dot.

```
NOVISIT NA
```

Inserts the 2 letters NA.

```
NOVISIT blank
```

Leaves the fields blank.

- **RECSTATUS.** If the `RECSTATUS` statement is not used, **DFsas** retrieves final, incomplete and missed data records from the database. It does not retrieve pending records because this status is normally used to indicate that the data is not ready for statistical analysis, and in some cases might even indicate that one or more of the keys (subject ID, visit or plate) are uncertain. Missed records are included by default so that the data set includes all cases as is typically desired for an intention to treat analysis. The `MISSING missed` statement is also be included by default in new SAS® job files. This outputs blank fields for missed records. Alternatively a missing value code can be specified (See MISSING).

The `RECSTATUS` statement can include any combination of the following record status keywords: final, incomplete, pending and missed.

> **Note**
>
> While it is also possible to export 'secondary' records this is not generally useful, as the only meaningful data field on secondary records is the image ID.

The RECSTATUS statement applies only to data plates and not to queries. If you want to export data by query status, you must specify plate 511 when building an initial **DFsas** job file, as in

```
% DFsas job 1 -c 7 -p 511
```

In the data retrieval specifications for job1, specify

```
RECORD 511 unresolved
```

or

```
RECORD 511 resolved
```

to export unresolved or resolved queries respectively.

- **SETNAME.** **DFsas** names the input data files which it creates by appending d01, d02, d03, etc. to your SAS® job file name (specified using the SASJOB command). It is possible instead to have **DFsas** append the plate number as the extender following the SAS® job name. This is done using the SETNAME statement, as follows:

  ```
  SETNAME byplate
  ```

  which results in the naming of data sets by plate number (not d01, d02, etc.). The ASCII data files will be named jobname.# and the SAS® data sets will be named data# where # is the plate number.

  This might be helpful if you want to have a common data set name across different SAS® jobs or different studies, in situations where the same variables are always pulled from each plate, or the same plate numbers are used in different studies.

  Obviously, this option can not be used if you build more than one data set from a single plate. In the case of normalized data sets, which involve the creation of normalized records from more than 1 plate, **DFsas** will use the plate number from the first RECORDS statement to name the data set when `SETNAME byplate` is specified.

- **INFORMAT.** This statement controls the creation of SAS® informat statements. When a **DFsas** job file is created the following INFORMAT statement is automatically included:

  ```
  INFORMAT dates
  ```

  which instructs **DFsas** to create SAS® informat statements for date fields that SAS® recognizes. DFdiscover allows some date formats that the current version of SAS® does not recognize as dates, (e.g. Jan 25, 2016). Any date fields that SAS® does not allow are converted to string fields.

  DFsas identifies string fields which are up to 8 characters long using the SAS® $ identifier in the data variable list, and generates informat statements for any string fields that have more than 8 characters.

  DFsas converts fields which contain formatting characters to type string. Also if labels are requested for check or choice fields they too will be converted to SAS® string fields by **DFsas**, and if any of these labels is more than 8 characters long **DFsas** will automatically generate a SAS® informat statement for that field.

  A global INFORMAT statement can be used to get **DFsas** to convert all variables to type string and generate the appropriate SAS® INFORMAT statements as follows:

```
INFORMAT all
```

This converts all fields to type string including dates. To use date formats for dates and convert all other fields to type string use the following:

```
INFORMAT dates all
```

- **FORMAT.** This statement is used to create SAS® output format statements for dates. The following example sets the output format for all dates to the SAS® date format `DDMMYY10`:

```
FORMAT dates DDMMYY10
```

If this option is used without specifying a SAS® date format, **DFsas** creates SAS® format statements which correspond to the format defined for each date in the study schema.

- **FIELDCODE.** By default, for choice and check fields, code labels are taken from the variable style and written as SAS® format statements. Generally speaking, this is the desired behavior for such fields. There may however be situations where the unique code labels for the field may be preferred. The default behavior can then be overridden with this statement as a global specification.

```
FIELDCODE yes
```

With this specification, the code labels specified at the individual field level are written as SAS® format statements.

- **MERGE.** In order to read all of the data files created by **DFsas** into a single SAS® data set it is necessary to include the appropriate SAS® commands after the data statements in the SAS® job file. Most of the time the commands that will be needed are something like the following:

```
data final;
merge test.d01 test.d02;
by ID;
```

In this example, a data set named `final` will be created by merging files `test.d01` and `test.d02` on the subject ID. The above is what is written to your SAS® job file by default, or when you explicitly ask for it by including:

```
MERGE yes
```

The summary data files are sorted on ID when they are created by **DFsas** and thus `proc sort` is not needed in SAS®.

Sometimes, for example when building normalized data sets, you may want to specify a different SAS® merge command. In such cases specify:

```
MERGE no
```

and then put the desired SAS® merge commands at the top of the SAS® procedures section of your **DFsas** job file.

8.6.1.1. Recode Processing Order

DFsas includes several commands (labels, MISSING, BLANK, RECODE and NOVISIT) that can be used to recode data fields before they are written to the SAS® input data files. These commands are applied in the following order:

1. **labels.** converts numeric values to labels in choice and check fields
2. **MISSING.** converts different missing value codes to a single code
3. **BLANK.** converts blank fields to a specified value

4. **RECODE.** converts a single specified value to another specified value

5. **NOVISIT.** the missing visit code is applied to all fields of visits not in the database

Side effects of ordering

Watch out for possible unintended order effects. For example, if for check fields you use coding: 0="box not checked", 1="box checked", and your global statements include both:

```
CHECK labels
RECODE check 0 .
```

the `RECODE` statement will have no effect because zeros in check fields will have already been converted to the label "box not checked".

8.6.2. Data Retrieval Specifications

After the global statements come the data retrieval statements, which identify the data fields to be included in your SAS® job. **DFsas** will create 1 or more data input files depending on the number of different plates from which data are to be retrieved. These data files are merged within SAS®, using the SAS® merge command, to create the final SAS® data set. The summary data files created by **DFsas** are named using the **DFsas** job name plus .d01, .d02, .d03, etc. as suffixes (e.g. `test.d01`, `test.d02`, etc.)

8.6.2.1. RECORD

The definition of each data set begins with the keyword `RECORD` or `NORMALIZE`. The `RECORD` keyword is used when you want to pull specified data fields from a single plate, to create a single record for each subject (or for each subject/visit combination). It is followed by the plate number and optionally by record status criteria and/or either a single visit/sequence number or a list of visit/sequence numbers and ranges. This identifies the records in the study database from which variables are to be exported.

If more than one visit or sequence number list is specified, the individual sequence numbers or ranges must be separated by a space, and the 2 numbers making up a range must be separated by the range delimiter (`-` or ~), without any intervening spaces.

Example 8.14. Sample data retrieval

This example specifies that the variables listed below the `RECORD` keyword (i.e. `status` and `vdate`) are to be pulled from plate 101. Further it specifies that these variables are to be pulled from several visit numbers 0 to 5, 9, 12, 21 to 25 and 99. All of these variables will be assembled in a single record for each subject. The variables for visit 0 will be written first, then the variables for visit 1, and so on. Be careful, you can end up with very long records this way.

```
RECORD 101 0~5 9 12 21~25 99
1 status
9 vdate
```

If visit or sequence numbers are not specified, **DFsas** will create a summary data record for each data record that appears in the database for the specified plate. Thus instead of all variables being laid out on a single record for each subject, each subject will have as many summary data records as they have visits for that particular plate in the study database. In some situations this may be what you want to happen. Or you might know that the plate only occurs at one visit. It's up to you to decide how you want the data organized when you import it into SAS®.

If the global `RECSTATUS` and `RECLEVEL` statements are used, only data records meeting the specified status and level criteria will be retrieved from the study database. It is also possible to specify status and level criteria on the `RECORD` statement line itself, in which case they override the global specifications. In the following example final and incomplete records at levels 3,4,5 and 7 and at visits 0,1,2,3,4, and 9 will be exported from plate 101.

```
RECORD 101 final incomplete level:3-5,7 0~5 9
```

> **Note**
>
> Status and level specifications must follow the plate number and come before the visit criteria (if any). Status and level specifications can appear in any order. The level specification must not contain spaces.

When exporting queries (plate 511) the record status keywords `resolved` and `unresolved` may be used to retrieve only those queries which have the desired resolution status:

`RECORD 511 resolved` ... only export resolved queries
`RECORD 511 unresolved` ... only export unresolved queries

8.6.2.2. Variables

The variables to be retrieved from the specified plate are listed following the `RECORD` statement. Variables are identified by field number, as specified in the study schema. Each line, following the `RECORD` statement, can define either a single variable or a single contiguous range of variables. It is not legal to include a list of variables and ranges on a single line.

The variables to be retrieved may also be specified using the notation **`NF`** or **`NF-#`**. **`NF`** refers to the last field on the current plate, while **`NF-#`** refers to the field which is # fields before the last field.

> **Note**
>
> Use of the **`NF`** and **`NF-#`** notations are not permitted in normalization specifications. When specifying field mapping to a normalized data structure, the field numbers must be specified explicitly. Also, these notations may not be combined with **any** field qualifiers (:c, :j, :o, :s, etc.).

The following example shows legal syntax. Note that variables may be defined in any order.

```
RECORD 22
12~17
10
34~45
NF-1
NF
```

DFdiscover maintains a separate data file for each CRF plate. A listing of the study data dictionary for all plates, with data field numbers and variable names, can be displayed and printed by running **DF_SSvars**.

Do not specify the subject ID (always field number 7) as one of the variables to be retrieved. Since subject ID is needed to merge the summary data files into a SAS® data set this field is retrieved automatically and written as the first field of each summary data record. The variable name is set to the name specified in the study schema but may be changed by editing the global IDNAME statement. If the IDNAME statement is missing from a **DFsas** job file the subject ID is assigned variable name ID.

Normally variable names will be extracted from the study schema and written to the SAS® job file. This is what happens when you specify a field number without a variable name in a **DFsas** job file. However, you can override the schema names, and specify new ones in the **DFsas** job file, as we have done in the preceding example.

If a variable name is not specified in the **DFsas** job file, a name is constructed from the study schema as follows. If a field name exists it will be used, and if not, the required variable alias will be used. If SAS® version 6 is used and either of these names is longer than 8 characters, it will be truncated to 8 characters when it is written to the SAS® job file. If a sequence number range is specified, the sequence number will be appended to the variable names in that retrieval set. When **DFsas** is run with the existing **DFsas** job file to create SAS® job and data files, **DFsas** checks the length of all variable names in the **DFsas** job file and prints a warning if there are any which exceed the limit of the SAS® version specified.

All of these variables will be created for each subject record. If a subject does not have one or more of the specified visits in the database, the fields for missing visits will be written with the SAS® missing value code, i.e. `.`, a dot.

If a visit or sequence number is not specified, variable names will be used as they appear in the study schema, or as specified in the **DFsas** job file, without any appended visit or sequence numbers. If a particular plate is only completed at one visit there is really no need to specify a sequence number, but if one is specified, it will be appended to the variable names.

The first 6, and last 3, fields in all data records in a DFdiscover database are used for database management by DFdiscover, and are referred to by the same variable names in all DFdiscover studies. They are: `DFSTATUS` (data record status: final, incomplete, pending), `DFVALID` (data record validation/workflow level: 0~7), `DFRASTER` (the name of the file holding the fax image of the CRF page corresponding to the data record), `DFSTUDY` (the DFdiscover study number), `DFPLATE` (the data record plate number), `DFSEQ` (the data record sequence or visit number), `DFSCREEN` (data record status without consideration for primary/secondary), `DFCREATE` (the record creation date and time) and `DFMODIFY` (the record's last modification date and time). `DFSEQ` is assigned only if the sequence number is defined as being in the barcode; otherwise the variable name is user-defined. If you want to retrieve these variables from more than one data file you will have to give them unique variable names in your **DFsas** job file.

Date variables are specified as character string fields in the SAS® job file.

You can override the global specification to output codes or value labels for any field by including the keyword `codes` or `labels` after the variable name. For example:

```
10 sex1 codes
10 sex2 labels
```

will output the variable sex (field 10) twice, sex1 will be numeric (e.g. 1,2) and sex2 will be text (e.g. male, female). Note that if you wish to specify codes or labels at the variable level, a variable name must be specified as illustrated above, i.e. 10 codes, would assign the variable name codes to field 10, probably not what you intended.

8.6.2.3. Variable Labels

When **DFsas** is executed with the `-c` or `-C` options to create a **DFsas** job file, the data retrieval specifications for each plate includes one line for each variable with the database field number, variable name and variable label found in the study schema file. Both the variable name and variable label can be modified in the **DFsas** job file. Variable labels can be increased to the SAS® version's character maximum in the **DFsas** job file. When **DFsas** is executed to create the SAS® job and data files, it is the variable names and labels found in the **DFsas** job file that are used. **DFsas** reverts to the variable names and labels found in the schema if they are not specified in the **DFsas** job file. If the **DFsas** job file contains a variable label that is longer than the character maximum allowed by the SAS® version, the label is truncated to the maximum limit in the SAS® job file. Note that a variable label cannot be either "codes" or "labels", as these are key words used to determine whether the output data file is to be written with the numeric codes or text labels for specified variables.

8.6.2.4. `NORMALIZE`

It is not uncommon to see case report forms designed so that several medications, medical history items, adverse events, etc. can be recorded on the same page. Associated with each entry there are typically several data fields. For example, medications might include: drug name, indication, dose, start date, stop date, etc. These questions might be repeated several times on the same page so that several medications can be recorded in the same place in each subject's case record book. The same question blocks may also appear on optional continuation pages, or be used at both baseline and follow-up, and thus may appear on several different plates and at several different visits in the study database.

A normalized data set for such repeating question blocks, puts all of the data fields related to a single item (e.g. a medication, medical problem, or adverse event) on a single data record. Each subject might thus contribute none, one or more such records to the normalized data set, depending on the number of items (medications, medical problems, or adverse events) that were recorded for each subject.

When building a normalized data set, you usually only want to output records for those items that have data recorded. That is, you want to skip over empty question blocks. Also, you might want to specify additional retrieval criteria (e.g. build a data set consisting of only serious adverse events).

It is also possible that you might want to have a data field appear in the normalized records that does not actually appear in the study database. For example, if medical history items are described on the case report forms (e.g. hypertension, diabetes, etc.) but only appear as a yes/no choice field followed by other details on the case report forms, you would probably want to include a field in the normalized data records which specified the type of medical problem (e.g. "hbp" for hypertension, "dbm" for diabetes, etc.) being described by each data record.

Finally, in the SAS® data set you may want to merge a normalized data set with other subject data. For example you might want to combine adverse event data with demographic data (e.g. age, sex), initial diagnosis, etc.

DFsas includes the ability to create normalized data sets with all of these features. The syntax is illustrated in Section 8.7, “ Creating a Normalized Data Set”.

8.6.3. SAS® Procedures

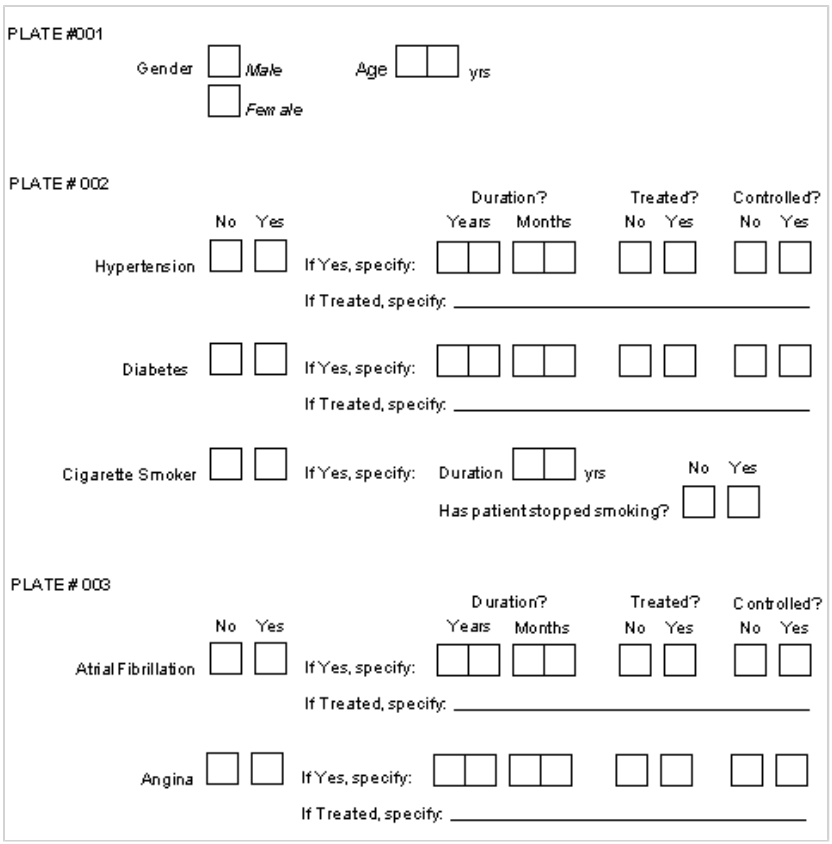
The third and final section of a **DFsas** job file begins with the keyword SAS on a line by itself. All lines following this keyword are written directly to the SAS® job file. This can be used to include SAS® commands following the data definition statements in the SAS® job file. This section is optional. Without it the SAS® job will end with the SAS® commands needed to merge the summary data files on subject ID.

8.7. Creating a Normalized Data Set

Sometimes you will want to be able to create more than one record for each subject, because certain data can naturally be divided into repeating record blocks. Examples include CRFs in which several medications, adverse events, or medical problems are listed on a single CRF page. In such cases you may want to be able to create a separate data record for each medication, adverse event or medical problem.

The example that we will use shows how to create a normalized data set for medical problems reported at baseline. Our objective will be to create a record for each problem that exists (i.e. for each problem checked Yes). Also we will show how to merge the problem records with the subject’s age and sex, and then print them out, one problem on each line. The case report forms used to record this data might appear as illustrated in Figure 8.1, “Sample Case Report Form”.

Figure 8.1. Sample Case Report Form



Example 8.15. Normalization code for Sample Case Report Form

```
MERGE no
NORMALIZE if(item==2)
SORT 1:n 2
medprob "Medical Problem"
item tempvar
yrs "Medical Problem - duration (yrs)"
mon "Medical Problem - duration (mon)"
treat labels "Medical Problem - on treatment"
ok "Medical Problem - controlled or stopped"
rx "Medical Problem - treatment specify"
RECORDS 2
"hbp" 10~15
"dbm" 16~21
"smoker" 55 56 "." "." 57 "."
RECORDS 3
"afib" 41~46
"angina" 47~52
RECORD 1
12 sex labels
13 age
SAS
data final;
merge medhx.d01 (in=medprob) medhx.d02;
```

```
by ID;
if medprob;
proc print;
```

Although most specifications will probably be simpler than the example shown above, this example illustrates most of the **DFsas** normalization features. A detailed description follows below. In this example we will assume that the yes/no questions are coded 1=no, 2=yes, and that plates 1, 2 and 3 only occur at baseline.

8.7.1. Merge

In our example the only global specification shown is `MERGE no`. This will suppress the standard merge command so that it can be replaced by the command shown at the bottom under the SAS keyword. With the specified merge command only subjects who have one or more medical problems will be included in the normalized data set. If the usual merge command were used subjects with no medical problems who appeared in the baseline (age/sex) file, would appear as a single record in the merged data set, with SAS® missing value codes (i.e. the dot) for the medical problem variables.

8.7.2. Specifying Data Fields

In our example, each medical problem is defined by 7 data fields, named: `medprob`, `item`, `yrs`, `mon`, `treat`, `ok`, `rx`. Each of these 7 data fields is defined on a separate line following the `NORMALIZE` command. The normalized records to be created consist of only 6 of these fields.

The variable named `item` is classified as a tempvar. Tempvars are variables that are needed for case selection but which are not be included in the normalized data records. Variable `item` is needed to select the problems to be printed but is of no use by itself. It is a choice field with 2 boxes coded 1 for no (the problem does not exist) and 2 for yes (problem exists). Since this field will equal 2 for all records that are written to the normalized data set, it would be an uninformative constant and can therefore be eliminated. It is legal to specify more than one tempvar within a set.

The type (choice, check, etc.) of each variable is determined from the definition in `DFschema` of those variables that make up the first normalized record. For this reason it is important to choose the first record carefully and to avoid using a record in which some of the fields are missing and therefor specified with a fixed value. The record that begins with "smoker" in the preceding example is like this and thus would be a poor choice for the first record.

If you can not avoid fixed fields in the first record, (e.g. `medprob` in the example) the variable type is determined by inspection of the fixed value. If this value is entirely numeric (i.e. composed of 1 or more digits and optionally including a decimal) it is defined as a number to SAS®, otherwise it is defined as a text field. When specifying fixed numeric fields remember to enclose them in double or single quotes, otherwise they will be interpreted as database field numbers.

8.7.3. String Fields in Normalized Data Sets

When **DFsas** creates a normalized data set, it determines the field type (i.e., string, number, date) of each variable by examining the definition of each variable on the first normalization record specified. If a fixed string is specified, **DFsas** examines it to determine whether it is a string or a number. In some cases it may determine the type incorrectly. For example, if the first record contains a field that is defined with a SAS missing value code, e.g. ".M", there is no way for **DFsas** to know whether the field is a number or a character string. To eliminate ambiguity, users may specify the string qualifiers of c (string) or n (number) for fixed strings in the **DFsas** job file. String qualifiers should only be specified on the first normalization record, because this is the only one examined to determine the field type of each variable in the normalized data set. This is all that is needed because each field can only be of one type. For example

```
RECORDS 3
"bp" 9~13 "mmHg":c
"wght" 14~18 "kg"
"hght" 19~23 "cm"
"pulse" 24~28 "beats per min"
```

```
"other" 29~33 ""
```

String qualifiers are defined in the **DFsas** job file and consist of:

- **`:c` - character string.** This option specifies that a fixed string is to be interpreted as a character field.
- **`:n` - number.** This option specifies that a fixed string is to be interpreted as a numeric field.

There are several important points to bear in mind when using string qualifiers:

- The qualification is only used from the first normalized record and is ignored if present on any other normalized records.
- Qualified strings may have embedded spaces, as for `pulse` in the example above.
- Single or double quotes may be used to specify qualified strings, but quotes of any type are not allowed within a string, and the `:q` qualifier is not allowed. Qualified strings must have matching quotes.
- Empty strings are allowed, and may be specified with either single or double quotes, as for `other` in the above example.

8.7.4. Case Selection

The `if` statement after the `NORMALIZE` command is optional. It instructs **DFsas** to print a data record if variable `item` equals 2 (i.e. the problem exists). The `if` statement uses **awk** syntax. Other examples of legal selection criteria for the above example would include:

- medical problems among older men

```
if(item==2 && sex==1 && age>65)
```

- untreated problems which are not resolved

```
if(item==2 && treat==1 && ok==1)
```

- problems among women of any age or men over 65

```
if(item==2 && (sex==2 || age>65))
```

Another common use of the case selection specification is to restrict record selection to a desired set of visits (e.g. baseline only, follow-up only, etc.). This can be accomplished by including the visit number in the variable list (perhaps as a tempvar) and then using it in the case selection specification. For example:

- medical problems at visit 0 (baseline)

```
if(item==2 && vnum==0)
```

- medical problems from visits 1 through 5 inclusive

```
if(item==2 && vnum>=1 && vnum<=5)
```

Another common example will arise when normalizing medication records or adverse events. In such cases each question block typically begins with a string variable (e.g. a drug name or adverse event name). To select blocks in which something was specified use the **awk** `length` function as follows:

```
if(length(drugname)>0)        # include if a drug name is specified
```

DFsas will also accept `SELECT if(condition statement)` on one or more separate lines following the `NORMALIZE` statement. If more than one `SELECT` statement is used, an OR is implied among them, i.e. a record only has to match one `SELECT` statement to be created. For example, the statement:

```
NORMALIZE if ( x==1 || y==2 || (z==3 && length(comment)>0) )
```

can also be written as:

```
NORMALIZE
SELECT if(x==1)
SELECT if(y==2)
SELECT if(z==3 && length(comment)>0)
```

`NORMALIZE` and `SELECT` must both appear in uppercase, `if` must be in lowercase, and the names must use case exactly as defined in the NORMALIZATION variable definitions. `SELECT if` must be considered a single phrase. `if` must follow `SELECT` and it is not legal to have anything except space(s) between `SELECT` and `if`. For example,

```
SELECT {if(...)}
```

is not legal.

Remember that the variables used for case selection must appear in the list of normalized variables. However, if they are not wanted in the normalized data records they can be removed by defining them as `tempvar`, as was done for variable `item` in the example.

8.7.5. Value codes or labels

Variable names may be followed by the keyword `labels` or `codes` to override global specifications. This is illustrated in variable `treated`, for which labels are requested. For example, this variable might have labels `no` and `yes`, which will be written to the normalized data set in place of the codes 1 and 2.

Value labels are taken from the study schema. Since all records are assumed to follow the same format, it does not matter which of the records specified under the `RECORDS` keyword(s) is used to locate variable labels. **DFsas** uses the very first record specified.

8.7.6. Variable Description

The variable name statements all end with a variable description or label. This is needed because these variables do not exist in a single place in the database, and thus a unique variable description can not be read from the study schema.

8.7.7. Specifying Normalized Records

The `RECORDS` statement identifies the plate from which the variables will be extracted. In our example, there are 2 `RECORDS` statements, one for records to be created from plate 2 and one for records to be created from plate 3.

As previously described for `RECORD` statements, it is possible to specify record status retrieval criteria following the plate number on a `RECORDS` statement. For example:

```
RECORDS 1 final        #only export final data records from plate 1
```

Each line following a `RECORDS` statement identifies the variables to be extracted from the specified plate to form a single normalized data record. Variables are specified as a space delimited list of single field numbers, field number ranges and/or quoted fixed string fields. The field numbers corresponding to the variables you want to select can be determined from **DFsetup**, or by running **DF_SSvars** or **DF_SSschema** from **DFexplore** in Reports View.

There must be a one-to-one correspondence between the variable names specified under the `NORMALIZE` statement, and the data fields identified under the `RECORDS` statement. Note that the first data field, which maps to variable `medprob`, is a fixed string field, and is a constant which identifies the question on the study case report forms from which the problem record was created. This technique is also used to insert missing codes for 3 variables (`mon`, `treat` and `specify`) for

history of smoking, which in our example inquires about duration in years (variable `yrs`) and whether the subject has stopped (variable `ok`), but not about duration in months, and treatment. Remember to enclose all fixed string fields within single or double quotes.

8.7.8. Sorting a Normalized Data Set

DFsas automatically sorts each normalized data set on subject ID, however sometimes this may not be enough. You may wish to sort the normalized set on some other variable(s) within subject ID, or even sort on some other variable ahead of subject ID.

You can specify your own sort order by including a `SORT` statement after the `NORMALIZE` statement as in:

```
SORT 1:n 2
```

This example statement will sort the normalized data set on the 1st field (`ID`) in numerical order, and then within `ID` will sort on the 2nd field (`medprob`) in ascending ASCII or character order. Note that field numbers correspond to the order in which the variables are defined in the normalized set. Remember that although subject ID is not included in the list it is always present as the first field.

Legal field sort qualifiers include:

- **`:n`.** Sort the field in ascending numeric order, as in:

  ```
  2:n
  ```

  which sorts on field 2 in ascending numeric order.

- **`:r`.** Sort the field in descending alphanumeric order, as in:

  ```
  2:r
  ```

  which sorts on field 2 in descending alphanumeric order.

- **`:nr`.** Sort the field in descending numeric order, as in:

  ```
  2:nr
  ```

  which sorts on field 2 in descending numeric order.

If a sort field is specified with no qualifier, sorting is done in ascending alphanumeric order (a.k.a. ASCII collating sequence).

8.7.9. Example Data File

The normalized data file created by running **DFsas** with our example is illustrated below. The fields would be named: `ID`, `medprob`, `yrs`, `mon`, `treat`, `ok`, `rx` in the SAS® job file.

```
22001|dbm|30|0|yes|2|insulin
22001|hbp|22|0|yes|1|beta blockers
22006|smoker|50|.|.|1|.
22009|angina|1|6|no|1|
```

Chapter 9. DFsqlload: DFdiscover to Relational Database Tables

9.1. Introduction

9.1.1. Overview

DFsqlload provides a convenient method for migrating data from the proprietary DFdiscover storage to storage in a relational database. Although this link is not maintained in real time, the relational side can be synchronized with the proprietary side whenever required. Data integrity is maintained in that only changes made to the data on the validated DFdiscover side are kept. These changes are reflected in the relational copy only after synchronizing with **DFsqlload**. **DFsqlload** can be scheduled using cron or run interactively as required. In this way, snapshots of the database at a known time can be generated and used for whatever purpose the user deems important, much in the same way as **DFsas** provides snapshots of the database in SAS format.

9.1.2. About DFsqlload

DFsqlload is only useful in situations where one of the following four database products are being used or are planned on being used in a particular computing environment.

1. MySQL - a common, multi-platform, open source relational database product.

2. PostgreSQL - another multi-platform, open source relational database product that has more sophisticated features than MySQL, which may make it better suited for server environments.

3. Oracle - commercial relational database product.

4. Microsoft SQLServer - commercial relational database product.

All four products are network-aware, and provide native as well as JDBC and ODBC-based connectivity from client applications running on any platform.

9.2. DFsqlload and Relational Database Concepts

DFsqlload is one of three data export utilities available in DFdiscover. **DFsqlload** provides an easy to use export facility for relational databases. **DFexport.rpc** is a flat-file data export utility, and **DFsas** provides DFdiscover export capability for the SAS environment.

All methods can be used at any time and produce a true equivalent to the data stored in DFdiscover at the time the export is performed. This chapter will focus on how this is accomplished with relational databases.

9.2.1. Why Relational Databases?

There are many applications written for relational databases for many purposes. The two main applications benefiting from **DFsqlload** are reporting and analysis. Writing custom reports for DFdiscover is possible, but can take effort compared to the many report-writing and spreadsheet applications with relational database connectivity on the market today. For Windows users, there is Microsoft Office, Crystal Reports, Visual Basic, to name just a few of the applications available. UNIX users have OpenOffice, many java-based report writers, and Perl at their disposal. Mac users in most cases can pick the best from both worlds. There are hundreds of applications out there, some of which you may already be using.

9.2.2. Why is DFsqlload a one-way street?

DFdiscover is a validated system. The ways to get data into DFdiscover have been rigorously tested and proven accurate. Providing for one-way movement of data out of DFdiscover allows DFdiscover to maintain the integrity of the DFdiscover database by limiting the ability of outside processes to compromise the validity of the system.

9.2.3. Relational Database Concepts

Plates: DFdiscover keeps all data from a given form type together as one record type or plate. There may be, for example, blocks of information on a particular plate that repeat and would be better modeled with separate tables. **DFsqlload** makes no attempt to do this. When **DFsqlload** is run, each plate becomes its own relational table.

Fields: DFdiscover plates are made up of fields, each field storing data according to the layout of the plate on the paper CRF form. When a DFdiscover study is setup, you will recall that each plate is imported into the setup tool as a PS or PDF representation of the printed page that will ultimately be used to collect data for the study you are designing. The same fields defined during DFdiscover setup are used to define column names for the relational tables **DFsqlload** will create. There are some differences in the rules for naming columns in relational tables, but these differences are handled by DFsqlload as it has its own set of rules for doing so. **DFsqlload** provides two options for the creation of tables. One is to export all data as if it were character string data. The other option is to create columns of the same data type as the source fields.

Coding: DFdiscover has the ability to use multiple missing value codes for different purposes. Data values with corresponding labels may be used to represent different discreet conditions. Dates may be incomplete and as such, have rules for imputation. None of these concepts are an integral part of relational databases and require different ways to handle these situations as they arise. **DFsqlload** provides options for passing both coded values and labels to the relational side.

Schemas and Tablespaces: DFdiscover keeps the information for any given study together under one study number. There is no sharing of data between studies, so in cases, for example, where two studies share the same sites, the sites database is duplicated for the two studies. Each study database is independent of the others. Some relational database products allow for multiple groups of potentially similar data in the same database through use of the concept of the database schema. **DFsqlload** is aware of these possibilities and supports multiple schemas if the relational database product supports them. Tablespaces provide for another layer of hierarchy in data modeling and are supported as well.

9.3. Using DFsqlload

9.3.1. DFsqlload defaults - a quick tutorial

It is very simple to create a relational database equivalent to a DFdiscover study once a working relational database environment is established on your network. On the relational database side, you will need to know the following:

- What relational database product am I using - MySQL, PostgreSQL, MS SQLServer or Oracle
- What is the name of the server hosting the relational database
- In the case of Oracle, what tablespace has been assigned to me for this purpose by my DBA.
- In the case of Oracle and Postgres and MS SQLServer, what database will be used to store my DFdiscover schemas
- What are my login credentials for the relational database server I am using.

With the answers to these questions, simply run **DFsqlload** as shown and a relational database equivalent to your DFdiscover study will be ready to use. Using Oracle (the default) as an example, the command would be:

```
% DFsqlload bluto:mystudies:foo.bar:olive:popeye 254
```

which will create a snapshot of study 254 in the `mystudies` database, in the `foo` schema with the tablespace name `bar` on the server `bluto` with user credentials username `olive` and password `popeye`.

By default, all columns are typed as closely as possible to the data types used by DFdiscover during setup. All dates are imputed. No coded values are translated. No missing codes are translated. No optional tables are created. If these defaults are acceptable, then this is all you need to know.

9.3.2. DFsqlload in Detail

The default settings for **DFsqlload** should be adequate for most users. However, if the purpose of using **DFsqlload** is to provide a relational database view of a study to a set of specialized users with different requirements, then you might want to get as much information as possible from the DFdiscover side to the relational database side. For this scenario, you will need to use some of the options **DFsqlload** offers.

9.3.2.1. DFsqlload Options

Answers to the following questions will affect how **DFsqlload** is used. See also the reference page for DFsqlload elsewhere in this guide.

Q: What is the target database type?

A: **DFsqlload** supports four popular SQL server platforms - Oracle, PostgreSQL, MS SQLServer and MySQL. Your target database will need to be one of these four types. Once this is known, **DFsqlload** is directed to create a set of relational tables for a given database type using the `-flavor` option. If the target database type is Oracle, then this option is not required as **DFsqlload** assumes Oracle by default. Otherwise,

- Target is a PostgreSQL database - use `-flavor postgresql`
- Target is a MySQL database - use `-flavor mysql`
- Target is a MS SQLServer database - use `-flavor mssql`
- Target is an Oracle database - omit this option, or use `-flavor oracle`

Q: Is it important to have the data type of each column in my relational tables match as closely as possible the data types for each field in my DFdiscover plates?

A: The default behavior of **DFsqlload** is to preserve data typing. The older version of **DFsqlload** that was shipped with DFdiscover 3.7 and 3.7.001 did not preserve data typing and all user fields were converted to type VARCHAR. If you want to retain this behavior, then you will need to use the `-type` option or the applications you have written that use any of the tables created by these older versions of **DFsqlload** will probably not work. If you are writing new applications, but want your old applications to work as well, you can get **DFsqlload** to create both typed and untyped tables in your target relational database.

To preserve Data Typing - omit this option or use `-type typed` To provide both typed and untyped tables - use `-type both` To provide just untyped tables - use `-type untyped`

Q: My DFdiscover setup makes extensive use of codes and value labels for these codes. How can I make this information accessible from relational tables?

A: Relational tables rely on other relational tables when a code has a corresponding label and it is the label that you want to report. Rather than create a separate table for every coded variable, **DFsqlload** offers two options which may be used together or separately depending on the specific requirements. The `-coding` option controls the inclusion of label data. By default, you get just the codes. You can create a column for the code and a column for the label corresponding to that code using the option `-coding both`. If all you want is the labels, use the option `-coding label`. The other way to get value/label into your relational tables is to create the optional `DFCODING` table. This is

done using the `-table dfcoding` option. This optional table contains all codes and labels for all DFdiscover fields with type `CHOICE`. See the DFsqlload reference page for more details.

Q: My DFdiscover setup includes subject aliases. How can I access this information from relational tables?

A: Use the `-table dfsubjectalias` option to request creation of the optional `DFSUBJECTALIAS` table containing two columns, `DFpid` and `DFalias`. Thereafter it is an easy SQL join statement to include the subject alias together with the subject id.

The `DFSUBJECTALIAS` table is also created by default if subject aliases are defined when loading of all tables is requested.

Q: In my DFdiscover setup, I have defined a number of missing value codes that are important for correct interpretation of the data. How do I make those codes available in relational tables?

A: How missing codes are handled depends upon the `-type` option. If the target tables are untyped, then by default, codes are output in the relational tables as is. To get the labels corresponding to a missing value code, use the option `-missing label`. If the target tables are typed, then all missing codes are converted to `NULL` and logged as such, regardless of how the `-missing` option is used. If the `-table dfnullvalue` option is used, a record of each substitution is created in the optional `DFNULLVALUE` table.

Q: How are dates handled by **DFsqlload**?

A: By default, **DFsqlload** creates date columns using the correct data type for the target system. A string representation of a date can be output in a separate column using the option `-date both`. If just the string representation is required, use the `-date untyped` option. Partial dates (i.e., dates where the day or month are missing) are imputed by default, according to the rules specified in the DFdiscover setup. If imputed dates are not desired, you can turn it off using the `-noimpute` option, in which case any partial dates will be converted to `NULL`.

Q: How do I find out if something went wrong?

A: **DFsqlload** writes extensive logging information. When **DFsqlload** encounters a problem, the problem is written to `stderr` by default, unless overridden with the `-q` option. In either case, problems are logged in the **DFsqlload** log file for a given run. If **DFsqlload** encounters problems with DFdiscover data, it replaces the problem data with a `NULL` value, writes the substitution to the log file and optionally creates a record for the substitution in the `DFNULLVALUE` table. The following identifies typical problems and how they are handled by **DFsqlload**.

- Any field that is blank or contains only white space (space, tab) will be converted to a `NULL`. These substitutions are not logged.
- All missing value codes are converted to `NULL` if the target tables are typed (the default). This is applied consistently, even if the missing value code happens to be legal for some field types.
- Any value wider than the storage width defined for the field in the DFdiscover schema is converted to `NULL`.
- If a field has a format defined in the DFdiscover schema, values are checked for adherence to the format and are converted to `NULL` if they do not conform.
- Invalid dates are converted to `NULL`.
- If date imputation is not defined in the DFdiscover schema, partial dates are converted to `NULL`. Any imputed dates that are not legal dates are also converted to `NULL`.
- If a check or choice box contains an undefined code, it is converted to `NULL`.

If you use the `-d drfname` option, a .drf file will be created containing a reference to each DFdiscover record having one or more non-blank substitutions to `NULL`.

Complete records will be rejected if the following conditions are encountered.

- the record does not contain the correct number of fields
- any of the DFdiscover fields are blank or invalid
- a record with the same keys has already been imported

These cases will also appear in the .drf file if the `-d drfname` option is used.

Q: Can I add tables to my SQL database outside DFdiscover?

A: Yes. **DFsqlload** will ignore them.

Q: What if the DFdiscover study schema is changed?

A: **DFsqlload** recreates the tables it needs each time it is run. Be careful when changing **DFsqlload** program options from run to run. SQL tables created from a previous run are not recreated if they are not required by the current run.

Q: What happens if I modify the definition of one of the SQL tables used by DFdiscover?

A: **DFsqlload** will drop the table (and all of your changes) and recreate it from the current `DFschema` and data in the DFdiscover study database.

Q: How does **DFsqlload** update my SQL tables?

A: If there have been no changes to the data definitions, the data is dropped from the SQL table and reloaded from DFdiscover. This occurs even if there have been no data changes for that DFdiscover plate since the last time **DFsqlload** was run.

Appendix A. Copyrights - Acknowledgments

A.1. External Software Copyrights

DFdiscover software uses several third-party software components as part of its server side and/or client tools.

The copyright information for each is provided below. If you would like to receive source codes of these third-party components, please send us your request at <help@dfnetresearch.com>.

A.1.1. DCMTK software package

Copyright © 1994-2011, OFFIS e.V. All rights reserved.

This software and supporting documentation were developed by

OFFIS e.V.
R&D Division Health
Eschereg 2
26121 Oldenburg, Germany

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of OFFIS nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS “AS IS” AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

A.1.2. Jansson License

Copyright © 2009-2014 Petri Lehtinen <petri&digip.org>

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the “Software”), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED “AS IS”, WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM,

DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

A.1.3. Mimencode

Copyright © 1991 Bell Communications Research, Inc. (Bellcore)

Permission to use, copy, modify, and distribute this material for any purpose and without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies, and that the name of Bellcore not be used in advertising or publicity pertaining to this material without the specific, prior written permission of an authorized representative of Bellcore. BELLCORE MAKES NO REPRESENTATIONS ABOUT THE ACCURACY OR SUITABILITY OF THIS MATERIAL FOR ANY PURPOSE. IT IS PROVIDED “AS IS”, WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES.

A.1.4. RSA Data Security, Inc., MD5 message-digest algorithm

Copyright © 1991-2, RSA Data Security, Inc. Created 1991. All rights reserved. License to copy and use this software is granted provided that it is identified as the “RSA Data Security, Inc. MD5 Message-Digest Algorithm” in all material mentioning or referencing this software or this function. License is also granted to make and use derivative works provided that such works are identified as “derived from the RSA Data Security, Inc. MD5 Message-Digest Algorithm” in all material mentioning or referencing the derived work. RSA Data Security, Inc. makes no representations concerning either the merchantability of this software or the suitability of this software for any particular purpose. It is provided “as is” without express or implied warranty of any kind. These notices must be retained in any copies of any part of this documentation and/or software.

A.1.5. mpack/munpack

Copyright © 1993,1994 by Carnegie Mellon University All Rights Reserved.

Permission to use, copy, modify, distribute, and sell this software and its documentation for any purpose is hereby granted without fee, provided that the above copyright notice appear in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the name of Carnegie Mellon University not be used in advertising or publicity pertaining to distribution of the software without specific, written prior permission. Carnegie Mellon University makes no representations about the suitability of this software for any purpose. It is provided “as is” without express or implied warranty.

CARNEGIE MELLON UNIVERSITY DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, IN NO EVENT SHALL CARNEGIE MELLON UNIVERSITY BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

A.1.6. TIFF

Copyright © 1988-1997 Sam Leffler Copyright © 1991-1997 Silicon Graphics, Inc.

Permission to use, copy, modify, distribute, and sell this software and its documentation for any purpose is hereby granted without fee, provided that (i) the above copyright notices and this permission notice appear in all copies of the software and related documentation, and (ii) the names of Sam Leffler and Silicon Graphics may not be used in any advertising or publicity relating to the software without the specific, prior written permission of Sam Leffler and Silicon Graphics.

THE SOFTWARE IS PROVIDED “AS-IS” AND WITHOUT WARRANTY OF ANY KIND, EXPRESS, IMPLIED OR OTHERWISE, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL SAM LEFFLER OR SILICON GRAPHICS BE LIABLE FOR ANY SPECIAL,

INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER OR NOT ADVISED OF THE POSSIBILITY OF DAMAGE, AND ON ANY THEORY OF LIABILITY, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

A.1.7. PostgreSQL

Portions © 1996-2019, PostgreSQL Global Development Group Portions © 1994, The Regents of the University of California

Permission to use, copy, modify, and distribute this software and its documentation for any purpose, without fee, and without a written agreement is hereby granted, provided that the above copyright notice and this paragraph and the following two paragraphs appear in all copies.

IN NO EVENT SHALL THE UNIVERSITY OF CALIFORNIA BE LIABLE TO ANY PARTY FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, ARISING OUT OF THE USE OF THIS SOFTWARE AND ITS DOCUMENTATION, EVEN IF THE UNIVERSITY OF CALIFORNIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

THE UNIVERSITY OF CALIFORNIA SPECIFICALLY DISCLAIMS ANY WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE SOFTWARE PROVIDED HEREUNDER IS ON AN "AS IS" BASIS, AND THE UNIVERSITY OF CALIFORNIA HAS NO OBLIGATIONS TO PROVIDE MAINTENANCE, SUPPORT, UPDATES, ENHANCEMENTS, OR MODIFICATIONS.

A.1.8. OpenSSL License

Copyright © 1998-2019 The OpenSSL Project. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.

2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

3. All advertising materials mentioning features or use of this software must display the following acknowledgment: “This product includes software developed by the OpenSSL Project for use in .the OpenSSL Toolkit.” (http://www.openssl.org/)

4. The names “OpenSSL Toolkit” and "OpenSSL Project" must not be used to endorse or promote products derived from this software without prior written permission. For written permission, please contact openssl-core@openssl.org.

5. Products derived from this software may not be called “OpenSSL” nor may “OpenSSL” appear in their names without prior written permission of the OpenSSL Project.

6. Redistributions of any form whatsoever must retain the following acknowledgment: “This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org)”

THIS SOFTWARE IS PROVIDED BY THE OpenSSL PROJECT “AS IS” AND ANY EXPRESSED OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE OpenSSL PROJECT OR ITS CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

This product includes cryptographic software written by Eric Young (<eay@cryptsoft.com>). This product includes software written by Tim Hudson (<tjh@cryptsoft.com>).

A.1.9. Original SSLeay License

Copyright © 1995-1998 Eric Young (<eay@cryptsoft.com>) All rights reserved.

This package is an SSL implementation written by Eric Young (<eay@cryptsoft.com>). The implementation was written so as to conform with Netscapes SSL.

This library is free for commercial and non-commercial use as long as the following conditions are aheared to. The following conditions apply to all code found in this distribution, be it the RC4, RSA, lhash, DES, etc., code; not just the SSL code. The SSL documentation included with this distribution is covered by the same copyright terms except that the holder is Tim Hudson (<tjh@cryptsoft.com>).

Copyright remains Eric Young's, and as such any Copyright notices in the code are not to be removed. If this package is used in a product, Eric Young should be given attribution as the author of the parts of the library used. This can be in the form of a textual message at program startup or in documentation (online or textual) provided with the package.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. All advertising materials mentioning features or use of this software must display the following acknowledgement: “This product includes cryptographic software written by Eric Young (<eay@cryptsoft.com>)” The word “cryptographic” can be left out if the rouines from the library being used are not cryptographic related :-).
4. If you include any Windows specific code (or a derivative thereof) from the apps directory (application code) you must include an acknowledgement: “This product includes software written by Tim Hudson (<tjh@cryptsoft.com>)”

THIS SOFTWARE IS PROVIDED BY ERIC YOUNG “AS IS” AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The licence and distribution terms for any publically available version or derivative of this code cannot be changed. i.e. this code cannot simply be copied and put under another distribution licence [including the GNU Public Licence.]

A.1.10. gawk

GNU GENERAL PUBLIC LICENSE Version 2, June 1991

http://www.gnu.org/licenses/gpl-2.0.html

Copyright © 1989, 1991 Free Software Foundation, Inc.

51 Franklin Street, Fifth Floor,
Boston, MA 02110-1301, USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

1. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The “Program”, below, refers to any such program or work, and a “work based on the Program” means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term “modification”.) Each licensee is addressed as “you”.

   Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

2. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

   You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

3. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a. You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b. You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c. If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.) These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

   Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

   In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

4. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

   a. Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

   b. Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

   c. Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.) The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

      If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

5. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

6. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your

acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

7. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

8. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

   If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

   It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

   This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

9. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

10. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

    Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

11. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally. NO WARRANTY

12. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

13. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED

ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

A.1.11. Ghostscript

The files in the base, psi, lib, toolbin, examples, doc and man directories (folders) and any subdirectories (sub-folders) thereof are part of GPL Ghostscript.

The files in the Resource directory and any subdirectories thereof are also part of GPL Ghostscript, with the explicit exception of the files in the CMap subdirectory (except “Identity-UTF16-H”, which is part of GPL Ghostscript). The CMap files are copyright Adobe Systems Incorporated and covered by a separate, GPL compatible license.

The files under the jpegxr directory and any subdirectories thereof are distributed under a no cost, open source license granted by the ITU/ISO/IEC but it is not GPL compatible - see jpegxr/COPYRIGHT.txt for details.

GPL Ghostscript is free software; you can redistribute it and/or modify it under the terms the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

GPL Ghostscript is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program so you can know your rights and responsibilities. It should be in a file named doc/COPYING. If not, write to the

Free Software Foundation, Inc., 59 Temple Place Suite 330, Boston, MA
02111-1307, USA.

GPL Ghostscript contains an implementation of techniques covered by US Patents 5,055,942 and 5,917,614, and corresponding international patents. These patents are licensed for use with GPL Ghostscript under the following grant:

Whereas, Raph Levien (hereinafter “Inventor”) has obtained patent protection for related technology (hereinafter “Patented Technology”), Inventor wishes to aid the the GNU free software project in achieving its goals, and Inventor also wishes to increase public awareness of Patented Technology, Inventor hereby grants a fully paid up, nonexclusive, royalty free license to practice the patents listed below (“the Patents”) if and only if practiced in conjunction with software distributed under the terms of any version of the GNU General Public License as published by the

Free Software Foundation, 59 Temple Place, Suite
330, Boston, MA 02111.

Inventor reserves all other rights, including without limitation, licensing for software not distributed under the GNU General Public License.

5055942 Photographic image reproduction device using digital halftoning to para images allowing adjustable coarseness 5917614 Method and apparatus for error diffusion paraing of images with improved smoothness in highlight and shadow regions

A.1.12. MariaDB and FreeTDS

GNU LESSER GENERAL PUBLIC LICENSE Version 2.1, February 1999 http://www.gnu.org/licenses/lgpl-2.1.html

Copyright © 1991, 1999

Free Software Foundation, Inc.
51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

Preamble The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages--typically libraries--of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

When we speak of free software, we are referring to freedom of use, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish); that you receive source code or can get it if you want it; that you can change the software and use pieces of it in new free programs; and that you are informed that you can do these things.

To protect your rights, we need to make restrictions that forbid distributors to deny you these rights or to ask you to surrender these rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link other code with the library, you must provide complete object files to the recipients, so that they can relink them with the library after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

We protect your rights with a two-step method:

1. we copyright the library, and

2. we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation will not be affected by problems that might be introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a “work based on the library” and a “work that uses the library”. The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

1. This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called “this License”). Each licensee is addressed as “you”.

   A “library” means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

   The “Library”, below, refers to any such software library or work which has been distributed under these terms. A “work based on the Library” means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term “modification”.)

   “Source code” for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

   Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

2. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

   You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

3. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a. The modified work must itself be a software library.

b. You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c. You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d. If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful. (For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

4. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

   Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

   This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

5. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

   If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

6. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

   However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a “work that uses the library”. The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a “work that uses the Library” uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

7. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

   You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License.

   Also, you must do one of these things:

   a. Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

   b. Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that

      i. uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and

      ii. will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

   c. Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

   d. If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

   e. Verify that the user has already received a copy of these materials or that you have already sent this user a copy. For an executable, the required form of the “work that uses the Library” must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

      It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

f. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:

   a. Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.

   b. Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

g. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

h. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.

i. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.

j. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

   If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

   It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

   This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

k. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

l. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

m. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

n. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

o. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

A.1.13. QtAV

© Wang Bin <wbsecg1@gmail.com> Shanghai University->S3 Graphics->Deepin, Shanghai, China 2013-01-21

QtAV is free software licensed under the term of LGPL v2.1. The player example is licensed under GPL v3. If you use QtAV or its constituent libraries, you must adhere to the terms of the license in question.

Rather than repeating the text of the LGPL v2.1, the original text can be found in GNU LESSER GENERAL PUBLIC LICENSE, Version 2.1 [455].

A.1.14. FFmpeg

Most files in FFmpeg are under the GNU Lesser General Public License version 2.1 or later (LGPL v2.1+). Read the file `COPYING.LGPLv2.1` for details. Some other files have MIT/X11/BSD-style licenses. In combination the LGPL v2.1+ applies to FFmpeg.

Rather than repeating the text of the LGPL v2.1, the original text can be found in GNU LESSER GENERAL PUBLIC LICENSE, Version 2.1 [455].

A.1.15. c3.js

The MIT License (MIT) © 2013 Masayuki Tanaka

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify,

merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED “AS IS”, WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

A.1.16. d3.js

Copyright 2010-2017 Mike Bostock All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met: * Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer. * Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution. * Neither the name of the author nor the names of contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS “AS IS” AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Index

Symbols

.DFreports.dat, 37

A

Audit Trail, 20

B

Batch Edit Checks, 302

C

c3.js, 461
Configuration Keywords, 43

D

d3.js, 462
Data Change Reasons, 16
Data Retrieval File, 10
Database Schema Styles, 40
DCMTK, 448
DFaccess.rpc, 72
DFaddHylaClient, 178-178
DFattach, 75
DFauditdb, 179
DFaudittrace, 78
DFbatch, 82
  A, 356
  ACTION, 327
  APPLY, 328
  Basics, 303-308
  BATCH, 330
  BATCHLIST, 331
  BATCHLOG, 357
  CONTROL, 333
  CREATE, 334
  CRITERIA, 335
  CWD, 358
  D, 359
  DD, 360
  DESC, 337
  DT, 361
  E, 362
  EDIT, 338
  Element Reference, 325
  EQ, 363
  Example, 322
  HL, 365
  HN, 366
  HR, 367
  ID, 339
  IDRF, 340
  Introduction, 302
  K, 368
  LEVEL, 341
  Limitations, 320
  LOG, 342
  Log Elements, 354
  M, 369
  MI, 370
  MM, 371
  MODIFY, 345
  MOVETO, 346
  MQ, 372
  MX, 374
  N, 375
  ND, 376
  NEQ, 377
  NM, 378
  NMQ, 379
  NMX, 380
  NODRF, 381
  NQ, 382
  NR, 383
  NSEC, 385
  NSM, 386
  NT, 384
  O, 387
  ODRF, 347
  OUTDRF, 388
  OUTLOG, 389
  PLATE, 350
  Q, 390
  QR, 392
  QRPLY, 393
  R, 394
  REASON, 351
  S, 395
  SC, 396
  SRC, 397
  STATUS, 352
  STUDY, 398
  SUMMARY, 399
  T, 400
  TITLE, 353
  TM, 401
  Troubleshooting, 324
  USER, 402
  Using, 308
  V, 403
  VISIT, 354
  XML, 404
  YY, 404
DFcenters, 23
DFcertReq, 180-182

DFclearIncoming, 183
DFcmpSchema, 184-186
DFcmpSeq, 187-188
DFcompiler, 84
DFcplate_map, 28
DFcrfbkgd_map, 30
DFCRFType_map, 30
DFcterm_map, 29
DFcvisit_map, 27
DFdisable.rpc, 85
DFedits, 23
DFedits.bin, 31
DFenable.rpc, 87
DFencryptpdf, 88
DFexport, 90
DFexport.rpc, 105
DFfaxq, 115
DFfaxrm, 117
DFfile_map, 31
DFget, 119
DFgetparam.rpc, 121
DFhostid, 124
DFimageio, 125
DFimport.rpc, 127
DFisRunning, 189
DFlistplates.rpc, 132
DFlogger, 134
DFlogo.png, 32
DFlut_map, 32
DFmigrate, 190-193
DFmissing_map, 33
DFpage_map, 34
DFpass, 135
DFpdf, 137
DFpdfpkg, 141
DFprint_filter, 145
DFprintdb, 146
DFpsprint, 148
DFqcproblem_map, 36
DFqcps, 149
DFqcsort, 35
DFras2png, 194
DFreport, 150
DFreportstyle, 56
DFsas, 152
DFschema, 38
DFsendfax, 154
DFsetup, 42
DFshowIdx, 195
DFsqlload, 158, 443-447
DFstatus, 171
DFstudyDiag, 196-197
DFstudyPerms, 198-199
DFsubjectalias_map, 44
DFsubjectalias_map.log, 45
DFtextps, 173
DFtiff2ras, 200
DFtips, 45, 47
DFuserdb, 174
DFuserPerms, 201-203
DFversion, 175
DFvisit_map, 48
DFwatermark, 50
DFwhich, 176
DFX_ccycle, 59
DFX_cplate, 61
DFX_cterm, 62
DFX_cvisit, 60
DFX_keys, 63
DFX_schedule, 63

E

Edit Checks
  DFedits, 23
  DFedits.bin, 31
Edit checks, 204
Example
  DFbatch Control File, 322
External Software Copyrights, 448-462
  c3.js, 461
  d3.js, 462
  DCMTK, 448
  FFmpeg, 461-462
  gawk, 451-455
  Ghostscript, 455-455
  Jansson License, 448-449
  MariaDB and FreeTDS, 455-461
  Mimencode, 449
  mpack/munpack, 449
  OpenSSL License, 450-451
  PostgreSQL, 450
  QtAV, 461
  RSA Data Security, Inc., MD5 message-digest algorithm, 449
  TIFF, 449

F

FFmpeg, 461
FreeTDS, 455

G

gawk, 451
Ghostscript, 455

H

Header Bits, 22

I

Index Files, 21
Introduction, 1-3

J

Jansson, 448

L

Lookup Tables, 58

M

MariaDB, 455
Mimencode, 449
Missed Records, 13
mpack/munpack, 449

O

OpenSSL, 450

P

Plate data files, 11
  Field Descriptions, 12
PostgreSQL, 450

Q

QCcovers, 51
QCmessages, 53
QCtitles, 56
QtAV, 461
Query database, 14
Query Titles, 54

R

Record Bits, 22
Reports History, 37
RSA Data Security, 449

S

SAS, 411-442
Server Configuration, 43
Shell Programs, 69-71
  DFaccess.rpc, 72-74
  DFattach, 75-77
  DFaudittrace, 78-81
  DFbatch, 82-83
  DFcompiler, 84-84
  DFdisable.rpc, 85-86
  DFenable.rpc, 87-87
  DFencryptpdf, 88-89
  DFexport, 90-104
  DFexport.rpc, 105-114
  DFfaxq, 115
  DFfaxrm, 117
  DFget, 119
  DFgetparam.rpc, 121
  DFhostid, 124
  DFimageio, 125
  DFimport.rpc, 127-131
  DFlistplates.rpc, 132
  DFlogger, 134
  DFpass, 135
  DFpdf, 137-140
  DFpdfpkg, 141-144
  DFprint_filter, 145
  DFprintdb, 146
  DFpsprint, 148
  DFqcps, 149
  DFreport, 150
  DFsas, 152
  DFsendfax, 154-157
  DFsqlload, 158-170
  DFstatus, 171
  DFtextps, 173
  DFuserdb, 174
  DFversion, 175
  DFwhich, 176
Study Files, 4-68
  DFccycle_map, 25
  DFcenters, 23, 25
  DFcplate_map, 28
  DFcrfbkgd_map, 30
  DFCRFType_map, 30
  DFcterm_map, 29
  DFcvisit_map, 27
  DFfile_map, 31
  DFlogo.png, 32
  DFlut_map, 32
  DFmissing_map, 33
  DFpage_map, 34
  DFqcproblem_map, 36
  DFsetup, 42
  DFsubjectalias_map, 44
  DFsubjectalias_map.log, 45, 45
  DFtips, 47
  DFvisit_map, 48, 49
  DFwatermark, 50
  DFX_ccycle, 59
  DFX_cplate, 61
  DFX_cterm, 62
  DFX_schedule, 63
  Lookup Tables, 58

T

TIFF, 449

Timing data, 66
Troubleshooting, 324

U

Utility Programs, 177

V

Visit Date, 67

W

Writing Reports, 407-410

X

XML Language, 404

Y

YYMM.jnl, 19