doxygen

Manual for version 1.9.3

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Contents

I User Manual 1

1 Introduction 3

2 Installation 7

2.1 Compiling from source on UNIX . . . 7

2.2 Installing the binaries on UNIX . . . 8

2.3 Compiling from source on Windows . . . 9

2.4 Installing the binaries on Windows . . . 9

3 Getting started 11

3.1 Step 0: Check if doxygen supports your programming language . . . 12

3.2 Step 1: Creating a configuration file . . . 12

3.3 Step 2: Running doxygen . . . 13

3.3.1 HTML output . . . 13

3.3.2 LaTeX output . . . 14

3.3.3 RTF output . . . 14

3.3.4 XML output . . . 14

3.3.5 Man page output . . . 14

3.3.6 DocBook output . . . 14

3.4 Step 3: Documenting the sources . . . 15

4 Documenting the code 17

4.1 Special comment blocks . . . 17

4.1.1 Comment blocks for C-like languages (C/C++/C#/Objective-C/PHP/Java) . . . 17

Putting documentation after members . . . 20

Examples . . . 21

Documentation at other places . . . 23

4.1.2 Comment blocks in Python . . . 25

4.1.3 Comment blocks in VHDL . . . 26

4.1.4 Comment blocks in Fortran . . . 26

4.2 Anatomy of a comment block . . . 27

5 Markdown support 29

5.1 Standard Markdown . . . 29
5.1.1 Paragraphs . . . 29
5.1.2 Headers . . . 29
5.1.3 Block quotes . . . 30
5.1.4 Lists . . . 30
5.1.5 Code Blocks . . . 30
5.1.6 Horizontal Rulers . . . 31
5.1.7 Emphasis . . . 31
5.1.8 Strikethrough . . . 31
5.1.9 code spans . . . 31
5.1.10 Links . . . 32
Inline Links . . . 32
Reference Links . . . 32
5.1.11 Images . . . 33
5.1.12 Automatic Linking . . . 33
5.2 Markdown Extensions . . . 33
5.2.1 Table of Contents . . . 33
5.2.2 Tables . . . 33
5.2.3 Fenced Code Blocks . . . 34
5.2.4 Header Id Attributes . . . 35
5.2.5 Image Attributes . . . 35
5.3 Doxygen specifics . . . 36
5.3.1 Including Markdown files as pages . . . 36
5.3.2 Treatment of HTML blocks . . . 36
5.3.3 Code Block Indentation . . . 36
5.3.4 Emphasis and strikethrough limits . . . 37
5.3.5 Code Spans Limits . . . 38
5.3.6 Lists Extensions . . . 38
5.3.7 Use of asterisks . . . 39
5.3.8 Limits on markup scope . . . 39
5.4 Debugging problems . . . 39

6 Lists **41**

7 Grouping **43**
7.1 Modules . . . 43
7.2 Member Groups . . . 45
7.3 Subpaging . . . 46

8 Including formulas **49**

9 Including tables 51

10 Graphs and diagrams 53

11 Preprocessing 57

12 Automatic link generation 61

12.1 Links to web pages and mail addresses . . . 61

12.2 Links to classes . . . 61

12.3 Links to files . . . 61

12.4 Links to functions . . . 61

12.5 Links to other members . . . 62

12.6 typedefs . . . 64

13 Output Formats 65

14 Searching 67

14.1 External Indexing and Searching . . . 69

14.1.1 Introduction . . . 69

14.1.2 Configuring . . . 70

Single project index . . . 71

Multi project index . . . 71

14.1.3 Updating the index . . . 72

14.1.4 Programming interface . . . 72

Indexer input format . . . 72

Search URL format . . . 73

Search results format . . . 73

15 Customizing the output 75

15.1 Minor Tweaks . . . 75

15.1.1 Overall Color . . . 75

15.1.2 Navigation . . . 75

15.1.3 Dynamic Content . . . 77

15.1.4 Header, Footer, and Stylesheet changes . . . 77

15.2 Changing the layout of pages . . . 78

15.3 Using the XML output . . . 81

16 Custom commands 83

16.1 Simple aliases . . . 83

16.2 Aliases with arguments . . . 83

16.3 Nesting custom command . . . 84

17 Linking to external documentation 85

18 Frequently Asked Questions 87

18.1 How to get information on the index page in HTML? . . . 87

18.2 Help, some/all of the members of my class / file / namespace are not documented? . . . 87

18.3 When I set EXTRACT_ALL to NO none of my functions are shown in the documentation. . . . 88

18.4 My file with a custom extension is not parsed (properly) (anymore). . . . 88

18.5 How can I make doxygen ignore some code fragment? . . . 88

18.6 How can I change what is after the #include in the class documentation? . . . 88

18.7 How can I use tag files in combination with compressed HTML? . . . 89

18.8 I don't like the quick index that is put above each HTML page, what do I do? . . . 89

18.9 The overall HTML output looks different, while I only wanted to use my own html header file . . . 89

18.10 Why does doxygen use Qt? . . . 89

18.11 How can I exclude all test directories from my directory tree? . . . 90

18.12 Doxygen automatically generates a link to the class MyClass somewhere in the running text. How do I prevent that at a certain place? . . . 90

18.13 My favorite programming language is X. Can I still use doxygen? . . . 90

18.14 Help! I get the cryptic message "input buffer overflow, can't enlarge buffer because scanner uses REJECT" . . . 90

18.15 When running make in the latex directory I get "TeX capacity exceeded". Now what? . . . 90

18.16 Why are dependencies via STL classes not shown in the dot graphs? . . . 91

18.17 I have problems getting the search engine to work with PHP5 and/or windows . . . 91

18.18 Can I configure doxygen from the command line? . . . 91

18.19 How did doxygen get its name? . . . 91

18.20 What was the reason to develop doxygen? . . . 91

18.21 How to prevent interleaved output . . . 92

19 Troubleshooting 93

19.1 Known Problems . . . 93

19.2 How to Help . . . 94

19.3 How to report a bug . . . 94

II Reference Manual 95

20 Features 97

21 Doxygen usage 99

21.1 Fine-tuning the output . . . 99

22 Doxywizard usage 101

22.1 Wizard tab . . . 102

22.1.1 Project settings . . . 103

22.1.2 Mode of operating . . . 104

22.1.3 Output to produce . . . 105

22.1.4 Diagrams to generate . . . 106
22.2 Expert tab . . . 106
22.3 Run tab . . . 109
22.4 Menu options . . . 110
22.4.1 File menu . . . 110
22.4.2 Settings menu . . . 110
22.4.3 Help menu . . . 111

23 Configuration **113**
23.1 Format . . . 113
23.2 Project related configuration options . . . 115
23.3 Build related configuration options . . . 120
23.4 Configuration options related to warning and progress messages . . . 124
23.5 Configuration options related to the input files . . . 125
23.6 Configuration options related to source browsing . . . 127
23.7 Configuration options related to the alphabetical class index . . . 129
23.8 Configuration options related to the HTML output . . . 129
23.9 Configuration options related to the LaTeX output . . . 138
23.10 Configuration options related to the RTF output . . . 143
23.11 Configuration options related to the man page output . . . 143
23.12 Configuration options related to the XML output . . . 144
23.13 Configuration options related to the DOCBOOK output . . . 144
23.14 Configuration options for the AutoGen Definitions output . . . 144
23.15 Configuration options related to Sqlite3 output . . . 145
23.16 Configuration options related to the Perl module output . . . 145
23.17 Configuration options related to the preprocessor . . . 146
23.18 Configuration options related to external references . . . 147
23.19 Configuration options related to the dot tool . . . 147
23.20 Examples . . . 151

24 Special Commands **155**
24.1 Introduction . . . 155
24.2 \addtogroup <name> [(title)] . . . 157
24.3 \callgraph . . . 157
24.4 \hidecallgraph . . . 157
24.5 \callergraph . . . 158
24.6 \hidecallergraph . . . 158
24.7 \showrefby . . . 158
24.8 \hiderefby . . . 158
24.9 \showrefs . . . 159
24.10 \hiderefs . . . 159

24.11 \category <name> [<header-file>] [<header-name>] . . . 159
24.12 \class <name> [<header-file>] [<header-name>] . . . 159
24.13 \concept <name> . . . 160
24.14 \def <name> . . . 160
24.15 \defgroup <name> (group title) . . . 160
24.16 \dir [<path fragment>] . . . 160
24.17 \enum <name> . . . 160
24.18 \example['{lineno}'] <file-name> . . . 161
24.19 \endinternal . . . 162
24.20 \extends <name> . . . 162
24.21 \file [<name>] . . . 162
24.22 \fn (function declaration) . . . 162
24.23 \headerfile <header-file> [<header-name>] . . . 163
24.24 \hideinitializer . . . 163
24.25 \idlexcept <name> . . . 164
24.26 \implements <name> . . . 164
24.27 \ingroup (<groupname> [<groupname> <groupname>]) . . . 164
24.28 \interface <name> [<header-file>] [<header-name>] . . . 164
24.29 \internal . . . 164
24.30 \mainpage [(title)] . . . 164
24.31 \memberof <name> . . . 165
24.32 \name [(header)] . . . 165
24.33 \namespace <name> . . . 165
24.34 \nosubgrouping . . . 165
24.35 \overload [(function declaration)] . . . 165
24.36 \package <name> . . . 166
24.37 \page <name> (title) . . . 166
24.38 \private . . . 167
24.39 \privatesection . . . 167
24.40 \property (qualified property name) . . . 167
24.41 \protected . . . 167
24.42 \protectedsection . . . 167
24.43 \protocol <name> [<header-file>] [<header-name>] . . . 168
24.44 \public . . . 168
24.45 \publicsection . . . 168
24.46 \pure . . . 168
24.47 \relates <name> . . . 168
24.48 \related <name> . . . 169
24.49 \relatesalso <name> . . . 169
24.50 \relatedalso <name> . . . 169

24.51 \showinitializer . . . 169
24.52 \static . . . 169
24.53 \struct <name> [<header-file>] [<header-name>] . . . 169
24.54 \typedef (typedef declaration) . . . 169
24.55 \union <name> [<header-file>] [<header-name>] . . . 170
24.56 \var (variable declaration) . . . 170
24.57 \vhdlflow [(title for the flow chart)] . . . 170
24.58 \weakgroup <name> [(title)] . . . 170
24.59 \attention { attention text } . . . 170
24.60 \author { list of authors } . . . 170
24.61 \authors { list of authors } . . . 171
24.62 \brief { brief description } . . . 171
24.63 \bug { bug description } . . . 171
24.64 \cond [(section-label)] . . . 171
24.65 \copyright { copyright description } . . . 172
24.66 \date { date description } . . . 172
24.67 \deprecated { description } . . . 172
24.68 \details { detailed description } . . . 172
24.69 \noop (text to be ignored) . . . 173
24.70 \raisewarning (text to be shown as warning) . . . 173
24.71 \else . . . 173
24.72 \elseif (section-label) . . . 173
24.73 \endcond . . . 173
24.74 \endif . . . 174
24.75 \exception <exception-object> { exception description } . . . 174
24.76 \if (section-label) . . . 174
24.77 \ifnot (section-label) . . . 175
24.78 \invariant { description of invariant } . . . 175
24.79 \note { text } . . . 175
24.80 \par [(paragraph title)] { paragraph } . . . 175
24.81 \param '['dir']' <parameter-name> { parameter description } . . . 176
24.82 \parblock . . . 176
24.83 \endparblock . . . 176
24.84 \tparam <template-parameter-name> { description } . . . 176
24.85 \post { description of the postcondition } . . . 176
24.86 \pre { description of the precondition } . . . 177
24.87 \remark { remark text } . . . 177
24.88 \remarks { remark text } . . . 177
24.89 \result { description of the result value } . . . 177
24.90 \return { description of the return value } . . . 177

24.91 \returns { description of the return value } . . . 177
24.92 \retval <return value> { description } . . . 177
24.93 \sa { references } . . . 177
24.94 \see { references } . . . 178
24.95 \short { short description } . . . 178
24.96 \since { text } . . . 178
24.97 \test { paragraph describing a test case } . . . 178
24.98 \throw <exception-object> { exception description } . . . 178
24.99 \throws <exception-object> { exception description } . . . 178
24.100 \todo { paragraph describing what is to be done } . . . 178
24.101 \version { version number } . . . 178
24.102 \warning { warning message } . . . 179
24.103 \xrefitem <key> "(heading)" "(list title)" { text } . . . 179
24.104 \addindex (text) . . . 179
24.105 \anchor <word> . . . 179
24.106 \cite <label> . . . 180
24.107 \endlink . . . 180
24.108 \link <link-object> . . . 180
24.109 \ref <name> ["(text)"] . . . 180
24.110 \refitem <name> . . . 180
24.111 \secreflist . . . 180
24.112 \endsecreflist . . . 180
24.113 \subpage <name> ["(text)"] . . . 180
24.114 \tableofcontents['{'[option[:level]][,option[:level]]*'}'] . . . 181
24.115 \section <section-name> (section title) . . . 181
24.116 \subsection <subsection-name> (subsection title) . . . 182
24.117 \subsubsection <subsubsection-name> (subsubsection title) . . . 182
24.118 \paragraph <paragraph-name> (paragraph title) . . . 182
24.119 \dontinclude['{lineno}'] <file-name> . . . 182
24.120 \include['{'option'}'] <file-name> . . . 183
24.121 \includelineno <file-name> . . . 184
24.122 \includedoc <file-name> . . . 184
24.123 \line (pattern) . . . 184
24.124 \skip (pattern) . . . 184
24.125 \skipline (pattern) . . . 184
24.126 \snippet['{'option'}'] <file-name> (block_id) . . . 184
24.127 \snippetlineno <file-name> (block_id) . . . 185
24.128 \snippetdoc <file-name> (block_id) . . . 185
24.129 \until (pattern) . . . 185
24.130 \verbinclude <file-name> . . . 185

24.131 \htmlinclude ["[block]"] <file-name> . . . 186
24.132 \latexinclude <file-name> . . . 186
24.133 \rtfinclude <file-name> . . . 186
24.134 \maninclude <file-name> . . . 186
24.135 \docbookinclude <file-name> . . . 186
24.136 \xmlinclude <file-name> . . . 187
24.137 \a <word> . . . 187
24.138 \arg { item-description } . . . 187
24.139 \b <word> . . . 188
24.140 \c <word> . . . 188
24.141 \code['{'<word>'}'] . . . 188
24.142 \copydoc <link-object> . . . 188
24.143 \copybrief <link-object> . . . 189
24.144 \copydetails <link-object> . . . 189
24.145 \docbookonly . . . 189
24.146 \dot ["caption"] [<sizeindication>=<size>] . . . 189
24.147 \emoji "name" . . . 190
24.148 \msc ["caption"] [<sizeindication>=<size>] . . . 190
24.149 \startuml ['{'option[,option]'}'] ["caption"] [<sizeindication>=<size>] . . . 191
24.150 \dotfile <file> ["caption"] [<sizeindication>=<size>] . . . 192
24.151 \mscfile <file> ["caption"] [<sizeindication>=<size>] . . . 192
24.152 \diafile <file> ["caption"] [<sizeindication>=<size>] . . . 192
24.153 \e <word> . . . 193
24.154 \em <word> . . . 193
24.155 \endcode . . . 193
24.156 \enddocbookonly . . . 193
24.157 \enddot . . . 193
24.158 \endmsc . . . 193
24.159 \enduml . . . 193
24.160 \endhtmlonly . . . 194
24.161 \endlatexonly . . . 194
24.162 \endmanonly . . . 194
24.163 \endrtfonly . . . 194
24.164 \endverbatim . . . 194
24.165 \endxmlonly . . . 194
24.166 \f$ . . . 194
24.167 \f(. . . 195
24.168 \f) . . . 195
24.169 \f[. . . 195
24.170 \f] . . . 195

24.171 \f{environment}{ . . . 195
24.172 \f} . . . 195
24.173 \htmlonly ["[block]"] . . . 196
24.174 \image['{'option[,option]'}'] <format> <file> ["caption"] [<sizeindication>=<size>] . . . 196
24.175 \latexonly . . . 197
24.176 \manonly . . . 197
24.177 \li { item-description } . . . 197
24.178 \n . . . 197
24.179 \p <word> . . . 198
24.180 \rtfonly . . . 198
24.181 \verbatim . . . 198
24.182 \xmlonly . . . 198
24.183 \\ . . . 198
24.184 \@ . . . 198
24.185 \~[LanguageId] . . . 199
24.186 \& . . . 199
24.187 \$ . . . 199
24.188 \# . . . 199
24.189 \< . . . 199
24.190 \> . . . 199
24.191 \% . . . 199
24.192 \" . . . 199
24.193 \. . . . 199
24.194 \= . . . 199
24.195 \:: . . . 200
24.196 \| . . . 200
24.197 \-- . . . 200
24.198 \--- . . . 200

25 HTML Commands **201**

26 XML Commands **213**

27 Emoji support **215**

27.1 Representation . . . 215
27.2 Emoji image retrieval . . . 215

III Developers Manual **217**

28 Internationalization **219**

29 Perl Module Output **225**

29.1 Usage . . . 225
29.2 Using the LaTeX generator. . . . 225
29.2.1 Creation of PDF and DVI output . . . 226
29.3 Documentation format. . . . 226
29.4 Data structure . . . 227
29.5 Perl Module Tree Nodes . . . 227

30 Doxygen's internals **233**

Appendices **237**

A Autolink Example **239**
A.1 Class Documentation . . . 239
A.1.1 Autolink_Test Class Reference . . . 239
Detailed Description . . . 239
Member Enumeration Documentation . . . 240
Constructor & Destructor Documentation . . . 240
Member Function Documentation . . . 240
A.2 File Documentation . . . 240
A.2.1 autolink.cpp File Reference . . . 240
Detailed Description . . . 241
Macro Definition Documentation . . . 241
Typedef Documentation . . . 241
Enumeration Type Documentation . . . 241
Variable Documentation . . . 242

B Resolving Typedef Example **243**
B.1 Class Documentation . . . 243
B.1.1 CoordStruct Struct Reference . . . 243
Detailed Description . . . 243
Member Data Documentation . . . 243
B.2 File Documentation . . . 243
B.2.1 restypedef.cpp File Reference . . . 243
Detailed Description . . . 243
Typedef Documentation . . . 244
Function Documentation . . . 244

C Modules Example **245**
C.1 Module Documentation . . . 245
C.1.1 The First Group . . . 245
Detailed Description . . . 245

C.1.2 The Second Group . . . 245
Detailed Description . . . 246
C.1.3 The Third Group . . . 246
Detailed Description . . . 246
C.1.4 The Fourth Group . . . 246
Detailed Description . . . 246
C.1.5 The Fifth Group . . . 246
C.2 Namespace Documentation . . . 247
C.2.1 N1 Namespace Reference . . . 247
Detailed Description . . . 247
C.3 Class Documentation . . . 247
C.3.1 C1 Class Reference . . . 247
Detailed Description . . . 247
C.3.2 C2 Class Reference . . . 247
Detailed Description . . . 247
C.3.3 C3 Class Reference . . . 247
Detailed Description . . . 247
C.3.4 C4 Class Reference . . . 247
Detailed Description . . . 248
C.3.5 C5 Class Reference . . . 248
Detailed Description . . . 248
C.4 File Documentation . . . 248
C.4.1 group.cpp File Reference . . . 248
Detailed Description . . . 248

D Member Groups Example **249**
D.1 Class Documentation . . . 249
D.1.1 Memgrp_Test Class Reference . . . 249
Detailed Description . . . 249
Member Function Documentation . . . 249
D.2 File Documentation . . . 250
D.2.1 memgrp.cpp File Reference . . . 250
Detailed Description . . . 250
Macro Definition Documentation . . . 250
Function Documentation . . . 250

E Style Examples **251**
E.1 After Block Example . . . 251
E.1.1 Class Documentation . . . 251
Afterdoc_Test Class Reference . . . 251
E.1.2 File Documentation . . . 252

afterdoc.h . . . 252
E.2 QT Style Example . . . 252
E.2.1 Class Documentation . . . 252
QTstyle_Test Class Reference . . . 252
E.3 Javadoc Style Example . . . 254
E.3.1 Class Documentation . . . 254
Javadoc_Test Class Reference . . . 254
E.4 Javadoc Banner Example . . . 256
E.4.1 File Documentation . . . 256
javadoc-banner.h File Reference . . . 256
javadoc-banner.h . . . 257

F Structural Commands Example 259
F.1 File Documentation . . . 259
F.1.1 structcmd.h File Reference . . . 259
Detailed Description . . . 259
Macro Definition Documentation . . . 259
Typedef Documentation . . . 260
Function Documentation . . . 260
Variable Documentation . . . 261
F.1.2 structcmd.h . . . 261

G Language Examples 263
G.1 Python Docstring Example . . . 263
G.1.1 Namespace Documentation . . . 263
docstring Namespace Reference . . . 263
G.1.2 Class Documentation . . . 263
docstring.PyClass Class Reference . . . 263
G.1.3 File Documentation . . . 264
docstring.py File Reference . . . 264
G.2 Python Example . . . 264
G.2.1 Namespace Documentation . . . 264
pyexample Namespace Reference . . . 264
G.2.2 Class Documentation . . . 265
pyexample.PyClass Class Reference . . . 265
G.3 VHDL Example . . . 265
G.3.1 Design Unit Documentation . . . 265
behavior Architecture Reference . . . 265
mux_using_with Entity Reference . . . 265
G.3.2 File Documentation . . . 266
mux.vhdl File Reference . . . 266

H Class Example **267**
H.1 Class Documentation . . . 267
H.1.1 Test Class Reference . . . 267
Detailed Description . . . 267
H.2 File Documentation . . . 267
H.2.1 class.h . . . 267

I Define Example **269**
I.1 File Documentation . . . 269
I.1.1 define.h File Reference . . . 269
Detailed Description . . . 269
Macro Definition Documentation . . . 269
I.1.2 define.h . . . 270

J Enum Example **271**
J.1 Class Documentation . . . 271
J.1.1 Enum_Test Class Reference . . . 271
Detailed Description . . . 271
Member Enumeration Documentation . . . 271
J.2 File Documentation . . . 272
J.2.1 enum.h . . . 272

K Example Example **273**
K.1 Class Documentation . . . 273
K.1.1 Example_Test Class Reference . . . 273
Detailed Description . . . 273
Member Function Documentation . . . 273
K.2 Example Documentation . . . 273
K.2.1 example_test.cpp . . . 273

L Extends/Implements Example **275**
L.1 Class Documentation . . . 275
L.1.1 Car Struct Reference . . . 275
Detailed Description . . . 275
L.1.2 Object Struct Reference . . . 275
Detailed Description . . . 276
Member Function Documentation . . . 276
L.1.3 Truck Struct Reference . . . 276
Detailed Description . . . 276
L.1.4 Vehicle Struct Reference . . . 277
Detailed Description . . . 277

Member Function Documentation . . . 277
L.2 File Documentation . . . 277
L.2.1 manual.c File Reference . . . 277
Function Documentation . . . 278

M File Example **279**
M.1 File Documentation . . . 279
M.1.1 file.h File Reference . . . 279
Detailed Description . . . 279
Variable Documentation . . . 279
M.1.2 file.h . . . 279

N Fn Example **281**
N.1 Class Documentation . . . 281
N.1.1 Fn_Test Class Reference . . . 281
Detailed Description . . . 281
Member Function Documentation . . . 281
N.2 File Documentation . . . 282
N.2.1 func.h . . . 282

O Overload Example **283**
O.1 Class Documentation . . . 283
O.1.1 Overload_Test Class Reference . . . 283
Detailed Description . . . 283
Member Function Documentation . . . 283

P Page Example **285**
P.1 A documentation page . . . 285
P.1.1 An example section . . . 285
The first subsection . . . 285
The second subsection . . . 285
P.2 Another page . . . 285

Q Relates Example **287**
Q.1 Class Documentation . . . 287
Q.1.1 String Class Reference . . . 287
Detailed Description . . . 287
Friends And Related Function Documentation . . . 287

R Author Example **289**
R.1 Bug List . . . 289
R.2 Class Documentation . . . 289

R.2.1 SomeNiceClass Class Reference 289
Detailed Description 289

S Par Example **291**
S.1 Class Documentation 291
S.1.1 Par_Test Class Reference 291
Detailed Description 291

T Include Example **293**
T.1 pag_example 293
T.2 Class Documentation 293
T.2.1 Include_Test Class Reference 293
Detailed Description 293

Part I

User Manual

Chapter 1

Introduction

Introduction

Doxygen is the de facto standard tool for generating documentation from annotated C++ sources, but it also supports other popular programming languages such as C, Objective-C, C#, PHP, Java, Python, IDL (Corba, Microsoft, and UNO/OpenOffice flavors), Fortran, VHDL and to some extent D.

Doxygen can help you in three ways:

1. It can generate an on-line documentation browser (in HTML) and/or an off-line reference manual (in LaTeX) from a set of documented source files. There is also support for generating output in RTF (MS-Word), PostScript, hyperlinked PDF, compressed HTML, and Unix man pages. The documentation is extracted directly from the sources, which makes it much easier to keep the documentation consistent with the source code.
2. You can configure doxygen to extract the code structure from undocumented source files. This is very useful to quickly find your way in large source distributions. Doxygen can also visualize the relations between the various elements by means of include dependency graphs, inheritance diagrams, and collaboration diagrams, which are all generated automatically.
3. You can also use doxygen for creating normal documentation (as I did for the doxygen user manual and web-site).

Doxygen is developed under Mac OS X and Linux, but is set-up to be highly portable. As a result, it runs on most other Unix flavors as well. Furthermore, executables for Windows are available.

This manual is divided into three parts, each of which is divided into several sections.

The first part forms a user manual:

- Section Installation discusses how to `download`, compile and install doxygen for your platform.
- Section Getting started tells you how to generate your first piece of documentation quickly.
- Section Documenting the code demonstrates the various ways that code can be documented.
- Section Markdown support show the Markdown formatting supported by doxygen.
- Section Lists shows how to create lists.
- Section Grouping shows how to group things together.
- Section Including tables shows how to insert tables in the documentation.
- Section Including formulas shows how to insert formulas in the documentation.

- Section Graphs and diagrams describes the diagrams and graphs that doxygen can generate.
- Section Preprocessing explains how doxygen deals with macro definitions.
- Section Automatic link generation shows how to put links to files, classes, and members in the documentation.
- Section Output Formats shows how to generate the various output formats supported by doxygen.
- Section Searching shows various ways to search in the HTML documentation.
- Section External Indexing and Searching shows how use the external search and index tools
- Section Customizing the output explains how you can customize the output generated by doxygen.
- Section Custom Commands show how to define and use custom commands in your comments.
- Section Linking to external documentation explains how to let doxygen create links to externally generated documentation.
- Section Frequently Asked Questions gives answers to frequently asked questions.
- Section Troubleshooting tells you what to do when you have problems.

The second part forms a reference manual:

- Section Features presents an overview of what doxygen can do.
- Section Doxygen usage shows how to use the `doxygen` program.
- Section Doxywizard usage shows how to use the `doxywizard` program.
- Section Configuration shows how to fine-tune doxygen, so it generates the documentation you want.
- Section Special Commands shows an overview of the special commands that can be used within the documentation.
- Section HTML Commands shows an overview of the HTML commands that can be used within the documentation.
- Section XML Commands shows an overview of the C# style XML commands that can be used within the documentation.
- Section Emoji support shows an introduction how emoji can be used within the documentation.

The third part provides information for developers:

- Section Doxygen's Internals gives a global overview of how doxygen is internally structured.
- Section Perl Module Output shows how to use the PerlMod output.
- Section Internationalization explains how to add support for new output languages.

Doxygen license

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Documents produced by doxygen are derivative works derived from the input used in their production; they are not affected by this license.

User examples

Doxygen supports a number of output formats where HTML is the most popular one. I've gathered some nice examples of real-life projects using doxygen.

These are part of a larger list of projects that use doxygen. If you know other projects, let me know and I'll add them.

Future work

Although doxygen is successfully used by large number of companies and open source projects already, there is always room for improvement.

You can also submit enhancement requests in the bug tracker.

Acknowledgments

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Chapter 2

Installation

2.1 Compiling from source on UNIX 7

2.2 Installing the binaries on UNIX 8

2.3 Compiling from source on Windows 9

2.4 Installing the binaries on Windows 9

First go to the download page to get the latest distribution, if you have not downloaded doxygen already.

2.1 Compiling from source on UNIX

If you downloaded the source distribution, you need at least the following to build the executable:

- The GNU tools flex, bison, libiconv and GNU make
- You need python (version 2.7 or higher, see https://www.python.org).
- In order to generate a Makefile for your platform, you need cmake version 3.3 or later.

To take full advantage of doxygen's features the following additional tools should be installed.

- Qt Software's GUI toolkit Qt version 4.3 or higher (including Qt 5). This is needed to build the GUI front-end doxywizard.
- A LaTeX distribution: for instance TeX Live This is needed for generating LaTeX, Postscript, and PDF output.
- the Graph visualization toolkit version 2.38 or higher Needed for the include dependency graphs, the graphical inheritance graphs, and the collaboration graphs. If you compile graphviz yourself, make sure you do include freetype support (which requires the freetype library and header files), otherwise the graphs will not render proper text labels.
- For formulas in the HTML output (when MathJax is not used) or in case you do not wish to use pdflatex, the ghostscript interpreter is needed. You can find it at www.ghostscript.com.

Compilation is now done by performing the following steps:

1. Unpack the archive, unless you already have done that:

```
gunzip doxygen-$VERSION.src.tar.gz    # uncompress the archive
tar xf doxygen-$VERSION.src.tar       # unpack it
```

2. Create a build directory (for instance inside the source tree)

```
cd doxygen-$VERSION
mkdir build
cd build
```

3. Run cmake with the makefile generator

   ```
   cmake -G "Unix Makefiles" ..
   ```

   `cmake` tries to determine the platform you use, and will look for the requires tools. It will report if something is missing.
   If you have Qt-4.3 or higher installed and want to build the GUI front-end, you should enable it as follows:

   ```
   cmake -Dbuild_wizard=YES ..
   ```

   For an overview of other configuration options use

   ```
   cmake -L ..
   ```

4. Compile the program by running make:

   ```
   make
   ```

   The program should compile without problems and the binaries (`doxygen` and optionally `doxywizard`) should be available in the bin directory within the build directory.

5. Optional: Generate the user manual.

   ```
   cmake -Dbuild_doc=YES ..
   make docs
   ```

   To let doxygen generate the HTML and PDF documentation.

   The HTML directory within the build directory will now contain the html documentation (just point a HTML browser to the file `index.html` in the html directory).

6. Optional: static linking
   If you want to build a statically linked version of doxygen that embeds libclang you need to first build LLVM and clang from sources using the following options:

   ```
   cmake -DLIBCLANG_BUILD_STATIC=ON \
         -DBUILD_SHARED_LIBS=OFF \
         -DLLVM_ENABLE_PIC=OFF \
         -DLLVM_BUILD_LLVM_DYLIB=OFF \
         -DLLVM_BUILD_LLVM_C_DYLIB=OFF \
         -DLLVM_ENABLE_TERMINFO=OFF \
         path_to_llvm_root_source_dir
   ```

   and then build doxygen with these options:

   ```
   cmake -DCMAKE_BUILD_TYPE=Release \
         "-DCMAKE_FIND_LIBRARY_SUFFIXES=.a" \
         "-ldl;-lz;-lpthread" \
         -Duse_libclang=YES \
         path_to_doxygen_root_source_dir
   ```

2.2 Installing the binaries on UNIX

After the compilation of the source code do a `make install` to install doxygen. If you downloaded the binary distribution for Linux, type:

```
make install
```

Binaries are installed into the directory `/usr/local/bin`, man pages in `/usr/local/man/man1` and documentation in `/usr/local/doc/doxygen` To change this just edit the Makefile.

Note

> You need the GNU install tool for this to work (it is part of the coreutils package). Other install tools may put the binaries in the wrong directory!

If you have a RPM or DEB package, then please follow the standard installation procedure that is required for these packages.

2.3 Compiling from source on Windows

From version 1.8.10 onwards, build files need to be generated by cmake. cmake can be downloaded from https://cmake.org/download/

At the moment only the express version of Visual Studio 2015 and 2017 are tested, but other version might also work.

Alternatively, you can compile doxygen the UNIX way using Cygwin or MinGW.

The next step is to install modern versions of bison and flex (see https://sourceforge.net/projects/winflexbison/. After installation and adding them to your path rename win_flex.exe to flex.exe and win_bison.exe to bison.exe) Furthermore you have to install python (version 2.7 or higher, see https://www.python.org). These packages are needed during the compilation process.

Download doxygen's source tarball and put it somewhere (e.g. use c:\tools)

Now start a visual studio native command shell (for either x86 or x64) and type

```
cd c:\tools
tar zxvf doxygen-x.y.z.src.tar.gz
```

to unpack the sources (you can obtain tar from e.g. http://gnuwin32.sourceforge.net/packages.html). Alternatively you can use an unpack program, like 7-Zip (see https://www.7-zip.org/) or use the built-in unpack feature of modern Windows systems).

Now your environment is setup to generate the required project files for doxygen.

cd into the doxygen-x.y.z directory, create and cd to a build directory

```
mkdir build
cd build
cmake -G "Visual Studio 14 2015" ..
```

This will create a project file then can be opened in Visual Studio.

If you prefer compiling from the command prompt you can use the following instead:

```
mkdir build
cd build
cmake -G "NMake Makefiles" ..
nmake
```

Note that compiling Doxywizard requires Qt 4.3 or newer (see https://www.qt.io/developers).

Also read the next section for additional tools you may need to install to run doxygen with certain features enabled.

2.4 Installing the binaries on Windows

Doxygen comes as a self-installing archive, so installation is extremely simple. Just follow the dialogs.

After installation it is recommended to also download and install GraphViz (version 2.38 or better is highly recommended). Doxygen can use the dot tool of the GraphViz package to render nicer diagrams, see the HAVE_DOT option in the configuration file.

If you want to produce compressed HTML files (see GENERATE_HTMLHELP) in the configuration file, then you need the Microsoft HTML help workshop. In the beginning of 2021 Microsoft took the original page, with a.o. the download links, offline the HTML help workshop was already many years in maintenance mode). You can download the HTML help workshop from the web archives at Installation executable.

If you want to produce Qt Compressed Help files (see QHG_LOCATION) in the configuration file, then you need qhelpgenerator which is part of Qt. You can download Qt from Qt Software Downloads.

In order to generate PDF output or use scientific formulas you will also need to install LaTeX and Ghostscript.

For LaTeX a number of distributions exists. Popular ones that should work with doxygen are MikTex and proTeXt.

Ghostscript can be downloaded from Sourceforge.

After installing LaTeX and Ghostscript you'll need to make sure the tools latex.exe, pdflatex.exe, and gswin32c.exe (or gswin64c.exe) are present in the search path of a command box. Follow these instructions if you are unsure and run the commands from a command box to verify it works.

Chapter 3

Getting started

3.1 Step 0: Check if doxygen supports your programming language . . . 12

3.2 Step 1: Creating a configuration file . . . 12

3.3 Step 2: Running doxygen . . . 13

3.3.1 HTML output . . . 13

3.3.2 LaTeX output . . . 14

3.3.3 RTF output . . . 14

3.3.4 XML output . . . 14

3.3.5 Man page output . . . 14

3.3.6 DocBook output . . . 14

3.4 Step 3: Documenting the sources . . . 15

The executable `doxygen` is the main program that parses the sources and generates the documentation. See section Doxygen usage for more detailed usage information.

Optionally, the executable `doxywizard` can be used, which is a graphical front-end for editing the configuration file that is used by doxygen and for running doxygen in a graphical environment. For Mac OS X doxywizard will be started by clicking on the doxygen application icon.

The following figure shows the relation between the tools and the flow of information between them (it looks complex but that's only because it tries to be complete):

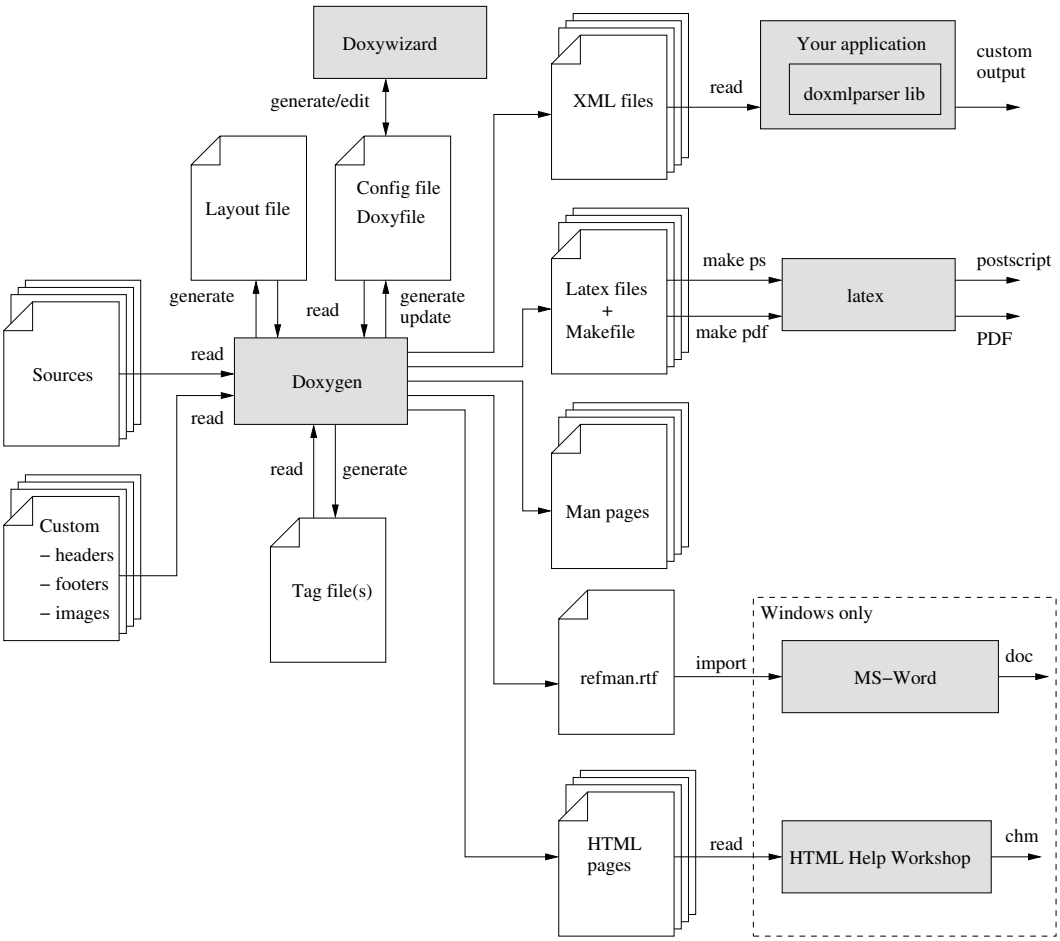


Figure 3.1: Doxygen information flow

3.1 Step 0: Check if doxygen supports your programming language

First, assure that your programming language has a reasonable chance of being recognized by doxygen. These languages are supported by default: C, C++, Lex, C#, Objective-C, IDL, Java, VHDL, PHP, Python, Fortran and D. It is possible to configure certain file type extensions to use certain parsers: see the Configuration/ExtensionMappings for details. Also, completely different languages can be supported by using preprocessor programs: see the `Helpers page` for details.

3.2 Step 1: Creating a configuration file

Doxygen uses a configuration file to determine all of its settings. Each project should get its own configuration file. A project can consist of a single source file, but can also be an entire source tree that is recursively scanned.

To simplify the creation of a configuration file, doxygen can create a template configuration file for you. To do this call `doxygen` from the command line with the `-g` option:

```
doxygen -g <config-file>
```

where <config-file> is the name of the configuration file. If you omit the file name, a file named `Doxyfile` will be created. If a file with the name <config-file> already exists, doxygen will rename it to <config-file>.bak before generating the configuration template. If you use – (i.e. the minus sign) as the file name then doxygen will try to read the configuration file from standard input (`stdin`), which can be useful for scripting.

The configuration file has a format that is similar to that of a (simple) Makefile. It consists of a number of assignments (tags) of the form:

```
TAGNAME = VALUE or
TAGNAME = VALUE1 VALUE2 ...
```

You can probably leave the values of most tags in a generated template configuration file to their default value. See section Configuration for more details about the configuration file.

If you do not wish to edit the configuration file with a text editor, you should have a look at doxywizard, which is a GUI front-end that can create, read and write doxygen configuration files, and allows setting configuration options by entering them via dialogs.

For a small project consisting of a few C and/or C++ source and header files, you can leave INPUT tag empty and doxygen will search for sources in the current directory.

If you have a larger project consisting of a source directory or tree you should assign the root directory or directories to the INPUT tag, and add one or more file patterns to the FILE_PATTERNS tag (for instance `*.cpp *.h`). Only files that match one of the patterns will be parsed (if the patterns are omitted a list of typical patterns is used for the types of files doxygen supports). For recursive parsing of a source tree you must set the RECURSIVE tag to `YES`. To further fine-tune the list of files that is parsed the EXCLUDE and EXCLUDE_PATTERNS tags can be used. To omit all `test` directories from a source tree for instance, one could use:

```
EXCLUDE_PATTERNS = */test/*
```

Doxygen looks at the file's extension to determine how to parse a file, using the following table:

Extension	Language	Extension	Language	Extension	Language
.dox	C / C++	.hpp	C / C++	.py	Python
.doc	C / C++	.h++	C / C++	.pyw	Python
.c	C / C++	.mm	C / C++	.f	Fortran
.cc	C / C++	.txt	C / C++	.for	Fortran
.cxx	C / C++	.idl	IDL	.f90	Fortran
.cpp	C / C++	.ddl	IDL	.f95	Fortran
.c++	C / C++	.odl	IDL	.f03	Fortran
.ii	C / C++	.java	Java	.f08	Fortran
.ixx	C / C++	.cs	C#	.f18	Fortran
.ipp	C / C++	.d	D	.vhd	VHDL
.i++	C / C++	.php	PHP	.vhdl	VHDL
.inl	C / C++	.php4	PHP	.ucf	VHDL
.h	C / C++	.php5	PHP	.qsf	VHDL
.H	C / C++	.inc	PHP	.l	Lex
.hh	C / C++	.phtml	PHP	.md	Markdown
.HH	C / C++	.m	Objective-C	.markdown	Markdown
.hxx	C / C++	.M	Objective-C	.ice	Slice

Please note that the above list might contain more items than that by default set in the FILE_PATTERNS.

Any extension that is not parsed can be set by adding it to FILE_PATTERNS and when the appropriate EXTENSION_MAPPING is set.

If you start using doxygen for an existing project (thus without any documentation that doxygen is aware of), you can still get an idea of what the structure is and how the documented result would look like. To do so, you must set the EXTRACT_ALL tag in the configuration file to `YES`. Then, doxygen will pretend everything in your sources is documented. Please note that as a consequence warnings about undocumented members will not be generated as long as EXTRACT_ALL is set to `YES`.

To analyze an existing piece of software it is useful to cross-reference a (documented) entity with its definition in the source files. Doxygen will generate such cross-references if you set the SOURCE_BROWSER tag to `YES`. It can also include the sources directly into the documentation by setting INLINE_SOURCES to `YES` (this can be handy

for code reviews for instance).

3.3 Step 2: Running doxygen

To generate the documentation you can now enter:

```
doxygen <config-file>
```

Depending on your settings doxygen will create `html`, `rtf`, `latex`, `xml`, `man`, and/or docbook directories inside the output directory. As the names suggest these directories contain the generated documentation in HTML, RTF, LaTeX, XML, Unix-Man page, and DocBook format.

The default output directory is the directory in which `doxygen` is started. The root directory to which the output is written can be changed using the OUTPUT_DIRECTORY. The format specific directory within the output directory can be selected using the HTML_OUTPUT, RTF_OUTPUT, LATEX_OUTPUT, XML_OUTPUT, MAN_OUTPUT, and DOCBOOK_OUTPUT. tags of the configuration file. If the output directory does not exist, `doxygen` will try to create it for you (but it will *not* try to create a whole path recursively, like `mkdir -p` does).

3.3.1 HTML output

The generated HTML documentation can be viewed by pointing a HTML browser to the `index.html` file in the `html` directory. For the best results a browser that supports cascading style sheets (CSS) should be used (I'm using Mozilla Firefox, Google Chrome, Safari, and sometimes IE8, IE9, and Opera to test the generated output).

Some of the features the HTML section (such as GENERATE_TREEVIEW or the search engine) require a browser that supports Dynamic HTML and JavaScript enabled.

3.3.2 LaTeX output

The generated LaTeX documentation must first be compiled by a LaTeX compiler (I use a recent teTeX distribution for Linux and MacOSX and MikTex for Windows). To simplify the process of compiling the generated documentation, `doxygen` writes a `Makefile` into the `latex` directory (on the Windows platform also a `make.bat` batch file is generated).

The contents and targets in the `Makefile` depend on the setting of USE_PDFLATEX. If it is disabled (set to `NO`), then typing `make` in the `latex` directory a `dvi` file called `refman.dvi` will be generated. This file can then be viewed using `xdvi` or converted into a PostScript file `refman.ps` by typing `make ps` (this requires `dvips`).

To put 2 pages on one physical page use `make ps_2on1` instead. The resulting PostScript file can be send to a PostScript printer. If you do not have a PostScript printer, you can try to use ghostscript to convert PostScript into something your printer understands.

Conversion to PDF is also possible if you have installed the ghostscript interpreter; just type `make pdf` (or `make pdf_2on1`).

To get the best results for PDF output you should set the PDF_HYPERLINKS and USE_PDFLATEX tags to `YES`. In this case the `Makefile` will only contain a target to build `refman.pdf` directly.

3.3.3 RTF output

Doxygen combines the RTF output to a single file called refman.rtf. This file is optimized for importing into the Microsoft Word. Certain information is encoded using so called fields. To show the actual value you need to select all (Edit - select all) and then toggle fields (right click and select the option from the drop down menu).

3.3.4 XML output

The XML output consists of a structured "dump" of the information gathered by doxygen. Each compound (class/-namespace/file/...) has its own XML file and there is also an index file called `index.xml`.

A file called `combine.xslt` XSLT script is also generated and can be used to combine all XML files into a single file.

Doxygen also generates two XML schema files `index.xsd` (for the index file) and `compound.xsd` (for the compound files). This schema file describes the possible elements, their attributes and how they are structured, i.e. it the describes the grammar of the XML files and can be used for validation or to steer XSLT scripts.

In the `addon/doxmlparser` directory you can find a parser library for reading the XML output produced by doxygen in an incremental way (see `addon/doxmlparser/doxmparser/index.py` and `addon/doxmlparser/doxmlparser/compound.py` for the interface of the library)

3.3.5 Man page output

The generated man pages can be viewed using the `man` program. You do need to make sure the man directory is in the man path (see the `MANPATH` environment variable). Note that there are some limitations to the capabilities of the man page format, so some information (like class diagrams, cross references and formulas) will be lost.

3.3.6 DocBook output

Doxygen can also generate output in the `DocBook` format. How to process the DocBook output is beyond the scope of this manual.

3.4 Step 3: Documenting the sources

Although documenting the sources is presented as step 3, in a new project this should of course be step 1. Here I assume you already have some code and you want doxygen to generate a nice document describing the API and maybe the internals and some related design documentation as well.

If the EXTRACT_ALL option is set to `NO` in the configuration file (the default), then doxygen will only generate documentation for *documented* entities. So how do you document these? For members, classes and namespaces there are basically two options:

1. Place a *special* documentation block in front of the declaration or definition of the member, class or namespace. For file, class and namespace members it is also allowed to place the documentation directly after the member.

   See section Special comment blocks to learn more about special documentation blocks.

2. Place a special documentation block somewhere else (another file or another location) *and* put a *structural command* in the documentation block. A structural command links a documentation block to a certain entity that can be documented (e.g. a member, class, namespace or file).

   See section Documentation at other places to learn more about structural commands.

The advantage of the first option is that you do not have to repeat the name of the entity.

Files can only be documented using the second option, since there is no way to put a documentation block before a file. Of course, file members (functions, variables, typedefs, defines) do not need an explicit structural command; just putting a special documentation block in front or behind them will work fine.

The text inside a special documentation block is parsed before it is written to the HTML and/or LaTeX output files.

During parsing the following steps take place:

- Markdown formatting is replaced by corresponding HTML or special commands.

- The special commands inside the documentation are executed. See section Special Commands for an overview of all commands.
- If a line starts with some whitespace followed by one or more asterisks (∗) and then optionally more whitespace, then all whitespace and asterisks are removed.
- All resulting blank lines are treated as a paragraph separators. This saves you from placing new-paragraph commands yourself in order to make the generated documentation readable.
- Links are created for words corresponding to documented classes (unless the word is preceded by a %; then the word will not be linked and the % sign is removed).
- Links to members are created when certain patterns are found in the text. See section Automatic link generation for more information on how the automatic link generation works.
- HTML tags that are in the documentation are interpreted and converted to LaTeX equivalents for the LaTeX output. See section HTML Commands for an overview of all supported HTML tags.

Chapter 4

Documenting the code

4.1 Special comment blocks . . . 17

4.1.1 Comment blocks for C-like languages (C/C++/C#/Objective-C/PHP/Java) . . . 17

Putting documentation after members . . . 20

Examples . . . 21

Documentation at other places . . . 23

4.1.2 Comment blocks in Python . . . 25

4.1.3 Comment blocks in VHDL . . . 26

4.1.4 Comment blocks in Fortran . . . 26

4.2 Anatomy of a comment block . . . 27

This chapter covers two topics:

1. How to put comments in your code such that doxygen incorporates them in the documentation it generates. This is further detailed in the next section.
2. Ways to structure the contents of a comment block such that the output looks good, as explained in section Anatomy of a comment block.

4.1 Special comment blocks

A special comment block is a C or C++ style comment block with some additional markings, so doxygen knows it is a piece of structured text that needs to end up in the generated documentation. The next section presents the various styles supported by doxygen.

For Python, VHDL, and Fortran code there are different commenting conventions, which can be found in sections Comment blocks in Python, Comment blocks in VHDL, and Comment blocks in Fortran respectively.

4.1.1 Comment blocks for C-like languages (C/C++/C#/Objective-C/PHP/Java)

For each entity in the code there are two (or in some cases three) types of descriptions, which together form the documentation for that entity; a *brief* description and *detailed* description, both are optional. For methods and functions there is also a third type of description, the so called *in body* description, which consists of the concatenation of all comment blocks found within the body of the method or function.

Having more than one brief or detailed description is allowed (but not recommended, as the order in which the descriptions will appear is not specified).

As the name suggest, a brief description is a short one-liner, whereas the detailed description provides longer, more detailed documentation. An "in body" description can also act as a detailed description or can describe a collection

of implementation details. For the HTML output brief descriptions are also used to provide tooltips at places where an item is referenced.

There are several ways to mark a comment block as a detailed description:

1. You can use the Javadoc style, which consist of a C-style comment block starting with two ∗'s, like this:

```
/**
 * ... text ...
 */
```

2. or you can use the Qt style and add an exclamation mark (!) after the opening of a C-style comment block, as shown in this example:

```
/*!
 * ... text ...
 */
```

   In both cases the intermediate ∗'s are optional, so

```
/*!
 ... text ...
*/
```

   is also valid.

3. A third alternative is to use a block of *at least two* C++ comment lines, where each line starts with an additional slash or an exclamation mark. Here are examples of the two cases:

```
///
/// ... text ...
///
```

   or

```
//!
//!... text ...
//!
```

   Note that a blank line ends a documentation block in this case.

4. Some people like to make their comment blocks more visible in the documentation. For this purpose you can use the following:

```
/**********************************************//**
 *  ... text
 ************************************************/
```

   Note: the 2 slashes to end the normal comment block and start a special comment block.

   Note: be careful when using a reformatter like clang-format as it may see this type of comment as 2 separate comments and introduce spacing between them.

   or

```
//////////////////////////////////////////////////
/// ... text ...
//////////////////////////////////////////////////
```

   or

```
/**************************************************
 *  ... text
 **************************************************/
```

   as long as JAVADOC_BANNER = YES is used.

```
/**
 * A brief history of JavaDoc-style (C-style) comments.
 *
 * This is the typical JavaDoc-style C-style comment. It starts with two
 * asterisks.
 *
 * @param theory Even if there is only one possible unified theory. it is just a
```

```
 *               set of rules and equations.
 */
void cstyle( int theory );
/*****************************************************************************
 * A brief history of JavaDoc-style (C-style) banner comments.
 *
 * This is the typical JavaDoc-style C-style "banner" comment. It starts with
 * a forward slash followed by some number, n, of asterisks, where n > 2. It's
 * written this way to be more "visible" to developers who are reading the
 * source code.
 *
 * Often, developers are unaware that this is not (by default) a valid Doxygen
 * comment block!
 *
 * However, as long as JAVADOC_BLOCK = YES is added to the Doxyfile, it will
 * work as expected.
 *
 * This style of commenting behaves well with clang-format.
 *
 * @param theory Even if there is only one possible unified theory. it is just a
 *               set of rules and equations.
 *****************************************************************************/
void javadocBanner( int theory );
/*****************************************************************************//**
 * A brief history of Doxygen-style banner comments.
 *
 * This is a Doxygen-style C-style "banner" comment. It starts with a "normal"
 * comment and is then converted to a "special" comment block near the end of
 * the first line. It is written this way to be more "visible" to developers
 * who are reading the source code.
 * This style of commenting behaves poorly with clang-format.
 *
 * @param theory Even if there is only one possible unified theory. it is just a
 *               set of rules and equations.
 *****************************************************************************/
void doxygenBanner( int theory );
```

See Javadoc Banner example for the corresponding LaTeX documentation that is generated by doxygen.

For the brief description there are also several possibilities:

1. One could use the \brief command with one of the above comment blocks. This command ends at the end of a paragraph, so the detailed description follows after an empty line.

   Here is an example:

   ```
   /*! \brief Brief description.
    *         Brief description continued.
    *
    *  Detailed description starts here.
    */
   ```

2. If JAVADOC_AUTOBRIEF is set to `YES` in the configuration file, then using Javadoc style comment blocks will automatically start a brief description which ends at the first dot followed by a space or new line. Here is an example:

   ```
   /** Brief description which ends at this dot. Details follow
    *  here.
    */
   ```

   The option has the same effect for multi-line special C++ comments:

   ```
   /// Brief description which ends at this dot. Details follow
   /// here.
   ```

3. A third option is to use a special C++ style comment which does not span more than one line. Here are two examples:

   ```
   /// Brief description.
   /** Detailed description. */
   ```

   or

   ```
   //! Brief description.

   //! Detailed description
   //! starts here.
   ```

Note the blank line in the last example, which is required to separate the brief description from the block containing the detailed description. The JAVADOC_AUTOBRIEF should also be set to NO for this case.

As you can see doxygen is quite flexible. If you have multiple detailed descriptions, like in the following example:

```
//! Brief description, which is
//! really a detailed description since it spans multiple lines.
/*! Another detailed description!
 */
```

They will be joined. Note that this is also the case if the descriptions are at different places in the code! In this case the order will depend on the order in which doxygen parses the code.

Unlike most other documentation systems, doxygen also allows you to put the documentation of members (including global functions) in front of the *definition*. This way the documentation can be placed in the source file instead of the header file. This keeps the header file compact, and allows the implementer of the members more direct access to the documentation. As a compromise the brief description could be placed before the declaration and the detailed description before the member definition.

Putting documentation after members

If you want to document the members of a file, struct, union, class, or enum, it is sometimes desired to place the documentation block after the member instead of before. For this purpose you have to put an additional < marker in the comment block. Note that this also works for the parameters of a function.

Here are some examples:

```
int var; /*!< Detailed description after the member */
```

This block can be used to put a Qt style detailed documentation block *after* a member. Other ways to do the same are:

```
int var; /**< Detailed description after the member */
```

or

```
int var; //!< Detailed description after the member
         //!<
```

or

```
int var; ///< Detailed description after the member
         ///<
```

Most often one only wants to put a brief description after a member. This is done as follows:

```
int var; //!< Brief description after the member
```

or

```
int var; ///< Brief description after the member
```

For functions one can use the @param command to document the parameters and then use `[in]`, `[out]`, `[in,out]` to document the direction. For inline documentation this is also possible by starting with the direction attribute, e.g.

```
void foo(int v /**< [in] docs for input parameter v. */);
```

Note that these blocks have the same structure and meaning as the special comment blocks in the previous section only the < indicates that the member is located in front of the block instead of after the block.

Here is an example of the use of these comment blocks:

```
/*! A test class */
class Afterdoc_Test
{
  public:
    /** An enum type.
     *  The documentation block cannot be put after the enum!
     */
    enum EnumType
    {
      int EVal1,      /**< enum value 1 */
      int EVal2       /**< enum value 2 */
    };
    void member();    //!< a member function.

  protected:
    int value;        /*!< an integer value */
};
```

See After Block example for the corresponding LaTeX documentation that is generated by doxygen.

Warning

> These blocks can only be used to document *members* and *parameters*. They cannot be used to document files, classes, unions, structs, groups, namespaces, macros, and enums themselves. Furthermore, the structural commands mentioned in the next section (like `\class`) are not allowed inside these comment blocks.
>
> Be careful using this construct as part of a macro definition, because when MACRO_EXPANSION is set to `YES` at the places where the macro is applied, also the comment will be substituted and this comment is then used as documentation for the last item encountered and not for the macro definition itself!

Examples

Here is an example of a documented piece of C++ code using the Qt style:

```
//!  A test class.
/*!
  A more elaborate class description.
*/
class QTstyle_Test
{
  public:

    //! An enum.
    /*! More detailed enum description. */
    enum TEnum {
                 TVal1, /*!< Enum value TVal1. */
                 TVal2, /*!< Enum value TVal2. */
                 TVal3  /*!< Enum value TVal3. */
               }
         //! Enum pointer.
         /*! Details. */
         *enumPtr,
         //! Enum variable.
         /*! Details. */
         enumVar;

    //! A constructor.
    /*!
      A more elaborate description of the constructor.
    */
    QTstyle_Test();

    //! A destructor.
    /*!
      A more elaborate description of the destructor.
    */
   ~QTstyle_Test();

    //! A normal member taking two arguments and returning an integer value.
    /*!
      \param a an integer argument.
      \param s a constant character pointer.
      \return The test results
      \sa QTstyle_Test(), ~QTstyle_Test(), testMeToo() and publicVar()
    */
    int testMe(int a,const char *s);

    //! A pure virtual member.
    /*!
      \sa testMe()
      \param c1 the first argument.
```

```
      \param c2 the second argument.
    */
    virtual void testMeToo(char c1,char c2) = 0;

    //! A public variable.
    /*!
      Details.
    */
    int publicVar;

    //! A function variable.
    /*!
      Details.
    */
    int (*handler)(int a,int b);
};
```

See QT Style example for the corresponding LaTeX documentation that is generated by doxygen.

The brief descriptions are included in the member overview of a class, namespace or file and are printed using a small italic font (this description can be hidden by setting BRIEF_MEMBER_DESC to NO in the configuration file). By default the brief descriptions become the first sentence of the detailed descriptions (but this can be changed by setting the REPEAT_BRIEF tag to NO). Both the brief and the detailed descriptions are optional for the Qt style.

By default a Javadoc style documentation block behaves the same way as a Qt style documentation block. This is not according the Javadoc specification however, where the first sentence of the documentation block is automatically treated as a brief description. To enable this behavior you should set JAVADOC_AUTOBRIEF to YES in the configuration file. If you enable this option and want to put a dot in the middle of a sentence without ending it, you should put a backslash and a space after it. Here is an example:

```
/** Brief description (e.g.\ using only a few words). Details follow. */
```

Here is the same piece of code as shown above, this time documented using the Javadoc style and JAVADOC_AUTOBRIEF set to YES:

```
/**
 *  A test class. A more elaborate class description.
 */
class Javadoc_Test
{
  public:

    /**
     * An enum.
     * More detailed enum description.
     */
    enum TEnum {
          TVal1, /**< enum value TVal1. */
          TVal2, /**< enum value TVal2. */
          TVal3  /**< enum value TVal3. */
         }
       *enumPtr, /**< enum pointer. Details. */
       enumVar;  /**< enum variable. Details. */

      /**
       * A constructor.
       * A more elaborate description of the constructor.
       */
      Javadoc_Test();

      /**
       * A destructor.
       * A more elaborate description of the destructor.
       */
     ~Javadoc_Test();

      /**
       * a normal member taking two arguments and returning an integer value.
       * @param a an integer argument.
       * @param s a constant character pointer.
       * @see Javadoc_Test()
       * @see ~Javadoc_Test()
       * @see testMeToo()
       * @see publicVar()
       * @return The test results
       */
       int testMe(int a,const char *s);

      /**
       * A pure virtual member.
       * @see testMe()
       * @param c1 the first argument.
       * @param c2 the second argument.
       */
```

```
      virtual void testMeToo(char c1,char c2) = 0;

     /**
      * a public variable.
      * Details.
      */
      int publicVar;

     /**
      * a function variable.
      * Details.
      */
      int (*handler)(int a,int b);
};
```

See Javadoc Style example for the corresponding LaTeX documentation that is generated by doxygen.

Similarly, if one wishes the first sentence of a Qt style documentation block to automatically be treated as a brief description, one may set QT_AUTOBRIEF to YES in the configuration file.

Documentation at other places

In the examples in the previous section the comment blocks were always located *in front* of the declaration or definition of a file, class or namespace or *in front* or *after* one of its members. Although this is often comfortable, there may sometimes be reasons to put the documentation somewhere else. For documenting a file this is even required since there is no such thing as "in front of a file".

Doxygen allows you to put your documentation blocks practically anywhere (the exception is inside the body of a function or inside a normal C style comment block).

The price you pay for not putting the documentation block directly before (or after) an item is the need to put a structural command inside the documentation block, which leads to some duplication of information. So in practice you should *avoid* the use of structural commands *unless* other requirements force you to do so.

Structural commands (like all other commands) start with a backslash (`\`), or an at-sign (`@`) if you prefer Javadoc style, followed by a command name and one or more parameters. For instance, if you want to document the class `Test` in the example above, you could have also put the following documentation block somewhere in the input that is read by doxygen:

```
/*! \class Test
    \brief A test class.

    A more detailed class description.
*/
```

Here the special command `\class` is used to indicate that the comment block contains documentation for the class `Test`. Other structural commands are:

- `\struct` to document a C-struct.
- `\union` to document a union.
- `\enum` to document an enumeration type.
- `\fn` to document a function.
- `\var` to document a variable or typedef or enum value.
- `\def` to document a #define.
- `\typedef` to document a type definition.
- `\file` to document a file.
- `\namespace` to document a namespace.
- `\package` to document a Java package.
- `\interface` to document an IDL interface.

See section Special Commands for detailed information about these and many other commands.

To document a member of a C++ class, you must also document the class itself. The same holds for namespaces. To document a global C function, typedef, enum or preprocessor definition you must first document the file that contains it (usually this will be a header file, because that file contains the information that is exported to other source files).

Attention

> Let's repeat that, because it is often overlooked: to document global objects (functions, typedefs, enum, macros, etc), you *must* document the file in which they are defined. In other words, there *must* at least be a
>
> ```
> /*! \file */
> ```
>
> or a
>
> ```
> /** @file */
> ```
>
> line in this file.

Here is an example of a C header named `structcmd.h` that is documented using structural commands:

```
/*! \file structcmd.h
    \brief A Documented file.

    Details.
*/

/*! \def MAX(a,b)
    \brief A macro that returns the maximum of \a a and \a b.

    Details.
*/

/*! \var typedef unsigned int UINT32
    \brief A type definition for a .

    Details.
*/

/*! \var int errno
    \brief Contains the last error code.

    \warning Not thread safe!
*/

/*! \fn int open(const char *pathname,int flags)
    \brief Opens a file descriptor.

    \param pathname The name of the descriptor.
    \param flags Opening flags.
*/

/*! \fn int close(int fd)
    \brief Closes the file descriptor \a fd.
    \param fd The descriptor to close.
*/

/*! \fn size_t write(int fd,const char *buf, size_t count)
    \brief Writes \a count bytes from \a buf to the filedescriptor \a fd.
    \param fd The descriptor to write to.
    \param buf The data buffer to write.
    \param count The number of bytes to write.
*/

/*! \fn int read(int fd,char *buf,size_t count)
    \brief Read bytes from a file descriptor.
    \param fd The descriptor to read from.
    \param buf The buffer to read into.
    \param count The number of bytes to read.
*/
#define MAX(a,b) (((a)>(b))?(a):(b))
typedef unsigned int UINT32;
int errno;
int open(const char *,int);
int close(int);
size_t write(int,const char *, size_t);
int read(int,char *,size_t);
```

See Structural Commands example for the corresponding LaTeX documentation that is generated by doxygen.

Because each comment block in the example above contains a structural command, all the comment blocks could be moved to another location or input file (the source file for instance), without affecting the generated documentation.

The disadvantage of this approach is that prototypes are duplicated, so all changes have to be made twice! Because of this you should first consider if this is really needed, and avoid structural commands if possible. I often receive examples that contain \fn command in comment blocks which are place in front of a function. This is clearly a case where the \fn command is redundant and will only lead to problems.

When you place a comment block in a file with one of the following extensions `.dox`, `.txt`, `.doc`, `.md` or `.markdown` or when the extension maps to `md` by means of the EXTENSION_MAPPING then doxygen will hide this file from the file list.

If you have a file that doxygen cannot parse but still would like to document it, you can show it as-is using \verbinclude, e.g.

```
/*! \file myscript.sh
 *  Look at this nice script:
 *  \verbinclude myscript.sh
 */
```

Make sure that the script is explicitly listed in the INPUT or that FILE_PATTERNS includes the `.sh` extension and the the script can be found in the path set via EXAMPLE_PATH.

4.1.2 Comment blocks in Python

For Python there is a standard way of documenting the code using so called documentation strings (`"""`). Such strings are stored in `__doc__` and can be retrieved at runtime. Doxygen will extract such comments and assume they have to be represented in a preformatted way.

```
"""@package docstring
Documentation for this module.

More details.
"""
def func():
    """Documentation for a function.

    More details.
    """
    pass
class PyClass:
    """Documentation for a class.

    More details.
    """

    def __init__(self):
        """The constructor."""
        self._memVar = 0;

    def PyMethod(self):
        """Documentation for a method."""
        pass
```

See Python Docstring example for the corresponding LaTeX documentation that is generated by doxygen.

Note

> When using `"""` none of doxygen's special commands are supported and the text is shown as verbatim text see \verbatim. To have the doxygen's special commands and have the text as regular documentation instead of `"""` use `"""!` or set PYTHON_DOCSTRING to `NO` in the configuration file.
>
> Instead of `"""` one can also use `'''`.

There is also another way to document Python code using comments that start with "##". These type of comment blocks are more in line with the way documentation blocks work for the other languages supported by doxygen and this also allows the use of special commands.

Here is the same example again but now using doxygen style comments:

```
## @package pyexample
#  Documentation for this module.
#
#  More details.
## Documentation for a function.
```

```
#
#  More details.
def func():
    pass
## Documentation for a class.
#
#  More details.
class PyClass:

    ## The constructor.
    def __init__(self):
        self._memVar = 0;

    ## Documentation for a method.
    #  @param self The object pointer.
    def PyMethod(self):
        pass

    ## A class variable.
    classVar = 0;
    ## @var _memVar
    #  a member variable
```

See Python example for the corresponding LaTeX documentation that is generated by doxygen.

Since python looks more like Java than like C or C++, you should set OPTIMIZE_OUTPUT_JAVA to `YES` in the configuration file.

4.1.3 Comment blocks in VHDL

For VHDL a comment normally start with "--". Doxygen will extract comments starting with "--!". There are only two types of comment blocks in VHDL; a one line "--!" comment representing a brief description, and a multi-line "--!" comment (where the "--!" prefix is repeated for each line) representing a detailed description.

Comments are always located in front of the item that is being documented with one exception: for ports the comment can also be after the item and is then treated as a brief description for the port.

Here is an example VHDL file with doxygen comments:

```
-------------------------------------------------------
--! @file
--! @brief 2:1 Mux using with-select
-------------------------------------------------------
--! Use standard library
library ieee;
--! Use logic elements
    use ieee.std_logic_1164.all;
--! Mux entity brief description
--! Detailed description of this
--! mux design element.
entity mux_using_with is
    port (
        din_0   : in  std_logic; --! Mux first input
        din_1   : in  std_logic; --! Mux Second input
        sel     : in  std_logic; --! Select input
        mux_out : out std_logic  --! Mux output
    );
end entity;
--! @brief Architecture definition of the MUX
--! @details More details about this mux element.
architecture behavior of mux_using_with is
begin
    with (sel) select
    mux_out <= din_0 when '0',
               din_1 when others;
end architecture;
```

See VHDL example for the corresponding LaTeX documentation that is generated by doxygen.

As of VHDL 2008 it is also possible to use `/*` style comments. Doxygen will handle `/* ... */` as plain comments and `/*! ... */` style comments as special comments to be parsed by doxygen.

To get proper looking output you need to set OPTIMIZE_OUTPUT_VHDL to `YES` in the configuration file. This will also affect a number of other settings. When they were not already set correctly doxygen will produce a warning telling which settings where overruled.

4.1.4 Comment blocks in Fortran

When using doxygen for Fortran code you should set OPTIMIZE_FOR_FORTRAN to `YES`.

The parser tries to guess if the source code is fixed format Fortran or free format Fortran code. This may not always be correct. If not one should use EXTENSION_MAPPING to correct this. By setting `EXTENSION_MAPPING = f=FortranFixed f90=FortranFree` files with extension `f` are interpreted as fixed format Fortran code and files with extension `f90` are interpreted as free format Fortran code.

For Fortran "!>" or "!<" starts a comment and "!!" or "!>" can be used to continue an one line comment into a multi-line comment.

Here is an example of a documented Fortran subroutine:

```
!> Build the restriction matrix for the aggregation
!! method.
!! @param aggr information about the aggregates
!! @todo Handle special case
subroutine intrestbuild(A,aggr,Restrict,A_ghost)
  implicit none
  Type(SpMtx), intent(in) :: A !< our fine level matrix
  Type(Aggrs), intent(in) :: aggr
  Type(SpMtx), intent(out) :: Restrict !< Our restriction matrix
  !...
end subroutine
```

As an alternative you can also use comments in fixed format code:

```
C> Function comment
C> another line of comment
      function a(i)
C> input parameter
        integer i
      end function A
```

4.2 Anatomy of a comment block

The previous section focused on how to make the comments in your code known to doxygen, it explained the difference between a brief and a detailed description, and the use of structural commands.

In this section we look at the contents of the comment block itself.

Doxygen supports various styles of formatting your comments.

The simplest form is to use plain text. This will appear as-is in the output and is ideal for a short description.

For longer descriptions you often will find the need for some more structure, like a block of verbatim text, a list, or a simple table. For this doxygen supports the `Markdown` syntax, including parts of the `Markdown Extra` extension.

Markdown is designed to be very easy to read and write. Its formatting is inspired by plain text mail. Markdown works great for simple, generic formatting, like an introduction page for your project. Doxygen also supports reading of markdown files directly. For more details see chapter Markdown support.

For programming language specific formatting doxygen has two forms of additional markup on top of Markdown formatting.

1. `Javadoc` like markup. See Special Commands for a complete overview of all commands supported by doxygen.
2. `XML` markup as specified in the `C# standard`. See XML Commands for the XML commands supported by doxygen.

If this is still not enough doxygen also supports a subset of the `HTML` markup language.

Chapter 5

Markdown support

Markdown support was introduced in doxygen version 1.8.0. It is a plain text formatting syntax written by John Gruber, with the following underlying design goal:

> The design goal for Markdown's formatting syntax is to make it as readable as possible. The idea is that a Markdown-formatted document should be publishable as-is, as plain text, without looking like it's been marked up with tags or formatting instructions. While Markdown's syntax has been influenced by several existing text-to-HTML filters, the single biggest source of inspiration for Markdown's syntax is the format of plain text email.

In the next section the standard Markdown features are briefly discussed. The reader is referred to the Markdown site for more details.

Some enhancements were made, for instance PHP Markdown Extra, and GitHub flavored Markdown. The section Markdown Extensions discusses the extensions that doxygen supports.

Finally section Doxygen specifics discusses some specifics for doxygen's implementation of the Markdown standard.

5.1 Standard Markdown

5.1.1 Paragraphs

Even before doxygen had Markdown support it supported the same way of paragraph handling as Markdown: to make a paragraph you just separate consecutive lines of text by one or more blank lines.

An example:

```
Here is text for one paragraph.

We continue with more text in another paragraph.
```

5.1.2 Headers

Just like Markdown, doxygen supports two types of headers

Level 1 or 2 headers can be made as the follows

```
This is a level 1 header
========================

This is a level 2 header
------------------------
```

A header is followed by a line containing only ='s or -'s. Note that the exact amount of ='s or -'s is not important as long as there are at least two.

Alternatively, you can use #'s at the start of a line to make a header. The number of #'s at the start of the line determines the level (up to 6 levels are supported). You can end a header by any number of #'s.

Here is an example:

```
# This is a level 1 header

### This is level 3 header #######
```

5.1.3 Block quotes

Block quotes can be created by starting each line with one or more >'s, similar to what is used in text-only emails.

```
> This is a block quote
> spanning multiple lines
```

Lists and code blocks (see below) can appear inside a quote block. Quote blocks can also be nested.

Note that doxygen requires that you put a space after the (last) > character to avoid false positives, i.e. when writing

```
0  if OK\n
>1 if NOK
```

the second line will not be seen as a block quote.

5.1.4 Lists

Simple bullet lists can be made by starting a line with -, +, or ∗.

```
- Item 1

  More text for this item.

- Item 2
  + nested list item.
  + another nested item.
- Item 3
```

List items can span multiple paragraphs (if each paragraph starts with the proper indentation) and lists can be nested. You can also make a numbered list like so

```
1. First item.
2. Second item.
```

Make sure to also read Lists Extensions for doxygen specifics.

5.1.5 Code Blocks

Preformatted verbatim blocks can be created by indenting each line in a block of text by at least 4 extra spaces

```
This a normal paragraph

    This is a code block

We continue with a normal paragraph again.
```

Doxygen will remove the mandatory indentation from the code block. Note that you cannot start a code block in the middle of a paragraph (i.e. the line preceding the code block must be empty).

See section Code Block Indentation for more info how doxygen handles indentation as this is slightly different than standard Markdown.

5.1.6 Horizontal Rulers

A horizontal ruler will be produced for lines containing at least three or more hyphens, asterisks, or underscores. The line may also include any amount of whitespace.

Examples:

```
- - -
_____
```

Note that using asterisks in comment blocks does not work. See Use of asterisks for details.
Note that when using hyphens and the previous line is not empty you have to use at least one whitespace in the sequence of hyphens otherwise it might be seen as a level 2 header (see Headers).

5.1.7 Emphasis

To emphasize a text fragment you start and end the fragment with an underscore or star. Using two stars or underscores will produce strong emphasis.

Examples:

```
*single asterisks*

_single underscores_

**double asterisks**

__double underscores__
```

See section Emphasis and strikethrough limits for more info how doxygen handles emphasis / strikethrough spans slightly different than standard / Markdown GitHub Flavored Markdown.

5.1.8 Strikethrough

To strikethrough a text fragment you start and end the fragment with two tildes.

Examples:

```
~~double tilde~~
```

See section Emphasis and strikethrough limits for more info how doxygen handles emphasis / strikethrough spans slightly different than standard Markdown / GitHub Flavored Markdown.

5.1.9 code spans

To indicate a span of code, you should wrap it in backticks (`). Unlike code blocks, code spans appear inline in a paragraph. An example:

```
Use the `printf()` function.
```

To show a literal backtick or single quote inside a code span use double backticks, i.e.

```
To assign the output of command `ls` to `var` use ``var=`ls```.

To assign the text 'text' to `var` use ``var='text'``.
```

See section Code Spans Limits for more info how doxygen handles code spans slightly different than standard Markdown.

5.1.10 Links

Doxygen supports both styles of make links defined by Markdown: *inline* and *reference*.

For both styles the link definition starts with the link text delimited by [square brackets].

Inline Links

For an inline link the link text is followed by a URL and an optional link title which together are enclosed in a set of regular parenthesis. The link title itself is surrounded by quotes.

Examples:

```
[The link text](http://example.net/)
[The link text](http://example.net/ "Link title")
[The link text](/relative/path/to/index.html "Link title")
[The link text](somefile.html)
```

In addition doxygen provides a similar way to link a documented entity:

```
[The link text](@ref MyClass)
```

in case the first non whitespace character of the reference is a # this is interpreted as a doxygen link and replaced as a @ref command:

```
[The link text](#MyClass)
```

will be interpreted as:

```
@ref MyClass "The link text"
```

Reference Links

Instead of putting the URL inline, you can also define the link separately and then refer to it from within the text.

The link definition looks as follows:

```
[link name]: http://www.example.com "Optional title"
```

Instead of double quotes also single quotes or parenthesis can be used for the title part.

Once defined, the link looks as follows

```
[link text][link name]
```

If the link text and name are the same, also

```
[link name][]
```

or even

```
[link name]
```

can be used to refer to the link. Note that the link name matching is not case sensitive as is shown in the following example:

```
I get 10 times more traffic from [Google] than from
[Yahoo] or [MSN].

[google]: http://google.com/        "Google"
[yahoo]:  http://search.yahoo.com/  "Yahoo Search"
[msn]:    http://search.msn.com/    "MSN Search"
```

Link definitions will not be visible in the output.

Like for inline links doxygen also supports @ref inside a link definition:

```
[myclass]: @ref MyClass "My class"
```

5.1.11 Images

Markdown syntax for images is similar to that for links. The only difference is an additional ! before the link text.

Examples:

```
![Caption text](/path/to/img.jpg)
![Caption text](/path/to/img.jpg "Image title")
![Caption text][img def]
![img def]

[img def]: /path/to/img.jpg "Optional Title"
```

Also here you can use @ref to link to an image:

```
![Caption text](@ref image.png)
![img def]

[img def]: @ref image.png "Caption text"
```

The caption text is optional.

5.1.12 Automatic Linking

To create a link to an URL or e-mail address Markdown supports the following syntax:

```
<http://www.example.com>
<https://www.example.com>
<ftp://www.example.com>
<mailto:address@example.com>
<address@example.com>
```

Note that doxygen will also produce the links without the angle brackets.

5.2 Markdown Extensions

5.2.1 Table of Contents

Doxygen supports a special link marker `[TOC]` which can be placed in a page to produce a table of contents at the start of the page, listing all sections.

Note that using `[TOC]` is the same as using a \tableofcontents command.

Note that the TOC_INCLUDE_HEADINGS has to be set to a value $>$ 0 otherwise no table of contents is shown when using Markdown Headers.

5.2.2 Tables

Of the features defined by "Markdown Extra" is support for `simple tables`:

A table consists of a header line, a separator line, and at least one row line. Table columns are separated by the pipe (|) character.

Here is an example:

```
First Header  | Second Header
------------- | -------------
Content Cell  | Content Cell
Content Cell  | Content Cell
```

which will produce the following table:

First Header	Second Header
Content Cell	Content Cell
Content Cell	Content Cell

Column alignment can be controlled via one or two colons at the header separator line:

```
| Right | Center | Left   |
| ----: | :----: | :---- |
| 10    | 10     | 10    |
| 1000  | 1000   | 1000  |
```

which will look as follows:

Right	Center	Left
10	10	10
1000	1000	1000

Additionally, column and row spans are supported. Using a caret ("^") in a cell indicates that the cell above should span rows. Sequences of carets may be used for any number of row spans. For example:

```
| Right | Center | Left   |
| ----: | :----: | :---- |
| 10    | 10     | 10    |
| ^     | 1000   | 1000  |
```

which will look as follows:

Right	Center	Left
10	10	10
	1000	1000

Column spans are supported by means of directly adjacent vertical bars ("|"). Each additional vertical bar indicates an additional column to be spanned. To put it another way, a single vertical bar indicates a single column span, two vertical bars indicates a 2 columns span, and so on. For example:

```
| Right | Center | Left   |
| ----: | :----: | :---- |
| 10    | 10     | 10    |
| 1000  |||
```

which will look as follows:

Right	Center	Left
10	10	10
		1000

For more complex tables in doxygen please have a look at: Including tables

5.2.3 Fenced Code Blocks

Another feature defined by "Markdown Extra" is support for `fenced code blocks`:

A fenced code block does not require indentation, and is defined by a pair of "fence lines". Such a line consists of 3 or more tilde (~) characters on a line. The end of the block should have the same number of tildes. Here is an example:

```
This is a paragraph introducing:
```

```
~~~~~~~~~~~~~~~~~~~~~
a one-line code block
~~~~~~~~~~~~~~~~~~~~~
```

By default the output is the same as for a normal code block.

For languages supported by doxygen you can also make the code block appear with syntax highlighting. To do so you need to indicate the typical file extension that corresponds to the programming language after the opening fence. For highlighting according to the Python language for instance, you would need to write the following:

```
~~~~~~~~~~~~~{.py}
# A class
class Dummy:
    pass
~~~~~~~~~~~~~
```

which will produce:

```
# A class
class Dummy:
    pass
```

and for C you would write:

```
~~~~~~~~~~~~~~~{.c}
int func(int a,int b) { return a*b; }
~~~~~~~~~~~~~~~
```

which will produce:

```
int func(int a,int b) { return a*b; }
```

The curly braces and dot are optional by the way.

Another way to denote fenced code blocks is to use 3 or more backticks (```):

```
```
also a fenced code block
```
```

5.2.4 Header Id Attributes

Standard Markdown has no support for labeling headers, which is a problem if you want to link to a section.

PHP Markdown Extra allows you to label a header by adding the following to the header

```
Header 1                {#labelid}
========

## Header 2 ##          {#labelid2}
```

To link to a section in the same comment block you can use

```
[Link text](#labelid)
```

to link to a section in general, doxygen allows you to use @ref

```
[Link text](@ref labelid)
```

Note this only works for the headers of level 1 to 4.

5.2.5 Image Attributes

Standard Markdown has no support for controlling image dimensions which results in less flexibility when writing docs.

PHP Markdown Extra allows you to add extra attributes to an image as in:

```
![Caption text](/path/to/img.jpg){attributes}
```

To allow for output format specific attributes the following syntax is supported

```
![Caption text](/path/to/img.jpg){format: attributes, format: attributes}
```

For a description of the possibilities see the paragraph Size indication for the \image command.

For example:

```
![Doxygen Logo](https://www.doxygen.org/images/doxygen.png){html: width=50%, latex: width=5cm}
```

5.3 Doxygen specifics

Even though doxygen tries to following the Markdown standard as closely as possible, there are couple of deviation and doxygen specifics additions.

5.3.1 Including Markdown files as pages

Doxygen can process files with Markdown formatting. For this to work the extension for such a file should be `.md` or `.markdown` (see EXTENSION_MAPPING if your Markdown files have a different extension, and use `md` as the name of the parser). Each file is converted to a page (see the page command for details).

By default the name and title of the page are derived from the file name. If the file starts with a level 1 header however, it is used as the title of the page. If you specify a label for the header (as shown in Header Id Attributes) doxygen will use that as the page name.

If the label is called `index` or `mainpage` doxygen will put the documentation on the front page (`index.html`).

Here is an example of a file `README.md` that will appear as the main page when processed by doxygen:

```
My Main Page                        {#mainpage}
============

Documentation that will appear on the main page
```

If a page has a label you can link to it using @ref as is shown above. To refer to a markdown page without such label you can simple use the file name of the page, e.g.

```
See [the other page](other.md) for more info.
```

5.3.2 Treatment of HTML blocks

Markdown is quite strict in the way it processes block-level HTML:

> block-level HTML elements — e.g. `<div>`, `<table>`, `<pre>`, `<p>`, etc. — must be separated from surrounding content by blank lines, and the start and end tags of the block should not be indented with tabs or spaces.

Doxygen does not have this requirement, and will also process Markdown formatting inside such HTML blocks. The only exception is `<pre>` blocks, which are passed untouched (handy for ASCII art).

Doxygen will not process Markdown formatting inside verbatim or code blocks, and in other sections that need to be processed without changes (for instance formulas or inline dot graphs).

5.3.3 Code Block Indentation

Markdown allows both a single tab or 4 spaces to start a code block. Since doxygen already replaces tabs by spaces before doing Markdown processing, the effect will only be same if TAB_SIZE in the configuration file has

been set to 4. When it is set to a higher value spaces will be present in the code block. A lower value will prevent a single tab to be interpreted as the start of a code block.

With Markdown any block that is indented by 4 spaces (and 8 spaces inside lists) is treated as a code block. This indentation amount is absolute, i.e. counting from the start of the line.

Since doxygen comments can appear at any indentation level that is required by the programming language, it uses a relative indentation instead. The amount of indentation is counted relative to the preceding paragraph. In case there is no preceding paragraph (i.e. you want to start with a code block), the minimal amount of indentation of the whole comment block is used as a reference.

In most cases this difference does not result in different output. Only if you play with the indentation of paragraphs the difference is noticeable:

```
text

 text

  text

   code
```

In this case Markdown will put the word code in a code block, whereas doxygen will treat it as normal text, since although the absolute indentation is 4, the indentation with respect to the previous paragraph is only 1.

Note that list markers are not counted when determining the relative indent:

```
1.  Item1

    More text for item1

2.  Item2

        Code block for item2
```

For Item1 the indentation is 4 (when treating the list marker as whitespace), so the next paragraph "More text..." starts at the same indentation level and is therefore not seen as a code block.

5.3.4 Emphasis and strikethrough limits

Unlike standard Markdown and Github Flavored Markdown doxygen will not touch internal underscores or stars or tildes, so the following will appear as-is:

```
a_nice_identifier
```

Furthermore, a $*$ or _ only starts an emphasis and a $\sim$ only starts a strikethrough if

- it is followed by an alphanumerical character, and
- it is preceded by a space, newline, or one the following characters `<{([,:;`

An emphasis or a strikethrough ends if

- it is not followed by an alphanumerical character, and
- it is not preceded by a space, newline, or one the following characters `({[<=+-\@`

The span of the emphasis or strikethrough is limited to a single paragraph.

Lastly, note that when you want to put emphasis on a piece of text at the start of a line by means of $*$s within a C-style doxygen comment block (i.e. `/** ... */`) that does not have leading $*$ as column "lineup", then doxygen will see the sequence of $*$s at the beginning of the line as "lineup" and not as emphasis. So the following will not render as bold:

```
/**
 **this is not bold**
 */
```

however this will render as bold:

```
/**
 * **this is bold**
 */
```

5.3.5 Code Spans Limits

Note that unlike standard Markdown, doxygen leaves the following untouched.

```
A `cool' word in a `nice' sentence.
```

In other words; a single quote cancels the special treatment of a code span wrapped in a pair of backtick characters. This extra restriction was added for backward compatibility reasons.

In case you want to have single quotes inside a code span, don't use one backtick but two backticks around the code span.

5.3.6 Lists Extensions

With Markdown two lists separated by an empty line are joined together into a single list which can be rather unexpected and many people consider it to be a bug. Doxygen, however, will make two separate lists as you would expect.

Example:

```
- Item1 of list 1
- Item2 of list 1

1. Item1 of list 2
2. Item2 of list 2
```

With Markdown the actual numbers you use to mark the list have no effect on the HTML output Markdown produces. I.e. standard Markdown treats the following as one list with 3 numbered items:

```
1. Item1
1. Item2
1. Item3
```

Doxygen however requires that the numbers used as marks are in strictly ascending order, so the above example would produce 3 lists with one item. An item with an equal or lower number than the preceding item, will start a new list. For example:

```
1. Item1 of list 1
3. Item2 of list 1
2. Item1 of list 2
4. Item2 of list 2
```

will produce:

1. Item1 of list 1
2. Item2 of list 1

1. Item1 of list 2
2. Item2 of list 2

Historically doxygen has an additional way to create numbered lists by using -# markers:

```
-# item1
-# item2
```

5.3.7 Use of asterisks

Special care has to be taken when using ∗'s in a comment block to start a list or make a ruler.

Doxygen will strip off any leading ∗'s from the comment before doing Markdown processing. So although the following works fine

```
/** A list:
 *  * item1
 *  * item2
 */
```

When you remove the leading ∗'s doxygen will strip the other stars as well, making the list disappear!

Rulers created with ∗'s will not be visible at all. They only work in Markdown files.

5.3.8 Limits on markup scope

To avoid that a stray ∗ or _ matches something many paragraphs later, and shows everything in between with emphasis, doxygen limits the scope of a ∗ and _ to a single paragraph.

For a code span, between the starting and ending backtick only two new lines are allowed.

Also for links there are limits; the link text, and link title each can contain only one new line, the URL may not contain any newlines.

5.4 Debugging problems

When doxygen parses the source code it first extracts the comments blocks, then passes these through the Markdown preprocessor. The output of the Markdown preprocessing consists of text with special commands and HTML commands. A second pass takes the output of the Markdown preprocessor and converts it into the various output formats.

During Markdown preprocessing no errors are produced. Anything that does not fit the Markdown syntax is simply passed on as-is. In the subsequent parsing phase this could lead to errors, which may not always be obvious as they are based on the intermediate format.

To see the result after Markdown processing you can run doxygen with the `-d Markdown` option. It will then print each comment block before and after Markdown processing.

Chapter 6

Lists

Doxygen provides a number of ways to create lists of items.

Using dashes

By putting a number of column-aligned minus (-) signs at the start of a line, a bullet list will automatically be generated. Instead of the minus sign also plus (+) or asterisk (∗) can be used.

Numbered lists can also be generated by using a minus followed by a hash or by using a number followed by a dot.

Nesting of lists is allowed and is based on indentation of the items.

Here is an example:

```
/*!
 *  A list of events:
 *    - mouse events
 *         -# mouse move event
 *         -# mouse click event\n
 *            More info about the click event.
 *         -# mouse double click event
 *    - keyboard events
 *         1. key down event
 *         2. key up event
 *
 *  More text here.
 */
```

The result will be:

A list of events:

- mouse events
  1. mouse move event
  2. mouse click event
     More info about the click event.
  3. mouse double click event
- keyboard events
  1. key down event
  2. key up event

More text here.

If you use tabs for indentation within lists, please make sure that TAB_SIZE in the configuration file is set to the correct tab size.

You can end a list by starting a new paragraph or by putting a dot (.) on an empty line at the same indentation level as the list you would like to end.

Here is an example that speaks for itself:

```
/**
 * Text before the list
 * - list item 1
 *   - sub item 1
 *     - sub sub item 1
 *     - sub sub item 2
 *     .
 *     The dot above ends the sub sub item list.
 *
 *     More text for the first sub item
 *   .
 *   The dot above ends the first sub item.
 *
 *   More text for the first list item
 *   - sub item 2
 *   - sub item 3
 * - list item 2
 * .
 * More text in the same paragraph.
 *
 * More text in a new paragraph.
 */
```

Using HTML commands

If you like you can also use HTML commands inside the documentation blocks.

Here is the above example with HTML commands:

```
/*!
 *  A list of events:
 *  <ul>
 *  <li> mouse events
 *     <ol>
 *     <li>mouse move event
 *     <li>mouse click event<br>
 *         More info about the click event.
 *     <li>mouse double click event
 *     </ol>
 *  <li> keyboard events
 *     <ol>
 *     <li>key down event
 *     <li>key up event
 *     </ol>
 *  </ul>
 *  More text here.
 */
```

Note

In this case the indentation is not important.

Using \arg or \li

For compatibility with the Qt Software's internal documentation tool qdoc and with KDoc, doxygen has two commands that can be used to create simple unnested lists.

See \arg and \li for more info.

Chapter 7

Grouping

Doxygen has three mechanisms to group things together. One mechanism works at a global level, creating a new page for each group. These groups are called 'modules' in the documentation. The second mechanism works within a member list of some compound entity, and is referred to as a 'member groups'. For pages there is a third grouping mechanism referred to as subpaging.

7.1 Modules

Modules are a way to group things together on a separate page. You can document a group as a whole, as well as all individual members. Members of a group can be files, namespaces, classes, functions, variables, enums, typedefs, and defines, but also other groups.

To define a group, you should put the \defgroup command in a special comment block. The first argument of the command is a label that should uniquely identify the group.
The second argument is the name or title of the group as it should appear in the documentation.

You can make an entity a member of a specific group by putting a \ingroup command inside its documentation block.

To avoid putting \ingroup commands in the documentation for each member you can also group members together by the open marker `@{` before the group and the closing marker `@}` after the group. The markers can be put in the documentation of the group definition or in a separate documentation block.

Groups themselves can also be nested using these grouping markers.

You will get an error message when you use the same group label more than once. If you don't want doxygen to enforce unique labels, then you can use \addtogroup instead of \defgroup. It can be used exactly like \defgroup, but when the group has been defined already, then it silently merges the existing documentation with the new one. The title of the group is optional for this command, so you can use

```
/** \addtogroup <label>
 *  @{
 */
...

/** @}*/
```

to add additional members to a group that is defined in more detail elsewhere.

Note that compound entities (like classes, files and namespaces) can be put into multiple groups, but members (like variable, functions, typedefs and enums) can only be a member of one group (this restriction is in place to avoid ambiguous linking targets in case a member is not documented in the context of its class, namespace or file, but only visible as part of a group).

Doxygen will put members into the group whose definition has the highest "priority": e.g. An explicit \ingroup overrides an implicit grouping definition via `@{ @}`. Conflicting grouping definitions with the same priority trigger a warning, unless one definition was for a member without any explicit documentation.

The following example puts VarInA into group A and silently resolves the conflict for IntegerVariable by putting it into

group IntVariables, because the second instance of IntegerVariable is undocumented:

```
/**
 * \ingroup A
 */
extern int VarInA;

/**
 * \defgroup IntVariables Global integer variables
 * @{
 */

/** an integer variable */
extern int IntegerVariable;

/**@}*/

....

/**
 * \defgroup Variables Global variables
 */
/**@{*/

/** a variable in group A */
int VarInA;

int IntegerVariable;

/**@}*/
```

The \ref command can be used to refer to a group. The first argument of the \ref command should be group's label. To use a custom link name, you can put the name of the links in double quotes after the label, as shown by the following example

```
This is the \ref group_label "link" to this group.
```

The priorities of grouping definitions are (from highest to lowest): \ingroup, \defgroup, \addtogroup, \weakgroup. The \weakgroup command is exactly like \addtogroup with a lower priority. It was added to allow "lazy" grouping definitions: you can use commands with a higher priority in your .h files to define the hierarchy and \weakgroup in .c files without having to duplicate the hierarchy exactly.

Example:

```
/** @defgroup group1 The First Group
 *  This is the first group
 *  @{
 */

/** @brief class C1 in group 1 */
class C1 {};

/** @brief class C2 in group 1 */
class C2 {};

/** function in group 1 */
void func() {}

/** @} */ // end of group1

/**
 *  @defgroup group2 The Second Group
 *  This is the second group
 */

/** @defgroup group3 The Third Group
 *  This is the third group
 */

/** @defgroup group4 The Fourth Group
 *  @ingroup group3
 *  Group 4 is a subgroup of group 3
 */

/**
```

```
 *  @ingroup group2
 *  @brief class C3 in group 2
 */
class C3 {};

/** @ingroup group2
 *  @brief class C4 in group 2
 */
class C4 {};

/** @ingroup group3
 *  @brief class C5 in @link group3 the third group@endlink.
 */
class C5 {};

/** @ingroup group1 group2 group3 group4
 *  namespace N1 is in four groups
 *  @sa @link group1 The first group@endlink, group2, group3, group4
 *
 *  Also see @ref mypage2
 */
namespace N1 {};

/** @file
 *  @ingroup group3
 *  @brief this file in group 3
 */

/** @defgroup group5 The Fifth Group
 *  This is the fifth group
 *  @{
 */

/** @page mypage1 This is a section in group 5
 *  Text of the first section
 */

/** @page mypage2 This is another section in group 5
 *  Text of the second section
 */

/** @} */ // end of group5

/** @addtogroup group1
 *
 *  More documentation for the first group.
 *  @{
 */

/** another function in group 1 */
void func2() {}

/** yet another function in group 1 */
void func3() {}

/** @} */ // end of group1
```

See Modules example for the corresponding LaTeX documentation that is generated by doxygen.

7.2 Member Groups

If a compound (e.g. a class or file) has many members, it is often desired to group them together. Doxygen already automatically groups things together on type and protection level, but maybe you feel that this is not enough or that that default grouping is wrong. For instance, because you feel that members of different (syntactic) types belong to the same (semantic) group.

A member group is defined by a

```
///@{
  ...
///@}
```

block or a

```
/**@{*/
  ...
/**@}*/
```

block if you prefer C style comments. Note that the members of the group should be physically inside the member group's body.

Before the opening marker of a block a separate comment block may be placed. This block should contain the @name (or \name) command and is used to specify the header of the group. Optionally, the comment block may also contain more detailed information about the group.

Nesting of member groups is not allowed.

If all members of a member group inside a class have the same type and protection level (for instance all are static public members), then the whole member group is displayed as a subgroup of the type/protection level group (the group is displayed as a subsection of the "Static Public Members" section for instance). If two or more members have different types, then the group is put at the same level as the automatically generated groups. If you want to force all member-groups of a class to be at the top level, you should put a \nosubgrouping command inside the documentation of the class.

Example:

```
/** A class. Details */
class Memgrp_Test
{
  public:
    ///@{
    /** Same documentation for both members. Details */
    void func1InGroup1();
    void func2InGroup1();
    ///@}

    /** Function without group. Details. */
    void ungroupedFunction();
    void func1InGroup2();
  protected:
    void func2InGroup2();
};
void Memgrp_Test::func1InGroup1() {}
void Memgrp_Test::func2InGroup1() {}

/** @name Group2
 *  Description of group 2.
 */
///@{
/** Function 2 in group 2. Details. */
void Memgrp_Test::func2InGroup2() {}
/** Function 1 in group 2. Details. */
void Memgrp_Test::func1InGroup2() {}
///@}

/*! \file
 *  docs for this file
 */

//!@{
//! one description for all members of this group
//! (because DISTRIBUTE_GROUP_DOC is YES in the config file)
#define A 1
#define B 2
void glob_func();
//!@}
```

See Member Groups example for the corresponding LaTeX documentation that is generated by doxygen.

Here Group1 is displayed as a subsection of the "Public Members". And Group2 is a separate section because it contains members with different protection levels (i.e. public and protected).

7.3 Subpaging

Information can be grouped into pages using the \page and \mainpage commands. Normally, this results in a flat list of pages, where the "main" page is the first in the list.

Instead of adding structure using the approach described in section modules it is often more natural and convenient to add additional structure to the pages using the \subpage command.

For a page A the \subpage command adds a link to another page B and at the same time makes page B a subpage of A. This has the effect of making two groups GA and GB, where GB is part of GA, page A is put in group GA, and

page B is put in group GB.

Chapter 8

Including formulas

Doxygen allows you to put LaTeX formulas in the output (this works only for the HTML, LaTeX and RTF output. To be able to include formulas (as images) in the HTML and RTF documentation, you will also need to have the following tools installed

- `latex`: the LaTeX compiler, needed to parse the formulas. To test I have used the teTeX 1.0 distribution.
- `dvips`: a tool to convert DVI files to PostScript files I have used version 5.92b from Radical Eye software for testing.
- `gs`: the GhostScript interpreter for converting PostScript files to bitmaps. I have used Aladdin GhostScript 8.0 for testing.

For the HTML output there is also an alternative solution using `MathJax` which does not require the above tools. If you enable USE_MATHJAX in the configuration then the latex formulas will be copied to the HTML "as is" and a client side javascript will parse them and turn them into (interactive) images.

There are four ways to include formulas in the documentation.

1. Using in-text formulas that appear in the running text. These formulas should be put between a pair of \f$ commands, so

   ```
   The distance between \f$(x_1,y_1)\f$ and \f$(x_2,y_2)\f$ is
   \f$\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}\f$.
   ```

   results in:

   The distance between (x_1,y_1) and (x_2,y_2) is $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$.

2. Using in-text formulas that appear in the running text, contrary to \f$ it will not explicitly open the math mode in LaTeX. These formulas should be put between \f(and \f) commands, so

   ```
   The LaTeX and Tex logos are: \f(\LaTeX \f) and \f(\TeX \f).
   ```

   results in:

   The LaTeX and Tex logos are: LaTeXand TeX.

3. Unnumbered displayed formulas that are centered on a separate line. These formulas should be put between \f[and \f] commands. An example:

   ```
   \f[
     |I_2|=\left| \int_{0}^T \psi(t)
              \left\{
                 u(a,t)-
                 \int_{\gamma(t)}^a
                 \frac{d\theta}{k(\theta,t)}
                 \int_{a}^\theta c(\xi)u_t(\xi,t)\,d\xi
              \right\} dt
           \right|
   \f]
   ```

results in:

$$|I_2| = \left| \int_0^T \psi(t) \left\{ u(a,t) - \int_{\gamma(t)}^a \frac{d\theta}{k(\theta,t)} \int_a^\theta c(\xi) u_t(\xi,t)\, d\xi \right\} dt \right|$$

4. Formulas or other latex elements that are not in a math environment can be specified using \f{environment}, where `environment` is the name of the LaTeX environment, the corresponding end command is \f}. Here is an example for an equation array

```
\f{eqnarray*}{
     g &=& \frac{Gm_2}{r^2} \\
       &=& \frac{(6.673 \times 10^{-11}\,\mbox{m}^3\,\mbox{kg}^{-1}\,
           \mbox{s}^{-2})(5.9736 \times 10^{24}\,\mbox{kg})}{(6371.01\,\mbox{km})^2} \\
       &=& 9.82066032\,\mbox{m/s}^2
\f}
```

which results in:

$$\begin{aligned} g &= \frac{Gm_2}{r^2} \\ &= \frac{(6.673 \times 10^{-11}\,\mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2})(5.9736 \times 10^{24}\,\mathrm{kg})}{(6371.01\,\mathrm{km})^2} \\ &= 9.82066032\,\mathrm{m/s}^2 \end{aligned}$$

For the first and third commands one should make sure formulas contain valid commands in LaTeX's math-mode. The second command should valid text-mode commands that also work in math-mode when using USE_MATHJAX. For the fourth command the section should contain valid command for the specific environment.

Warning

Currently, doxygen is not very fault tolerant in recovering from typos in formulas. It may be necessary to remove the files `formula.repository` that are written to the html, rtf etc. directories to get rid of an incorrect formula as well as the `form_*` files.

To have the possibility to define your own LaTeX commands, for e.g. formula building blocks or consistent writing of certain words, the configuration option FORMULA_MACROFILE can be used. to supply a file with LaTeX commands. This file can contain LaTeX `\newcommand` and `\renewcommand` commands and they are included formulas (image version and MathJax version) as well as in the generated LaTeX output (for PDF generation).
The `\newcommand` (and `\renewcommand`) are restricted to a version without optional parameters so only the following types are supported:

```
\newcommand{\cmd}{replacement}
\newcommand{\cmd}[nr]{replacement}
```

e.g.

```
\newcommand{\E}{\mathrm{E}}
\newcommand{\ccSum}[3]{\sum_{#1}^{#2}{#3}}
```

Chapter 9

Including tables

Doxygen supports two ways to put tables in the documentation.

The easiest is to use the Markdown format as shown in Markdown Extensions section Tables.

Although this format is easy to use and read, it is also rather limited. It supports only a simple grid of cells, while each cell is a single line of plain text.

For more complex tables the HTML syntax can be used. Doxygen will process such tables and translate them to the various output formats (at least for the formats that do support tables such as HTML and LaTeX).

Note a table should at least contain 1 row (`<tr>`) and in case a `<caption>` is used the `<caption>` should precede the first row.

Here is an example of a complex table:

```
<table>
<caption id="multi_row">Complex table</caption>
<tr><th>Column 1                      <th>Column 2        <th>Column 3
<tr><td rowspan="2">cell row=1+2,col=1<td>cell row=1,col=2<td>cell row=1,col=3
<tr><td rowspan="2">cell row=2+3,col=2                    <td>cell row=2,col=3
<tr><td>cell row=3,col=1                                  <td rowspan="2">cell row=3+4,col=3
<tr><td colspan="2">cell row=4,col=1+2
<tr><td>cell row=5,col=1              <td colspan="2">cell row=5,col=2+3
<tr><td colspan="2" rowspan="2">cell row=6+7,col=1+2      <td>cell row=6,col=3
<tr>                                                      <td>cell row=7,col=3
<tr><td>cell row=8,col=1              <td>cell row=8,col=2\n
  <table>
    <tr><td>Inner cell row=1,col=1<td>Inner cell row=1,col=2
    <tr><td>Inner cell row=2,col=1<td>Inner cell row=2,col=2
  </table>
  <td>cell row=8,col=3
  <ul>
    <li>Item 1
    <li>Item 2
  </ul>
</table>
```

It has a caption, table heading, various row and column spans, a nested table as one of the cells, and a item list in another cell.

Note that the end tags (like `</td>`) are left out in the example above. This is allowed, and in the HTML output doxygen will add the end tags again.

The output will look as follows:

Table 9.1: Complex table

Column 1	Column 2	Column 3
cell row=1+2,col=1	cell row=1,col=2	cell row=1,col=3
	cell row=2+3,col=2	cell row=2,col=3

<table>
<tr><th>Column 1</th><th>Column 2</th><th>Column 3</th></tr>
<tr><td>cell row=3,col=1</td><td></td><td rowspan="2">cell row=3+4,col=3</td></tr>
<tr><td colspan="2">cell row=4,col=1+2</td></tr>
<tr><td>cell row=5,col=1</td><td colspan="2">cell row=5,col=2+3</td></tr>
<tr><td colspan="2" rowspan="2">cell row=6+7,col=1+2</td><td>cell row=6,col=3</td></tr>
<tr><td>cell row=7,col=3</td></tr>
<tr><td>cell row=8,col=1</td><td>cell row=8,col=2
<table>
<tr><td>Inner cell row=1,col=1</td><td>Inner cell row=1,col=2</td></tr>
<tr><td>Inner cell row=2,col=1</td><td>Inner cell row=2,col=2</td></tr>
</table></td><td>cell row=8,col=3
• Item 1
• Item 2</td></tr>
</table>

One can refer to the caption of the table using \ref using the caption's id as the label.

Chapter 10

Graphs and diagrams

Doxygen has built-in support to generate inheritance diagrams for C++ classes.

Doxygen can use the "dot" tool from graphviz to generate more advanced diagrams and graphs. Graphviz is an open-source, cross-platform graph drawing toolkit and can be found at http://www.graphviz.org/

If you have the "dot" tool in the path, you can set HAVE_DOT to YES in the configuration file to let doxygen use it.

Doxygen uses the "dot" tool to generate the following graphs:

- A graphical representation of the class hierarchy will be drawn, along with the textual one. Currently this feature is supported for HTML only.
  Warning: When you have a very large class hierarchy where many classes derive from a common base class, the resulting image may become too big to handle for some browsers.
- An inheritance graph will be generated for each documented class showing the direct and indirect inheritance relations. This disables the generation of the built-in class inheritance diagrams.
- An include dependency graph is generated for each documented file that includes at least one other file. This feature is currently supported for HTML and RTF only.
- An inverse include dependency graph is also generated showing for a (header) file, which other files include it.
- A graph is drawn for each documented class and struct that shows:
  - the inheritance relations with base classes.
  - the usage relations with other structs and classes (e.g. class A has a member variable m_a of type class B, then A has an arrow to B with m_a as label).
- if CALL_GRAPH is set to YES, a graphical call graph is drawn for each function showing the functions that the function directly or indirectly calls (see also section \callgraph and section \hidecallgraph).
- if CALLER_GRAPH is set to YES, a graphical caller graph is drawn for each function showing the functions that the function is directly or indirectly called by (see also section \callergraph and section \hidecallergraph).
- If DIRECTORY_GRAPH is set to YES, doxygen will generate graphs that show the directory dependencies for every directory. The graph will show directories as boxes. Subdirectories are shown nested into the box of its parent directory. The depth of the graph is configured through DIR_GRAPH_MAX_DEPTH. Include dependencies between the directories are shown as arrows.

Using a layout file you can determine which of the graphs are actually shown.

The options DOT_GRAPH_MAX_NODES and MAX_DOT_GRAPH_DEPTH can be used to limit the size of the various graphs.

The elements in the class diagrams in HTML and RTF have the following meaning:

- A **yellow** box indicates a class. A box can have a little marker in the lower right corner to indicate that the class contains base classes that are hidden. For the class diagrams the maximum tree width is currently 8 elements. If a tree is wider some nodes will be hidden. If the box is filled with a dashed pattern the inheritance relation is virtual.
- A **white** box indicates that the documentation of the class is currently shown.
- A **gray** box indicates an undocumented class.
- A **solid dark blue** arrow indicates public inheritance.
- A **dashed dark green** arrow indicates protected inheritance.
- A **dotted dark green** arrow indicates private inheritance.

The elements in the class diagram in LaTeX have the following meaning:

- A **white** box indicates a class. A **marker** in the lower right corner of the box indicates that the class has base classes that are hidden. If the box has a **dashed** border this indicates virtual inheritance.
- A **solid** arrow indicates public inheritance.
- A **dashed** arrow indicates protected inheritance.
- A **dotted** arrow indicates private inheritance.

The elements in the graphs generated by the dot tool have the following meaning:

- A **white** box indicates a class or struct or file.
- A box with a **red** border indicates a node that has *more* arrows than are shown! In other words: the graph is *truncated* with respect to this node. The reason why a graph is sometimes truncated is to prevent images from becoming too large. For the graphs generated with dot doxygen tries to limit the width of the resulting image to 1024 pixels.

- A **black** box indicates that the class' documentation is currently shown.
- A **dark blue** arrow indicates an include relation (for the include dependency graph) or public inheritance (for the other graphs).
- A **dark green** arrow indicates protected inheritance.
- A **dark red** arrow indicates private inheritance.
- A **purple dashed** arrow indicated a "usage" relation, the edge of the arrow is labeled with the variable(s) responsible for the relation. Class `A` uses class `B`, if class `A` has a member variable `m` of type C, where B is a subtype of C (e.g. `C` could be `B`, `B*`, `T<B>*`).

The elements in the directory dependency graphs have the following meaning:

- A box with a **bold** border indicates the directory that the directory dependency graph has been generated for.
- A box with a **red solid** border indicates a directory whose subdirectories are not shown in the graph ("truncated"). To configure the depth of subdirectories that are shown in the graph see DIR_GRAPH_MAX_DEPTH.
- A box with a **red dashed** border indicates a truncated directory whose parent directories are not shown in the graph either.
- A box with a **dashed** border other than red indicates that not all but at least one subdirectory are shown.
- A box with a **light gray** border indicates a directory with both of the following two attributes:
  - Its parent directory is not shown.

  - At least one subdirectory is shown.

- A box with **no background color** indicates a directory which is not a subdirectory of the origin's parent directories which are shown. The origin is the directory for which the directory dependency graph is shown.

- An **arrow** between two boxes indicates an include dependency between two directories. The include dependency exists if a file in a directory includes a file of another directory. If a directory that is involved in an include dependency is not shown in the graph, the arrow is attached to the first parent directory that is shown. This parent directory is shown as truncated (see above).

Here are a couple of header files that together show the various diagrams that doxygen can generate:

diagrams_a.h
```
#ifndef DIAGRAMS_A_H
#define DIAGRAMS_A_H
class A { public: A *m_self; };
#endif
```

diagrams_b.h
```
#ifndef DIAGRAMS_B_H
#define DIAGRAMS_B_H
class A;
class B { public: A *m_a; };
#endif
```

diagrams_c.h
```
#ifndef DIAGRAMS_C_H
#define DIAGRAMS_C_H
#include "diagrams_c.h"
class D;
class C : public A { public: D *m_d; };
#endif
```

diagrams_d.h
```
#ifndef DIAGRAM_D_H
#define DIAGRAM_D_H
#include "diagrams_a.h"
#include "diagrams_b.h"
class C;
class D : virtual protected  A, private B { public: C m_c; };
#endif
```

diagrams_e.h
```
#ifndef DIAGRAM_E_H
#define DIAGRAM_E_H
#include "diagrams_d.h"
class E : public D {};
#endif
```

Chapter 11

Preprocessing

Source files that are used as input to doxygen can be parsed by doxygen's built-in C-preprocessor.

By default doxygen does only partial preprocessing. That is, it evaluates conditional compilation statements (like `#if`) and evaluates macro definitions, but it does not perform macro expansion.

So if you have the following code fragment

```
#define VERSION 200
#define CONST_STRING const char *

#if VERSION >= 200
  static CONST_STRING version = "2.xx";
#else
  static CONST_STRING version = "1.xx";
#endif
```

Then by default doxygen will feed the following to its parser:

```
#define VERSION
#define CONST_STRING

  static CONST_STRING version = "2.xx";
```

You can disable all preprocessing by setting ENABLE_PREPROCESSING to `NO` in the configuration file. In the case above doxygen will then read both statements, i.e.:

```
  static CONST_STRING version = "2.xx";
  static CONST_STRING version = "1.xx";
```

In case you want to expand the `CONST_STRING` macro, you should set the MACRO_EXPANSION tag in the configuration file to `YES`. Then the result after preprocessing becomes:

```
#define VERSION
#define CONST_STRING

  static const char * version = "2.xx";
```

Note that doxygen will now expand *all* macro definitions (recursively if needed). This is often too much. Therefore, doxygen also allows you to expand only those defines that you explicitly specify. For this you have to set the EXPAND_ONLY_PREDEF tag to `YES` and specify the macro definitions after the PREDEFINED or EXPAND_AS_DEFINED tag.

A typically example where some help from the preprocessor is needed is when dealing with the language extension from Microsoft: `__declspec`. The same goes for GNU's `__attribute__` extension. Here is an example function.

```
extern "C" void __declspec(dllexport) ErrorMsg( String aMessage,...);
```

When nothing is done, doxygen will be confused and see `__declspec` as some sort of function. To help doxygen one typically uses the following preprocessor settings:

```
ENABLE_PREPROCESSING   = YES
MACRO_EXPANSION        = YES
EXPAND_ONLY_PREDEF     = YES
PREDEFINED             = __declspec(x)=
```

This will make sure the `__declspec(dllexport)` is removed before doxygen parses the source code.

Similar settings can be used for removing `__attribute__` expressions from the input:

```
ENABLE_PREPROCESSING   = YES
MACRO_EXPANSION        = YES
EXPAND_ONLY_PREDEF     = YES
PREDEFINED             = __attribute__(x)=
```

For a more complex example, suppose you have the following obfuscated code fragment of an abstract base class called `IUnknown`:

```
/*! A reference to an IID */
#ifdef __cplusplus
#define REFIID const IID &
#else
#define REFIID const IID *
#endif


/*! The IUnknown interface */
DECLARE_INTERFACE(IUnknown)
{
  STDMETHOD(HRESULT,QueryInterface) (THIS_ REFIID iid, void **ppv) PURE;
  STDMETHOD(ULONG,AddRef) (THIS) PURE;
  STDMETHOD(ULONG,Release) (THIS) PURE;
};
```

without macro expansion doxygen will get confused, but we may not want to expand the `REFIID` macro, because it is documented and the user that reads the documentation should use it when implementing the interface.

By setting the following in the configuration file:

```
ENABLE_PREPROCESSING = YES
MACRO_EXPANSION      = YES
EXPAND_ONLY_PREDEF   = YES
PREDEFINED           = "DECLARE_INTERFACE(name)=class name" \
                       "STDMETHOD(result,name)=virtual result name" \
                       "PURE= = 0" \
                       THIS_= \
                       THIS= \
                __cplusplus
```

we can make sure that the proper result is fed to doxygen's parser:

```
/*! A reference to an IID */
#define REFIID

/*! The IUnknown interface */
class  IUnknown
{
  virtual  HRESULT   QueryInterface ( REFIID iid, void **ppv) = 0;
  virtual  ULONG   AddRef () = 0;
  virtual  ULONG   Release () = 0;
};
```

Note that the PREDEFINED tag accepts function like macro definitions (like `DECLARE_INTERFACE`), normal macro substitutions (like `PURE` and `THIS`) and plain defines (like `__cplusplus`).

Note also that preprocessor definitions that are normally defined automatically by the preprocessor (like `__cplusplus`), have to be defined by hand with doxygen's parser (this is done because these defines are often platform/compiler specific).

In some cases you may want to substitute a macro name or function by something else without exposing the result to further macro substitution. You can do this but using the `:=` operator instead of `=`

As an example suppose we have the following piece of code:

```
#define QList QListT
class QListT
{
};
```

Then the only way to get doxygen interpret this as a class definition for class `QList` is to define:

```
PREDEFINED = QListT:=QList
```

Here is an example provided by Valter Minute and Reyes Ponce that helps doxygen to wade through the boilerplate code in Microsoft's ATL & MFC libraries:

```
PREDEFINED           = "DECLARE_INTERFACE(name)=class name" \
                       "STDMETHOD(result,name)=virtual result name" \
                       "PURE= = 0" \
                       THIS_= \
                       THIS= \
                       DECLARE_REGISTRY_RESOURCEID=// \
                       DECLARE_PROTECT_FINAL_CONSTRUCT=// \
                       "DECLARE_AGGREGATABLE(Class)= " \
                       "DECLARE_REGISTRY_RESOURCEID(Id)= " \
                       DECLARE_MESSAGE_MAP= \
                       BEGIN_MESSAGE_MAP=/* \
                       END_MESSAGE_MAP=*/// \
                       BEGIN_COM_MAP=/* \
                       END_COM_MAP=*/// \
                       BEGIN_PROP_MAP=/* \
                       END_PROP_MAP=*/// \
                       BEGIN_MSG_MAP=/* \
                       END_MSG_MAP=*/// \
                       BEGIN_PROPERTY_MAP=/* \
                       END_PROPERTY_MAP=*/// \
                       BEGIN_OBJECT_MAP=/* \
                       END_OBJECT_MAP()=*/// \
                       DECLARE_VIEW_STATUS=// \
                       "STDMETHOD(a)=HRESULT a" \
                       "ATL_NO_VTABLE= " \
                       "__declspec(a)= " \
                       BEGIN_CONNECTION_POINT_MAP=/* \
                       END_CONNECTION_POINT_MAP=*/// \
                       "DECLARE_DYNAMIC(class)= " \
                       "IMPLEMENT_DYNAMIC(class1, class2)= " \
                       "DECLARE_DYNCREATE(class)= " \
                       "IMPLEMENT_DYNCREATE(class1, class2)= " \
                       "IMPLEMENT_SERIAL(class1, class2, class3)= " \
                       "DECLARE_MESSAGE_MAP()= " \
                       TRY=try \
                       "CATCH_ALL(e)= catch(...)" \
                       END_CATCH_ALL= \
                       "THROW_LAST()= throw"\
                       "RUNTIME_CLASS(class)=class" \
                       "MAKEINTRESOURCE(nId)=nId" \
                       "IMPLEMENT_REGISTER(v, w, x, y, z)= " \
                       "ASSERT(x)=assert(x)" \
                       "ASSERT_VALID(x)=assert(x)" \
                       "TRACE0(x)=printf(x)" \
                       "OS_ERR(A,B)={ #A, B }" \
                       __cplusplus \
                       "DECLARE_OLECREATE(class)= " \
                       "BEGIN_DISPATCH_MAP(class1, class2)= " \
                       "BEGIN_INTERFACE_MAP(class1, class2)= " \
                       "INTERFACE_PART(class, id, name)= " \
```

```
                    "END_INTERFACE_MAP()=" \
                    "DISP_FUNCTION(class, name, function, result, id)=" \
                    "END_DISPATCH_MAP()=" \
                    "IMPLEMENT_OLECREATE2(class, name, id1, id2, id3, id4,\
                     id5, id6, id7, id8, id9, id10, id11)="
```

As you can see doxygen's preprocessor is quite powerful, but if you want even more flexibility you can always write an input filter and specify it after the INPUT_FILTER tag.

If you are unsure what the effect of doxygen's preprocessing will be you can run doxygen as follows:

```
doxygen -d Preprocessor
```

or when the line numbers are not wanted:

```
doxygen -d Preprocessor -d NoLineno
```

This will instruct doxygen to dump the input sources to standard output after preprocessing has been done (Hint: set `QUIET = YES` and `WARNINGS = NO` in the configuration file to disable any other output).

Note preprocessing is not done for all languages. Preprocessing is enabled for files that use the "C" scanner (with the exception of 'java', 'd' and 'php'), Fortran files (only in case the extension contains at least one upper case character) and vhdl files.

Chapter 12

Automatic link generation

12.1 Links to web pages and mail addresses 61

12.2 Links to classes 61

12.3 Links to files 61

12.4 Links to functions 61

12.5 Links to other members 62

12.6 typedefs 64

Most documentation systems have special 'see also' sections where links to other pieces of documentation can be inserted. Although doxygen also has a command to start such a section (See section \sa), it does allow you to put these kind of links anywhere in the documentation. For LaTeX documentation a reference to the page number is written instead of a link. Furthermore, the index at the end of the document can be used to quickly find the documentation of a member, class, namespace or file. For man pages no reference information is generated.

The next sections show how to generate links to the various documented entities in a source file.

12.1 Links to web pages and mail addresses

Doxygen will automatically replace any URLs and mail addresses found in the documentation by links (in HTML). To manually specify link text, use the HTML '`a`' tag:

```
<a href="linkURL">link text</a>
```

which will be automatically translated to other output formats by doxygen.

12.2 Links to classes

All words in the documentation that correspond to a documented class and contain at least one non-lower case character will automatically be replaced by a link to the page containing the documentation of the class. If you want to prevent that a word that corresponds to a documented class is replaced by a link you should put a % in front of the word. To link to an all lower case symbol, use \ref.

12.3 Links to files

All words that contain a dot (`.`) that is not the last character in the word are considered to be file names. If the word is indeed the name of a documented input file, a link will automatically be created to the documentation of that file.

12.4 Links to functions

Links to functions are created if one of the following patterns is encountered:

1. `<functionName>"("<argument-list>")"`
2. `<functionName>"()"`
3. `"::"<functionName>`
4. `(<className>"::")`^{n}`<functionName>"("<argument-list>")"`
5. `(<className>"::")`^{n}`<functionName>"("<argument-list>")"<modifiers>`
6. `(<className>"::")`^{n}`<functionName>"()"`
7. `(<className>"::")`^{n}`<functionName>`

where n>0.

Note 1:

Function arguments should be specified with correct types, i.e. 'fun(const std::string&,bool)' or '()' to match any prototype.

Note 2:

Member function modifiers (like 'const' and 'volatile') are required to identify the target, i.e. 'func(int) const' and 'func(int)' target different member functions.

Note 3:

For Javadoc compatibility a # may be used instead of a :: in the patterns above.

Note 4:

In the documentation of a class containing a member foo, a reference to a global variable is made using "::foo", whereas #foo will link to the member.

For non overloaded members the argument list may be omitted.

If a function is overloaded and no matching argument list is specified (i.e. pattern 2 or 6 is used), a link will be created to the documentation of one of the overloaded members.

For member functions the class scope (as used in patterns 4 to 7) may be omitted, if:

1. The pattern points to a documented member that belongs to the same class as the documentation block that contains the pattern.
2. The class that corresponds to the documentation blocks that contains the pattern has a base class that contains a documented member that matches the pattern.

12.5 Links to other members

All of these entities can be linked to in the same way as described in the previous section. For sake of clarity it is advised to only use patterns 3 and 7 in this case.

Example:

```
/*! \file autolink.cpp
  Testing automatic link generation.

  A link to a member of the Autolink_Test class: Autolink_Test::member,

  More specific links to the each of the overloaded members:
  Autolink_Test::member(int) and Autolink_Test#member(int,int)

  A link to a protected member variable of Autolink_Test: Autolink_Test#var,

  A link to the global enumeration type #GlobEnum.

  A link to the define #ABS(x).

  A link to the destructor of the Autolink_Test class: Autolink_Test::~Autolink_Test,

  A link to the typedef ::B.

  A link to the enumeration type Autolink_Test::EType

  A link to some enumeration values Autolink_Test::Val1 and ::GVal2
*/

/*!
  Since this documentation block belongs to the class Autolink_Test no link to
  Autolink_Test is generated.

  Two ways to link to a constructor are: #Autolink_Test and Autolink_Test().

  Links to the destructor are: #~Autolink_Test and ~Autolink_Test().

  A link to a member in this class: member().

  More specific links to the each of the overloaded members:
  member(int) and member(int,int).

  A link to the variable #var.

  A link to the global typedef ::B.

  A link to the global enumeration type #GlobEnum.

  A link to the define ABS(x).

  A link to a variable \link #var using another text\endlink as a link.

  A link to the enumeration type #EType.

  A link to some enumeration values: \link Autolink_Test::Val1 Val1 \endlink and ::GVal1.

  And last but not least a link to a file: autolink.cpp.

  \sa Inside a see also section any word is checked, so EType,
      Val1, GVal1, ~Autolink_Test and member will be replaced by links in HTML.
*/
class Autolink_Test
{
  public:
    Autolink_Test();               //!< constructor
   ~Autolink_Test();               //!< destructor
    void member(int);     /**< A member function. Details. */
    void member(int,int); /**< An overloaded member function. Details */

    /** An enum type. More details */
    enum EType {
      Val1,               /**< enum value 1 */
      Val2                /**< enum value 2 */
    };
  protected:
    int var;              /**< A member variable */
};

/*! details. */
Autolink_Test::Autolink_Test() { }

/*! details. */
Autolink_Test::~Autolink_Test() { }

/*! A global variable. */
int globVar;

/*! A global enum. */
enum GlobEnum {
                GVal1,    /*!< global enum value 1 */
                GVal2     /*!< global enum value 2 */
```

```
                };

/*!
 *  A macro definition.
 */
#define ABS(x) (((x)>0)?(x):-(x))
typedef Autolink_Test B;

/*! \fn typedef Autolink_Test B
 *  A type definition.
 */
```

See Autolink example for the corresponding LaTeX documentation that is generated by doxygen.

12.6 typedefs

Typedefs that involve classes, structs and unions, like

```
typedef struct StructName TypeName
```

create an alias for StructName, so links will be generated to StructName, when either StructName itself or TypeName is encountered.

Example:

```
/*! \file restypedef.cpp
 * An example of resolving typedefs.
 */

/*! \struct CoordStruct
 * A coordinate pair.
 */
struct CoordStruct
{
  /*! The x coordinate */
  float x;
  /*! The y coordinate */
  float y;
};

/*! Creates a type name for CoordStruct */
typedef CoordStruct Coord;

/*!
 * This function returns the addition of \a c1 and \a c2, i.e:
 * (c1.x+c2.x,c1.y+c2.y)
 */
Coord add(Coord c1,Coord c2)
{
}
```

See Typedef example for the corresponding LaTeX documentation that is generated by doxygen.

Chapter 13

Output Formats

The following output formats are *directly* supported by doxygen:

HTML Generated if GENERATE_HTML is set to `YES` in the configuration file.

LaTeX Generated if GENERATE_LATEX is set to `YES` in the configuration file.

Man pages Generated if GENERATE_MAN is set to `YES` in the configuration file.

RTF Generated if GENERATE_RTF is set to `YES` in the configuration file.

Note that the RTF output probably only looks nice with Microsoft's Word. If you have success with other programs, please let me know.

XML Generated if GENERATE_XML is set to `YES` in the configuration file.

DocBook Generated if GENERATE_DOCBOOK is set to `YES` in the configuration file.

The following output formats are *indirectly* supported by doxygen:

Compiled HTML Help (a.k.a. Windows 98 help) Generated by Microsoft's HTML Help workshop from the HTML output if GENERATE_HTMLHELP is set to `YES`.

Qt Compressed Help (.qch) Generated by Qt's qhelpgenerator tool from the HTML output if GENERATE_QHP is set to `YES`.

Eclipse Help Generated from HTML with a special index file that is generated when GENERATE_ECLIPSEHELP is set to `YES`.

XCode DocSets Compiled from HTML with a special index file that is generated when GENERATE_DOCSET is set to `YES`.

PostScript Generated from the LaTeX output by running `make ps` in the output directory. For the best results PDF_HYPERLINKS should be set to `NO`.

PDF Generated from the LaTeX output by running `make pdf` in the output directory. To improve the PDF output, you typically would want to enable the use of `pdflatex` by setting USE_PDFLATEX to `YES` in the configuration file. In order to get hyperlinks in the PDF file you also need to enable PDF_HYPERLINKS.

Chapter 14

Searching

Doxygen indexes your source code in various ways to make it easier to navigate and find what you are looking for. There are also situations however where you want to search for something by keyword rather than browse for it.

HTML browsers by default have no search capabilities that work across multiple pages, so either doxygen or external tools need to help to facilitate this feature.

Doxygen has 7 different ways to add searching to the HTML output, each of which has its own advantages and disadvantages:

1. Client side searching

The easiest way to enable searching is to enable the built-in client side search engine. This engine is implemented using JavaScript and DHTML only and runs entirely on the clients browser. So no additional tooling is required to make it work.

To enable it set SEARCHENGINE to `YES` in the configuration file and make sure SERVER_BASED_SEARCH is set to `NO`.

An additional advantage of this method is that it provides live searching, i.e. the search results are presented and adapted as you type.

This method also has its drawbacks: it is limited to searching for symbols only. It does not provide full text search capabilities and it does not scale well to very large projects (then searching becomes very slow). Furthermore the searching is done from the beginning of the indexed items, so when having the available items `A_STRING`, `AA_STRING` and `STRING` and typing in the search box `A` it will find `A_STRING` and `AA_STRING`, but when typing e.g. `STR` it will only find `STRING` and not `A_STRING`.

2. Server side searching

If you plan to put the HTML documentation on a web server, and that web server has the capability to process PHP code, then you can also use doxygen's built-in server side search engine.

To enable this set both SEARCHENGINE and SERVER_BASED_SEARCH to `YES` in the configuration file and set EXTERNAL_SEARCH to `NO`.

Advantages over the client side search engine are that it provides full text search and it scales well to medium side projects.

Disadvantages are that it does not work locally (i.e. using a "file://" URL) and that it does not provide live search capabilities.

Note

In the future this option will probably be replaced by the next search option.

3. Server side searching with external indexing

With release 1.8.3 of doxygen, another server based search option has been added. With this option doxygen generates the raw data that can be searched and leaves it up to external tools to do the indexing and searching, meaning that you could use your own indexer and search engine of choice. To make life easier doxygen ships with an example indexer (doxyindexer) and search engine (doxysearch.cgi) based on the `Xapian` open source search engine library.

To enable this search method set SEARCHENGINE, SERVER_BASED_SEARCH and EXTERNAL_SEARCH all to `YES`.

See External Indexing and Searching for configuration details.

Advantages over option 2 are that this method (potentially) scales to very large projects. It is also possible to combine multiple doxygen projects and external data into one search index. The way the interaction with the search engine is done, makes it possible to search from local HTML pages. Also the search results have better ranking and show context information (if available).

Disadvantages are that is requires a web server that can execute a CGI binary, and an additional indexing step after running doxygen.

4. Windows Compiled HTML Help

If you are running doxygen on Windows, then you can make a compiled HTML Help file (.chm) out of the HTML files produced by doxygen. This is a single file containing all HTML files and it also includes a search index. There are viewers for this format on many platforms, and Windows even supports it natively.

To enable this set GENERATE_HTMLHELP to `YES` in the configuration file. To let doxygen compile the HTML Help file for you, you also need to specify the path to the HTML compiler (hhc.exe) using the HHC_LOCATION configuration option and the name of the resulting CHM file using CHM_FILE.

An advantage of this method is that the result is a single file that can easily be distributed. It also provides full text search.

Disadvantages are that compiling the CHM file only works on Windows and requires Microsoft's HTML compiler, which is not very actively supported by Microsoft. Although the tool works fine for most people, it can sometimes crash for no apparent reason (how typical).

5. Mac OS X Doc Sets

If you are running doxygen on Mac OS X 10.5 or higher, then you can make a "doc set" out of the HTML files produced by doxygen. A doc set consists of a single directory with a special structure containing the HTML files along with a precompiled search index. A doc set can be embedded in Xcode (the integrated development environment provided by Apple).

To enable the creation of doc sets set GENERATE_DOCSET to `YES` in the configuration file. There are a couple of other doc set related options you may want to set. After doxygen has finished you will find a Makefile in the HTML output directory. Running "make install" on this Makefile will compile and install the doc set. See `this article` for more info.

Advantage of this method is that it nicely integrates with the Xcode development environment, allowing for instance to click on an identifier in the editor and jump to the corresponding section in the doxygen documentation.

Disadvantage is that it only works in combination with Xcode on MacOSX.

6. Qt Compressed Help

If you develop for or want to install the Qt application framework, you will get an application called `Qt assistant`. This is a help viewer for Qt Compressed Help files (`.qch`).

To enable this feature set GENERATE_QHP to YES. You also need to fill in the other Qt help related options, such as QHP_NAMESPACE, QHG_LOCATION, QHP_VIRTUAL_FOLDER. See this article for more info.

Feature wise the Qt compressed help feature is comparable with the CHM output, with the additional advantage that compiling the QCH file is not limited to Windows.

Disadvantage is that it requires setting up a Qt 4.5 (or better) for each user, or distributing the Qt help assistant along with the documentation, which is complicated by the fact that it is not available as a separate package at this moment.

7. Eclipse Help Plugin

If you use eclipse, you can embed the documentation generated by doxygen as a help plugin. It will then appear as a topic in the help browser that can be started from "Help contents" in the Help menu. Eclipse will generate a search index for the documentation when you first search for a keyword.

To enable the help plugin set GENERATE_ECLIPSEHELP to YES, and define a unique identifier for your project via ECLIPSE_DOC_ID, i.e.:

```
GENERATE_ECLIPSEHELP = YES
ECLIPSE_DOC_ID       = com.yourcompany.yourproject
```

then create the com.yourcompany.yourproject directory (so with the same name as the value of ECLIPSE_DOC_ID) in the plugin directory of eclipse and after doxygen completes copy to contents of the help output directory to the com.yourcompany.yourproject directory. Then restart eclipse to make let it find the new plugin.

The eclipse help plugin provides similar functionality as the Qt compressed help or CHM output, but it does require that Eclipse is installed and running.

14.1 External Indexing and Searching

14.1.1 Introduction

With release 1.8.3, doxygen provides the ability to search through HTML using an external indexing tool and search engine. This has several advantages:

- For large projects it can have significant performance advantages over doxygen's built-in search engine, as doxygen uses a rather simple indexing algorithm.
- It allows combining the search data of multiple projects into one index, allowing a global search across multiple doxygen projects.
- It allows adding additional data to the search index, i.e. other web pages not produced by doxygen.
- The search engine needs to run on a web server, but clients can still browse the web pages locally.

To avoid that everyone has to start writing their own indexer and search engine, doxygen provides an example tool for each action: doxyindexer for indexing the data and doxysearch.cgi for searching through the index.

The data flow is shown in the following diagram:

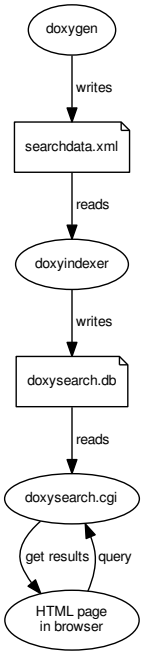


Figure 14.1: External Search Data Flow

- `doxygen` produces the raw search data
- `doxyindexer` indexes the data into a search database `doxysearch.db`
- when a user performs a search from a doxygen generated HTML page, the CGI binary `doxysearch.cgi` will be invoked.
- the `doxysearch.cgi` tool will perform a query on the database and return the results.
- The browser will show the search results.

14.1.2 Configuring

The first step is to make the search engine available via a web server. If you use `doxysearch.cgi` this means making the `CGI` binary available from the web server (i.e. be able to run it from a browser via an URL starting with http:)

How to setup a web server is outside the scope of this document, but if you for instance have Apache installed, you could simply copy the `doxysearch.cgi` file from doxygen's `bin` directory to the `cgi-bin` directory of the Apache web server. Read the `apache documentation` for details.

To test if `doxysearch.cgi` is accessible start your web browser and point to URL to the binary and add `?test` at the end

```
http://yoursite.com/path/to/cgi/doxysearch.cgi?test
```

You should get the following message:

```
Test failed: cannot find search index doxysearch.db
```

If you use Internet Explorer you may be prompted to download a file, which will then contain this message.

Since we didn't create or install a doxysearch.db it is OK for the test to fail for this reason. How to correct this is discussed in the next section.

Before continuing with the next section add the above URL (without the `?test` part) to the SEARCHENGINE_URL tag in doxygen's configuration file:

```
SEARCHENGINE_URL = http://yoursite.com/path/to/cgi/doxysearch.cgi
```

Single project index

To use the external search option, make sure the following options are enabled in doxygen's configuration file:

```
SEARCHENGINE           = YES
SERVER_BASED_SEARCH    = YES
EXTERNAL_SEARCH        = YES
```

This will make doxygen generate a file called `searchdata.xml` in the output directory (configured with OUTPUT_DIRECTORY). You can change the file name (and location) with the SEARCHDATA_FILE option.

The next step is to put the raw search data into an index for efficient searching. You can use `doxyindexer` for this. Simply run it from the command line:

```
doxyindexer searchdata.xml
```

This will create a directory called `doxysearch.db` with some files in it. By default the directory will be created at the location from which doxyindexer was started, but you can change the directory using the `-o` option.

Copy the `doxysearch.db` directory to the same directory as where the `doxysearch.cgi` is located and rerun the browser test by pointing the browser to

```
http://yoursite.com/path/to/cgi/doxysearch.cgi?test
```

You should now get the following message:

```
Test successful.
```

Now you should be able to search for words and symbols from the HTML output.

Multi project index

In case you have more than one doxygen project and these projects are related, it may be desirable to allow searching for words in all projects from within the documentation of any of the projects.

To make this possible all that is needed is to combine the search data for all projects into a single index, e.g. for two projects A and B for which the searchdata.xml is generated in directories project_A and project_B run:

```
doxyindexer project_A/searchdata.xml project_B/searchdata.xml
```

and then copy the resulting `doxysearch.db` to the directory where also `doxysearch.cgi` is located.

The `searchdata.xml` file doesn't contain any absolute paths or links, so how can the search results from multiple projects be linked back to the right documentation set? This is where the EXTERNAL_SEARCH_ID and EXTRA_SEARCH_MAPPINGS options come into play.

To be able to identify the different projects, one needs to set a unique ID using EXTERNAL_SEARCH_ID for each project.

To link the search results to the right project, you need to define a mapping per project using the EXTRA_SEARCH_MAPPINGS tag. With this option to can define the mapping from IDs of other projects to the (relative) location of documentation of those projects.

So for projects A and B the relevant part of the configuration file could look as follows:

```
project_A/Doxyfile
------------------
EXTERNAL_SEARCH_ID     = A
EXTRA_SEARCH_MAPPINGS = B=../../project_B/html
```

for project A and for project B

```
project_B/Doxyfile
------------------
EXTERNAL_SEARCH_ID    = B
EXTRA_SEARCH_MAPPINGS = A=../../project_A/html
```

with these settings, projects A and B can share the same search database, and the search results will link to the right documentation set.

14.1.3 Updating the index

When you modify the source code, you should re-run doxygen to get up to date documentation again. When using external searching you also need to update the search index by re-running `doxyindexer`. You could wrap the call to `doxygen` and `doxyindexer` together in a script to make this process easier.

14.1.4 Programming interface

Previous sections have assumed you use the tools `doxyindexer` and `doxysearch.cgi` to do the indexing and searching, but you could also write your own index and search tools if you like.

For this 3 interfaces are important

- The format of the input for the index tool.
- The format of the input for the search engine.
- The format of the output of search engine.

The next subsections describe these interfaces in more detail.

Indexer input format

The search data produced by doxygen follows the `Solr XML index message` format.

The input for the indexer is an XML file, which consists of one `<add>` tag containing multiple `<doc>` tags, which in turn contain multiple `<field>` tags.

Here is an example of one doc node, which contains the search data and meta data for one method:

```
<add>
  ...
  <doc>
    <field name="type">function</field>
    <field name="name">QXmlReader::setDTDHandler</field>
    <field name="args">(QXmlDTDHandler *handler)=0</field>
    <field name="tag">qtools.tag</field>
    <field name="url">de/df6/class_q_xml_reader.html#a0b24b1fe26a4c32a8032d68ee14d5dba</field>
    <field name="keywords">setDTDHandler QXmlReader::setDTDHandler QXmlReader</field>
    <field name="text">Sets the DTD handler to handler DTDHandler()</field>
  </doc>
  ...
</add>
```

Each field has a name. The following field names are supported:

- *type*: the type of the search entry; can be one of: source, function, slot, signal, variable, typedef, enum, enumvalue, property, event, related, friend, define, file, namespace, group, package, page, dir
- *name*: the name of the search entry; for a method this is the qualified name of the method, for a class it is the name of the class, etc.

- *args*: the parameter list (in case of functions or methods)
- *tag*: the name of the tag file used for this project.
- *url*: the (relative) URL to the HTML documentation for this entry.
- *keywords*: important words that are representative for the entry. When searching for such keyword, this entry should get a higher rank in the search results.
- *text*: the documentation associated with the item. Note that only words are present, no markup.

Note

Due to the potentially large size of the XML file, it is recommended to use a SAX based parser to process it.

Search URL format

When the search engine is invoked from a doxygen generated HTML page, a number of parameters are passed to via the query string.

The following fields are passed:

- *q*: the query text as entered by the user
- *n*: the number of search results requested.
- *p*: the number of search page for which to return the results. Each page has *n* values.
- *cb*: the name of the callback function, used for JSON with padding, see the next section.

From the complete list of search results, the range `[n*p - n*(p+1)-1]` should be returned.

Here is an example of how a query looks like.

```
http://yoursite.com/path/to/cgi/doxysearch.cgi?q=list&n=20&p=1&cb=dummy
```

It represents a query for the word 'list' (`q=list`) requesting 20 search results (`n=20`), starting with the result number 20 (`p=1`) and using callback 'dummy' (`cb=dummy`):

Note

The values are URL encoded so they have to be decoded before they can be used.

Search results format

When invoking the search engine as shown in the previous subsection, it should reply with the results. The format of the reply is JSON with padding, which is basically a javascript struct wrapped in a function call. The name of function should be the name of the callback (as passed with the *cb* field in the query).

With the example query as shown the previous subsection the main structure of the reply should look as follows:

```
dummy({
  "hits":179,
  "first":20,
  "count":20,
  "page":1,
  "pages":9,
  "query": "list",
  "items":[
  ...
 ]})
```

The fields have the following meaning:

- *hits*: the total number of search results (could be more than was requested).
- *first*: the index of first result returned: $\min(n * p, \mathit{hits})$.
- *count*: the actual number of results returned: $\min(n, \mathit{hits} - \mathit{first})$
- *page*: the page number of the result: p
- *pages*: the total number of pages: $\lceil \frac{\mathit{hits}}{n} \rceil$.
- *items*: an array containing the search data per result.

Here is an example of how the element of the *items* array should look like:

```
{"type": "function",
 "name": "QDir::entryInfoList(const QString &nameFilter, int filterSpec=DefaultFilter, int sortSpec=DefaultSor
 "tag": "qtools.tag",
 "url": "d5/d8d/class_q_dir.html#a9439ea6b331957f38dbad981c4d050ef",
 "fragments":[
   "Returns a <span class=\"hl\">list</span> of QFileInfo objects for all files and directories...",
   "... pointer to a QFileInfoList The <span class=\"hl\">list</span> is owned by the QDir object...",
   "... to keep the entries of the <span class=\"hl\">list</span> after a subsequent call to this..."
 ]
},
```

The fields for such an item have the following meaning:

- *type*: the type of the item, as found in the field with name "type" in the raw search data.
- *name*: the name of the item, including the parameter list, as found in the fields with name "name" and "args" in the raw search data.
- *tag*: the name of the tag file, as found in the field with name "tag" in the raw search data.
- *url*: the name of the (relative) URL to the documentation, as found in the field with name "url" in the raw search data.
- "fragments": an array with 0 or more fragments of text containing words that have been search for. These words should be wrapped in `<span class="hl">` and `</span>` tags to highlight them in the output.

Chapter 15

Customizing the output

15.1 Minor Tweaks 75
15.1.1 Overall Color 75
15.1.2 Navigation 75
15.1.3 Dynamic Content 77
15.1.4 Header, Footer, and Stylesheet changes 77
15.2 Changing the layout of pages 78
15.3 Using the XML output 81

Doxygen provides various levels of customization. The section Minor Tweaks discusses what to do if you want to do minor tweaking to the look and feel of the output. The section Layout show how to reorder and hide certain information on a page. The section XML output show how to generate whatever output you want based on the XML output produced by doxygen.

15.1 Minor Tweaks

The next subsections describe some aspects that can be tweaked with little effort.

15.1.1 Overall Color

To change the overall color of the HTML output doxygen provides three options

- HTML_COLORSTYLE_HUE
- HTML_COLORSTYLE_SAT
- HTML_COLORSTYLE_GAMMA

to change the hue, saturation, and gamma correction of the colors respectively.

For your convenience the GUI frontend Doxywizard has a control that allows you to see the effect of changing the values of these options on the output in real time.

15.1.2 Navigation

By default doxygen shows navigation tabs on top of every HTML page, corresponding with the following settings:

- DISABLE_INDEX = `NO`

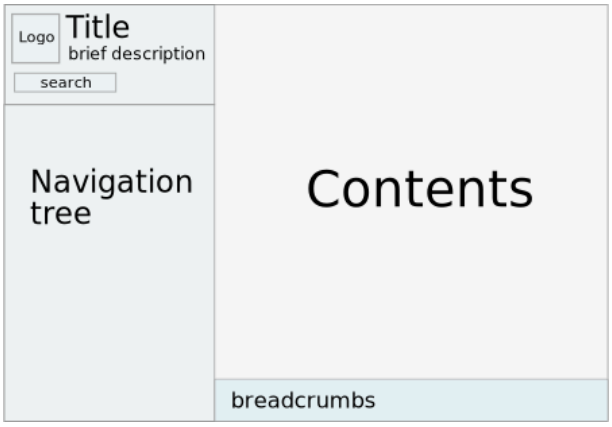
- GENERATE_TREEVIEW = NO

you can switch to an interactive navigation tree as sidebar using

- DISABLE_INDEX = YES
- GENERATE_TREEVIEW = YES
- FULL_SIDEBAR = NO

you can also make the content span the title area of the screen using

- DISABLE_INDEX = YES
- GENERATE_TREEVIEW = YES
- FULL_SIDEBAR = YES



or even have both forms of navigation:

- DISABLE_INDEX = `NO`
- GENERATE_TREEVIEW = `YES`

if you already use an external index (i.e. have one of the following options enabled GENERATE_HTMLHELP, GENERATE_ECLIPSEHELP, GENERATE_QHP, or GENERATE_DOCSET) then you can also disable all indices, like so:

- DISABLE_INDEX = `YES`
- GENERATE_TREEVIEW = `NO`

15.1.3 Dynamic Content

To make the HTML output more interactive, doxygen provides a number of options that are disabled by default:

- enabling HTML_DYNAMIC_SECTIONS will make doxygen hide certain content (like graphs) in the HTML by default, and let the reader expand these sections on request.
- enabling HAVE_DOT along with INTERACTIVE_SVG while setting DOT_IMAGE_FORMAT to `svg`, will make doxygen produce SVG images that will allow the user to zoom and pan (this only happens when the size of the images exceeds a certain size).

15.1.4 Header, Footer, and Stylesheet changes

To tweak things like fonts or colors, margins, or other look & feel aspects of the HTML output in detail, you can create a different `cascading style sheet`. You can also let doxygen use a custom header and footer for

each HTML page it generates, for instance to make the output conform to the style used on the rest of your web site.

To do this first run doxygen as follows:

```
doxygen -w html header.html footer.html customdoxygen.css
```

This will create 3 files:

- header.html is a HTML fragment which doxygen normally uses to start a HTML page. Note that the fragment ends with a body tag and that is contains a couple of commands of the form $word. These will be replaced by doxygen on the fly.
- footer.html is a HTML fragment which doxygen normally uses to end a HTML page. Also here special commands can be used. This file contain the link to www.doxygen.org and the body and html end tags.
- customdoxygen.css is the default cascading style sheet used by doxygen. It is recommended only to look into this file and overrule some settings you like by putting them in a separate stylesheets and referencing those extra files via HTML_EXTRA_STYLESHEET.

You should edit these files and then reference them from the configuration file.

- HTML_HEADER = `header.html`
- HTML_FOOTER = `footer.html`
- HTML_EXTRA_STYLESHEET = `my_customdoxygen.css`

Note

it is not longer recommended to use HTML_STYLESHEET, as it make it difficult to upgrade to a newer version of doxygen. Use HTML_EXTRA_STYLESHEET instead.

See the documentation of the HTML_HEADER tag for more information about the possible meta commands you can use inside your custom header.

Note

You should not put the style sheet in the HTML output directory. Treat it as a source file. Doxygen will copy it for you.

If you use images or other external content in a custom header you need to make sure these end up in the HTML output directory yourself, for instance by writing a script that runs doxygen can then copies the images to the output.

Warning

The structure of headers and footers may change after upgrading to a newer version of doxygen, so if you are using a custom header or footer, it might not produce valid output anymore after upgrading.

15.2 Changing the layout of pages

In some cases you may want to change the way the output is structured. A different style sheet or custom headers and footers do not help in such case.

The solution doxygen provides is a layout file, which you can modify and doxygen will use to control what information is presented, in which order, and to some extent also how information is presented. The layout file is an XML file.

The default layout can be generated by doxygen using the following command:

```
doxygen -l
```

optionally the name of the layout file can be specified, if omitted `DoxygenLayout.xml` will be used.

The next step is to mention the layout file in the configuration file

```
LAYOUT_FILE = DoxygenLayout.xml
```

To change the layout all you need to do is edit the layout file.

The toplevel structure of the file looks as follows:

```
<doxygenlayout version="1.0">
  <navindex>
    ...
  </navindex>
  <class>
    ...
  </class>
  <namespace>
    ...
  </namespace>
  <file>
    ...
  </file>
  <group>
    ...
  </group>
  <directory>
    ...
  </directory>
</doxygenlayout>
```

The root element of the XML file is `doxygenlayout`, it has an attribute named `version`, which will be used in the future to cope with changes that are not backward compatible.

The first section, identified by the `navindex` element, represents the layout of the navigation tabs displayed at the top of each HTML page. At the same time it also controls the items in the navigation tree in case GENERATE_TREEVIEW is enabled. Each tab is represented by a `tab` element in the XML file.

You can hide tabs by setting the `visible` attribute to `no`. You can also override the default title of a tab by specifying it as the value of the `title` attribute. If the title field is the empty string (the default) then doxygen will fill in an appropriate language specific title.

You can reorder the tabs by moving the tab elements in the XML file within the `navindex` element and even change the tree structure. Do not change the value of the `type` attribute however. Only a fixed set of types are supported, each representing a link to a specific index.

You can also add custom tabs using a type with name "user". Here is an example that shows how to add a tab with title "Google" pointing to www.google.com:

```
  <navindex>
    ...
    <tab type="user" url="http://www.google.com" title="Google"/>
    ...
  </navindex>
```

The url field can also be a relative URL. If the URL starts with @ref the link will point to a documented entities, such as a class, a function, a group, or a related page. Suppose we have defined a page using @page with label mypage, then a tab with label "My Page" to this page would look as follows:

```
  <navindex>
    ...
    <tab type="user" url="@ref mypage" title="My Page"/>
    ...
  </navindex>
```

You can also group tabs together in a custom group using a tab with type "usergroup". The following example puts the above tabs in a user defined group with title "My Group":

```
<navindex>
  ...
  <tab type="usergroup" title="My Group">
    <tab type="user" url="http://www.google.com" title="Google"/>
    <tab type="user" url="@ref mypage" title="My Page"/>
  </tab>
  ...
</navindex>
```

Groups can be nested to form a hierarchy.

By default a usergroup entry in the navigation tree is a link to a landing page with the contents of the group. You can link to a different page using the `url` attribute just like you can for the `<tab>` element and prevent any link using `url="[none]"`, i.e.

```
<tab type="usergroup" title="Group without link" url="[none]">
...
</tab>
```

The elements after `navindex` represent the layout of the different pages generated by doxygen:

- The `class` element represents the layout of all pages generated for documented classes, structs, unions, and interfaces.
- The `namespace` element represents the layout of all pages generated for documented namespaces (and also Java packages).
- The `file` element represents the layout of all pages generated for documented files.
- The `group` element represents the layout of all pages generated for documented groups (or modules).
- The `directory` element represents the layout of all pages generated for documented directories.

Each XML element within one of the above page elements represents a certain piece of information. Some pieces can appear in each type of page, others are specific for a certain type of page. Doxygen will list the pieces in the order in which they appear in the XML file.

The following generic elements are possible for each page:

`briefdescription` Represents the brief description on a page.

`detaileddescription` Represents the detailed description on a page.

`authorsection` Represents the author section of a page (only used for man pages). This is a separate section for man pages with a text like: `Generated automatically by Doxygen for My Project from the source code.` This should not be misinterpreted with the doxygen commands \author or \authors that generate an author paragraph inside a detailed description.

`memberdecl` Represents the quick overview of members on a page (member declarations). This elements has child elements per type of member list. The possible child elements are not listed in detail in the document, but the name of the element should be a good indication of the type of members that the element represents.

`memberdef` Represents the detailed member list on a page (member definition). Like the `memberdecl` element, also this element has a number of possible child elements.

The class page has the following specific elements:

`includes` Represents the include file needed to obtain the definition for this class.

`inheritancegraph` Represents the inheritance relations for a class. Note that the CLASS_GRAPH option determines if the inheritance relation is a list of base and derived classes or a graph.

`collaborationgraph` Represents the collaboration graph for a class.

allmemberslink Represents the link to the list of all members for a class.

usedfiles Represents the list of files from which documentation for the class was extracted.

The file page has the following specific elements:

includes Represents the list of #include statements contained in this file.

includegraph Represents the include dependency graph for the file.

includedbygraph Represents the included by dependency graph for the file.

sourcelink Represents the link to the source code of this file.

The group page has a specific `groupgraph` element which represents the graph showing the dependencies between groups.

Similarly, the directory page has a specific `directorygraph` element which represents the graph showing the dependencies between the directories based on the #include relations of the files inside the directories.

Some elements have a `visible` attribute which can be used to hide the fragment from the generated output, by setting the attribute's value to "no". You can also use the value of a configuration option to determine the visibility, by using its name prefixed with a dollar sign, e.g.

```
...
<includes visible="$SHOW_INCLUDE_FILES"/>
...
```

This was mainly added for backward compatibility. Note that the `visible` attribute is just a hint for doxygen. If no relevant information is available for a certain piece it is omitted even if it is set to `yes` (i.e. no empty sections are generated).

Some elements have a `title` attribute. This attribute can be used to customize the title doxygen will use as a header for the piece.

Warning

> at the moment you should not remove elements from the layout file as a way to hide information. Doing so can cause broken links in the generated output!

15.3 Using the XML output

If the above two methods still do not provide enough flexibility, you can also use the XML output produced by doxygen as a basis to generate the output you like. To do this set GENERATE_XML to `YES`.

The XML output consists of an index file named `index.xml` which lists all items extracted by doxygen with references to the other XML files for details. The structure of the index is described by a schema file `index.xsd`. All other XML files are described by the schema file named `compound.xsd`. If you prefer one big XML file you can combine the index and the other files using the XSLT file `combine.xslt`.

You can use any XML parser to parse the files or use the one that can be found in the `addon/doxmlparser` directory of doxygen's source distribution. Look at `addon/doxmlparser/doxmlparser/index.py` and `addon/doxmlparser/doxmlparser/compound.py` for the interface of the parser (it is generated by `generatedDS` and follows the XML schema files `index.xsd` and `compound.xsd` found in `templates/xml`). Look in `addon/doxmlparser/examples` for examples.

The advantage of using the doxmlparser is that it allows you to only read the index file into memory and then only those XML files that you implicitly load via navigating through the index. As a result this works even for very large projects where reading all XML files as one big DOM tree would not fit into memory.

See `the Breathe project` for an example that uses doxygen XML output from Python to bridge it with the `Sphinx` document generator.

Chapter 16

Custom commands

16.1 Simple aliases 83
16.2 Aliases with arguments 83
16.3 Nesting custom command 84

Doxygen provides a large number of special commands, XML commands, and HTML commands. that can be used to enhance or structure the documentation inside a comment block. If you for some reason have a need to define new commands you can do so by means of an *alias* definition.

The definition of an alias should be specified in the configuration file using the ALIASES configuration tag.

16.1 Simple aliases

The simplest form of an alias is a simple substitution of the form

```
name=value
```

For example defining the following alias:

```
ALIASES += sideeffect="\par Side Effects:^^"
```

will allow you to put the command `\sideeffect` (or `@sideeffect`) in the documentation, which will result in a user-defined paragraph with heading **Side Effects:**.

Note that you cannot put `\n`'s in the value part of an alias to insert newlines (in the resulting output). You can put `^^` in the value part of an alias to insert a newline as if a physical newline was in the original file.

Note when you need a literal `{` or `}` or `,` in the value part of an alias you have to escape them by means of a backslash (`\`), this can lead to conflicts with the commands `\{` and `\}` for these it is advised to use the version `@{` and `@}` or use a double escape (`\\{` and `\\}`)

Also note that you can redefine existing special commands if you wish.

Some commands, such as \xrefitem are designed to be used in combination with aliases.

16.2 Aliases with arguments

Aliases can also have one or more arguments. In the alias definition you then need to specify the number of arguments between curly braces. In the value part of the definition you can place `\x` markers, where '`x`' represents the argument number starting with 1.

Here is an example of an alias definition with a single argument:

```
ALIASES += l{1}="\ref \1"
```

Inside a comment block you can use it as follows

```
/** See \l{SomeClass} for more information. */
```

which would be the same as writing

```
/** See \ref SomeClass for more information. */
```

Note that you can overload an alias by a version with multiple arguments, for instance:

```
ALIASES += l{1}="\ref \1"
ALIASES += l{2}="\ref \1 \"\2\""
```

Note that the quotes inside the alias definition have to be escaped with a backslash.

With these alias definitions, we can write

```
/** See \l{SomeClass,Some Text} for more information. */
```

inside the comment block and it will expand to

```
/** See \ref SomeClass "Some Text" for more information. */
```

where the command with a single argument would still work as shown before.

Aliases can also be expressed in terms of other aliases, e.g. a new command `\reminder` can be expressed as a \xrefitem via an intermediate `\xreflist` command as follows:

```
ALIASES += xreflist{3}="\xrefitem \1 \"\2\" \"\3\" "
ALIASES += reminder="\xreflist{reminders,Reminder,Reminders}"
```

Note that if for aliases with more than one argument a comma is used as a separator, if you want to put a comma inside the command, you will need to escape it with a backslash, i.e.

```
\l{SomeClass,Some text\, with an escaped comma}
```

given the alias definition of `\l` in the example above.

16.3 Nesting custom command

You can use commands as arguments of aliases, including commands defined using aliases.

As an example consider the following alias definitions

```
ALIASES += Bold{1}="<b>\1</b>"
ALIASES += Emph{1}="<em>\1</em>"
```

Inside a comment block you can now use:

```
/** This is a \Bold{bold \Emph{and} Emphasized} text fragment. */
```

which will expand to

```
/** This is a <b>bold <em>and</em> Emphasized</b> text fragment. */
```

Chapter 17

Linking to external documentation

If your project depends on external libraries or tools, there are several reasons to not include all sources for these with every run of doxygen:

Disk space: Some documentation may be available outside of the output directory of doxygen already, for instance somewhere on the web. You may want to link to these pages instead of generating the documentation in your local output directory.

Compilation speed: External projects typically have a different update frequency from your own project. It does not make much sense to let doxygen parse the sources for these external project over and over again, even if nothing has changed.

Memory: For very large source trees, letting doxygen parse all sources may simply take too much of your system's memory. By dividing the sources into several "packages", the sources of one package can be parsed by doxygen, while all other packages that this package depends on, are linked in externally. This saves a lot of memory.

Availability: For some projects that are documented with doxygen, the sources may just not be available.

Copyright issues: If the external package and its documentation are copyright someone else, it may be better - or even necessary - to reference it rather than include a copy of it with your project's documentation. When the author forbids redistribution, this is necessary. If the author requires compliance with some license condition as a precondition of redistribution, and you do not want to be bound by those conditions, referring to their copy of their documentation is preferable to including a copy.

If any of the above apply, you can use doxygen's tag file mechanism. A tag file is basically a compact representation of the entities found in the external sources. Doxygen can both generate and read tag files.

To generate a tag file for your project, simply put the name of the tag file after the GENERATE_TAGFILE option in the configuration file.

To combine the output of one or more external projects with your own project you should specify the name of the tag files after the TAGFILES option in the configuration file.

A tag file typically only contains a relative location of the documentation from the point where doxygen was run. So when you include a tag file in other project you have to specify where the external documentation is located in relation this project. You can do this in the configuration file by assigning the (relative) location to the tag files specified after the TAGFILES configuration option. If you use a relative path it should be relative with respect to the directory where the HTML output of your project is generated; so a relative path from the HTML output directory of a project to the HTML output of the other project that is linked to.

Example:

Suppose you have a project `proj` that uses two external projects called `ext1` and `ext2`. The directory structure looks as follows:

```
<root>
  +- proj
  |   +- html              HTML output directory for proj
  |   +- src               sources for proj
  |   |- proj.cpp
  +- ext1
  |   +- html              HTML output directory for ext1
  |   |- ext1.tag          tag file for ext1
  +- ext2
  |   +- html              HTML output directory for ext2
  |   |- ext2.tag          tag file for ext2
  |- proj.cfg              doxygen configuration file for proj
  |- ext1.cfg              doxygen configuration file for ext1
  |- ext2.cfg              doxygen configuration file for ext2
```

Then the relevant parts of the configuration files look as follows:

proj.cfg:

```
OUTPUT_DIRECTORY  = proj
INPUT             = proj/src
TAGFILES          = ext1/ext1.tag=../../ext1/html \
                    ext2/ext2.tag=../../ext2/html
```

ext1.cfg:

```
OUTPUT_DIRECTORY  = ext1
GENERATE_TAGFILE  = ext1/ext1.tag
```

ext2.cfg:

```
OUTPUT_DIRECTORY  = ext2
GENERATE_TAGFILE  = ext2/ext2.tag
```

Chapter 18

Frequently Asked Questions

18.1 How to get information on the index page in HTML? . . . 87
18.2 Help, some/all of the members of my class / file / namespace are not documented? . . . 87
18.3 When I set EXTRACT_ALL to NO none of my functions are shown in the documentation. . . . 88
18.4 My file with a custom extension is not parsed (properly) (anymore). . . . 88
18.5 How can I make doxygen ignore some code fragment? . . . 88
18.6 How can I change what is after the #include in the class documentation? . . . 88
18.7 How can I use tag files in combination with compressed HTML? . . . 89
18.8 I don't like the quick index that is put above each HTML page, what do I do? . . . 89
18.9 The overall HTML output looks different, while I only wanted to use my own html header file . . . 89
18.10 Why does doxygen use Qt? . . . 89
18.11 How can I exclude all test directories from my directory tree? . . . 90
18.12 Doxygen automatically generates a link to the class MyClass somewhere in the running text. How do I prevent that at a certain place? . . . 90
18.13 My favorite programming language is X. Can I still use doxygen? . . . 90
18.14 Help! I get the cryptic message "input buffer overflow, can't enlarge buffer because scanner uses REJECT" . . . 90
18.15 When running make in the latex directory I get "TeX capacity exceeded". Now what? . . . 90
18.16 Why are dependencies via STL classes not shown in the dot graphs? . . . 91
18.17 I have problems getting the search engine to work with PHP5 and/or windows . . . 91
18.18 Can I configure doxygen from the command line? . . . 91
18.19 How did doxygen get its name? . . . 91
18.20 What was the reason to develop doxygen? . . . 91
18.21 How to prevent interleaved output . . . 92

18.1 How to get information on the index page in HTML?

You should use the \mainpage command inside a comment block like this:

```
/*! \mainpage My Personal Index Page
 *
 * \section intro_sec Introduction
 *
```

```
* This is the introduction.
*
* \section install_sec Installation
*
* \subsection step1 Step 1: Opening the box
*
* etc...
*/
```

18.2 Help, some/all of the members of my class / file / namespace are not documented?

Check the following:

1. Is your class / file / namespace documented? If not, it will not be extracted from the sources unless EXTRACT_ALL is set to `YES` in the configuration file.
2. Are the members private? If so, you must set EXTRACT_PRIVATE to `YES` to make them appear in the documentation.
3. Is there a function macro in your class that does not end with a semicolon (e.g. MY_MACRO())? If so then you have to instruct doxygen's preprocessor to remove it.

   This typically boils down to the following settings in the configuration file:

   ```
   ENABLE_PREPROCESSING   = YES
   MACRO_EXPANSION        = YES
   EXPAND_ONLY_PREDEF     = YES
   PREDEFINED             = MY_MACRO()=
   ```

   Please read the preprocessing section of the manual for more information.

18.3 When I set EXTRACT_ALL to NO none of my functions are shown in the documentation.

In order for global functions, variables, enums, typedefs, and defines to be documented you should document the file in which these commands are located using a comment block containing a \file (or @file) command.

Alternatively, you can put all members in a group (or module) using the \ingroup command and then document the group using a comment block containing the \defgroup command.

For member functions or functions that are part of a namespace you should document either the class or namespace.

18.4 My file with a custom extension is not parsed (properly) (anymore).

Doxygen only parses files that are specified as input (via the INPUT tag) and that match a specified extension (mentioned in FILE_PATTERNS) The list of files is then reduced by excluding files listed as EXCLUDE or files that match the patterns set by EXCLUDE_PATTERNS.

In the past doxygen parsed all files with an unknown extension as C files which could lead to undesired results. Since version 1.8.8, doxygen requires that you specify a mapping that tells for a certain file extension, which parser to use. This mapping is specified using the EXTENSION_MAPPING tag. If no mapping is specified the file's contents will be ignored.

18.5 How can I make doxygen ignore some code fragment?

The new and easiest way is to add one comment block with a \cond command at the start and one comment block with a \endcond command at the end of the piece of code that should be ignored. This should be within the same file of course.

But you can also use doxygen's preprocessor for this: If you put

```
#ifndef DOXYGEN_SHOULD_SKIP_THIS

 /* code that must be skipped by doxygen */

#endif /* DOXYGEN_SHOULD_SKIP_THIS */
```

around the blocks that should be hidden and put:

```
  PREDEFINED = DOXYGEN_SHOULD_SKIP_THIS
```

in the configuration file then all blocks should be skipped by doxygen as long as ENABLE_PREPROCESSING is set to `YES`.

18.6 How can I change what is after the #include in the class documentation?

In most cases you can use STRIP_FROM_INC_PATH to strip a user defined part of a path.

You can also document your class as follows

```
/*! \class MyClassName include.h path/include.h
 *
 *  Docs for MyClassName
 */
```

To make doxygen put

```
#include <path/include.h>
```

in the documentation of the class MyClassName regardless of the name of the actual header file in which the definition of MyClassName is contained.

If you want doxygen to show that the include file should be included using quotes instead of angle brackets you should type:

```
/*! \class MyClassName myhdr.h "path/myhdr.h"
 *
 *  Docs for MyClassName
 */
```

18.7 How can I use tag files in combination with compressed HTML?

If you want to refer from one compressed HTML file `a.chm` to another compressed HTML file called `b.chm`, the link in `a.chm` must have the following format:

```
<a href="b.chm::/file.html">
```

Unfortunately this only works if both compressed HTML files are in the same directory.

As a result you must rename the generated `index.chm` files for all projects into something unique and put all `.chm` files in one directory.

Suppose you have a project *a* referring to a project *b* using tag file `b.tag`, then you could rename the `index.chm` for project *a* into `a.chm` and the `index.chm` for project *b* into `b.chm`. In the configuration file for project *a* you write:

```
TAGFILES = b.tag=b.chm::
```

18.8 I don't like the quick index that is put above each HTML page, what do I do?

You can disable the index by setting DISABLE_INDEX to `YES`. Then you can put in your own header file by writing your own header and feed that to HTML_HEADER.

18.9 The overall HTML output looks different, while I only wanted to use my own html header file

You probably forgot to include the stylesheet `doxygen.css` that doxygen generates. You can include this by putting

```
<LINK HREF="doxygen.css" REL="stylesheet" TYPE="text/css">
```

in the HEAD section of the HTML page.

18.10 Why does doxygen use Qt?

In the past (prior to version 1.9.2) doxygen used a part of Qt 2.x for various utility classes. These have been replaced by STL container classes in the meantime.

The GUI front-end called Doxywizard is based on a modern version of Qt. Doxygen itself can also be used without the GUI.

18.11 How can I exclude all test directories from my directory tree?

Simply put an exclude pattern like this in the configuration file:

```
EXCLUDE_PATTERNS = */test/*
```

18.12 Doxygen automatically generates a link to the class MyClass somewhere in the running text. How do I prevent that at a certain place?

Put a % in front of the class name. Like this: %MyClass. Doxygen will then remove the % and keep the word unlinked.

18.13 My favorite programming language is X. Can I still use doxygen?

No, not as such; doxygen needs to understand the structure of what it reads. If you don't mind spending some time on it, there are several options:

- If the grammar of X is close to C or C++, then it is probably not too hard to tweak `src/scanner.l` a bit so the language is supported. This is done for all other languages directly supported by doxygen (i.e. Java, IDL, C#, PHP).

- If the grammar of X is somewhat different than you can write an input filter that translates X into something similar enough to C/C++ for doxygen to understand (this approach is taken for VB, Object Pascal, and Java↩ Script, see https://www.doxygen.org/download.html#helpers).
- If the grammar is completely different one could write a parser for X and write a backend that produces a similar syntax tree as is done by src/scanner.l (and also by src/tagreader.cpp while reading tag files).

18.14 Help! I get the cryptic message "input buffer overflow, can't enlarge buffer because scanner uses REJECT"

This error happens when doxygen's lexical scanner has a rule that matches more than 256K of input characters in one go. I've seen this happening on a very large generated file (>256K lines), where the built-in preprocessor converted it into an empty file (with >256K of newlines). Another case where this might happen is if you have lines in your code with more than 256K characters.

If you have run into such a case and want me to fix it, you should send me a code fragment that triggers the message. To work around the problem, put some line-breaks into your file, split it up into smaller parts, or exclude it from the input using EXCLUDE.

Another way to work around this problem is to use the cmake command with the option:
-Denlarge_lex_buffers=<size>

where <size> is the new size of the input (YY_BUF_SIZE) and read (YY_READ_BUF_SIZE) buffer. In case this option is not given the default value of 262144 (i.e. 256K) will be used.

18.15 When running make in the latex directory I get "TeX capacity exceeded". Now what?

You can edit the texmf.cfg file to increase the default values of the various buffers and then run "texconfig init".

18.16 Why are dependencies via STL classes not shown in the dot graphs?

Doxygen is unaware of the STL classes, unless the option BUILTIN_STL_SUPPORT is turned on.

18.17 I have problems getting the search engine to work with PHP5 and/or windows

Please read this for hints on where to look.

18.18 Can I configure doxygen from the command line?

Not via command line options, but doxygen can read from stdin, so you can pipe things through it. Here's an example how to override an option in a configuration file from the command line (assuming a UNIX like environment):

```
( cat Doxyfile ; echo "PROJECT_NUMBER=1.0" ) | doxygen -
```

For Windows command line the following would do the same:

```
( type Doxyfile & echo PROJECT_NUMBER=1.0 ) | doxygen.exe -
```

For Windows Powershell (checked with version 5.1) the following would do the same:

```
&{ type Doxyfile ; echo "PROJECT_NUMBER=1.0" } | doxygen -
```

If multiple options with the same name are specified then doxygen will use the last one. To append to an existing option you can use the += operator.

18.19 How did doxygen get its name?

Doxygen got its name from playing with the words documentation and generator.

```
documentation -> docs -> dox
generator -> gen
```

At the time I was looking into `lex` and `yacc`, where a lot of things start with "yy", so the "y" slipped in and made things pronounceable (the proper pronouncement is Docs-ee-gen, so with a long "e").

18.20 What was the reason to develop doxygen?

I once wrote a GUI widget based on the Qt library (it is still available at https://sourceforge.net/projects/qdbttabular/ but hasn't been updated since 2002). Qt had nicely generated documentation (using an internal tool which they didn't want to release) and I wrote similar docs by hand. This was a nightmare to maintain, so I wanted a similar tool. I looked at Doc++ but that just wasn't good enough (it didn't support signals and slots and did not have the Qt look and feel I had grown to like), so I started to write my own tool...

18.21 How to prevent interleaved output

When redirecting all the console output of doxygen, i.e. messages and warnings, this can be interleaved or in a non-expected order. The, technical, reason for this is that the `stdout` can be buffered. It is possible to overcome this by means of the `-b` of doxygen, like e.g `doxygen -b > out.txt 2>&1`. Note this might cost a little more time though.

Chapter 19

Troubleshooting

19.1 Known Problems

- Doxygen is *not* a real compiler, it is only a lexical scanner. This means that it can and will not detect errors in your source code.
- Doxygen has a built-in preprocessor, but this works slightly different than the C preprocessor. Doxygen assumes a header file is properly guarded against multiple inclusion, and that each include file is standalone (i.e. it could be placed at the top of a source file without causing compiler errors). As long as this is true (and this is a good design practice) you should not encounter problems.
- Since it is impossible to test all possible code fragments, it is very well possible, that some valid piece of C/↩ C++ code is not handled properly. If you find such a piece, please send it to me, so I can improve doxygen's parsing capabilities. Try to make the piece of code you send as small as possible, to help me narrow down the search.
- Doxygen does not work properly if there are multiple classes, structs or unions with the same name in your code. It should not crash however, rather it should ignore all of the classes with the same name except one.
- Some commands do not work inside the arguments of other commands. Inside a HTML link (i.↩ e. <A HREF="...">...</A>) for instance other commands (including other HTML commands) do not work! The sectioning commands are an important exception.
- Redundant braces can confuse doxygen in some cases. For example:

  ```
  void f (int);
  ```

  is properly parsed as a function declaration, but

  ```
  const int (a);
  ```

  is also seen as a function declaration with name `int`, because only the syntax is analyzed, not the semantics. If the redundant braces can be detected, as in

  ```
  int *(a[20]);
  ```

  then doxygen will remove the braces and correctly parse the result.
- Not all names in code fragments that are included in the documentation are replaced by links (for instance when using SOURCE_BROWSER = `YES`) and links to overloaded members may point to the wrong member. This also holds for the "Referenced by" list that is generated for each function.

  For a part this is because the code parser isn't smart enough at the moment. I'll try to improve this in the future. But even with these improvements not everything can be properly linked to the corresponding documentation, because of possible ambiguities or lack of information about the context in which the code fragment is found.

- It is not possible to insert a non-member function f in a class A using the \relates or \relatesalso command, if class A already has a member with name f and the same argument list.

- There is only very limited support for member specialization at the moment. It only works if there is a specialized template class as well.
- Not all special commands are properly translated to RTF.
- Version 1.8.6 of dot (and maybe earlier versions too) do not generate proper map files, causing the graphs that doxygen generates not to be properly clickable.
- PHP only: Doxygen requires that all PHP statements (i.e. code) is wrapped in a functions/methods, otherwise you may run into parse problems.

19.2 How to Help

The development of doxygen highly depends on your input!

If you are trying doxygen let me know what you think of it (do you miss certain features?). Even if you decide not to use it, please let me know why.

19.3 How to report a bug

Bugs are tracked in GitHub's issue tracker. Before submitting a new bug, first search through the database if the same bug has already been submitted by others. If you believe you have found a new bug, please report it.

If you are unsure whether or not something is a bug, please ask help first (subscription is required) on the users mailing list or at Stack Overflow using the `doxygen` label.

If you send only a (vague) description of a bug, you are usually not very helpful and it will cost me much more time to figure out what you mean. In the worst-case your bug report may even be completely ignored by me, so always try to include the following information in your bug report:

- The version of doxygen you are using (for instance 1.5.3, use `doxygen --version` if you are not sure or `doxygen --Version` for a bit more information).
- The name and version number of your operating system (for instance Ubuntu Linux 18.04 LTS)
- It is usually a good idea to send along the configuration file as well, but please use doxygen with the `-s` flag while generating it to keep it small (use `doxygen -s -u [configName]` to strip the comments from an existing configuration file).
- The easiest (and often the only) way for me to fix bugs is if you can attach a small example demonstrating the problem you have to the bug report, so I can reproduce it on my machine. Please make sure the example is valid source code (could potentially compile) and that the problem is really captured by the example (I often get examples that do not trigger the actual bug!). If you intend to send more than one file please zip or tar the files together into a single file for easier processing. Note that when reporting a new bug you'll get a chance to attach a file to it only *after* submitting the initial bug description.

You can (and are encouraged to) add a patch for a bug. If you do so please use PATCH as a keyword in the bug entry form.

If you have ideas how to fix existing bugs and limitations please discuss them on the developers mailing list (subscription required). Patches can also be sent directly to doxygen@gmail.com if you prefer not to send them via the bug tracker or mailing list.

For patches please use "diff -uN" or include the files you modified. If you send more than one file please tar or zip everything, so I only have to save and download one file.

Part II

Reference Manual

Chapter 20

Features

- Requires very little overhead from the writer of the documentation. Plain text will do, Markdown is support, and for more fancy or structured output HTML tags and/or some of doxygen's special commands can be used.
- Cross platform: works on Windows and many Unix flavors (including Linux and MacOSX).
- Indexes, organizes and generates browsable and cross-referenced output even from undocumented code.
- Generates structured XML output for parsed sources, which can be used by external tools.
- Supports C/C++, Lex, Java, (Corba and Microsoft) Java, Python, VHDL, PHP IDL, C#, Fortran, Objective-C 2.0, and to some extent D sources.
- Supports documentation of files, namespaces, packages, classes, structs, unions, templates, variables, functions, typedefs, enums and defines.
- Javadoc (1.1), qdoc3 (partially), and ECMA-334 (C# spec.) compatible.
- Comes with a GUI frontend (Doxywizard) to ease editing the options and run doxygen. The GUI is available on Windows, Linux, and MacOSX.
- Automatically generates class and collaboration diagrams in HTML (as clickable image maps) and LaTeX (as Encapsulated PostScript images).
- Uses the `dot` tool of the Graphviz tool kit to generate include dependency graphs, collaboration diagrams, call graphs, directory structure graphs, and graphical class hierarchy graphs.
- Allows grouping of entities in modules and creating a hierarchy of modules.
- Flexible comment placement: Allows you to put documentation in the header file (before the declaration of an entity), source file (before the definition of an entity) or in a separate file.
- Generates a list of all members of a class (including any inherited members) along with their protection level.
- Outputs documentation in on-line format (XHTML and UNIX man page) and off-line format (LaTeX and RTF) simultaneously (any of these can be disabled if desired). All formats are optimized for ease of reading. Furthermore, compressed HTML can be generated from HTML output using Microsoft's HTML Help Workshop (Windows only) and PDF can be generated from the LaTeX output.
- Support for various third party help formats including HTML Help, docsets, Qt-Help, and eclipse help.
- Includes a full C preprocessor to allow proper parsing of conditional code fragments and to allow expansion of all or part of macros definitions.
- Automatically detects public, protected and private sections, as well as the Qt specific signal and slots sections. Extraction of private class members is optional.
- Automatically generates references to documented classes, files, namespaces and members. Documentation of global functions, global variables, typedefs, defines and enumerations is also supported.

- References to base/super classes and inherited/overridden members are generated automatically.
- Includes a fast, rank based search engine to search for strings or words in the class and member documentation (PHP based).
- Includes an JavaScript based live search feature to search for symbols as you type (for small to medium sized projects).
- You can type normal HTML tags in your documentation. Doxygen will convert them to their equivalent LaTeX, RTF, and man-page counterparts automatically.
- Allows references to documentation generated for other (doxygen documented) projects (or another part of the same project) in a location independent way.
- Allows inclusion of source code examples that are automatically cross-referenced with the documentation.
- Inclusion of undocumented classes is also supported, allowing to quickly learn the structure and interfaces of a (large) piece of code without looking into the implementation details.
- Allows automatic cross-referencing of (documented) entities with their definition in the source code.
- All source code fragments are syntax highlighted for ease of reading.
- Allows inclusion of function/member/class definitions in the documentation.
- All options are read from an easy to edit and (optionally) annotated configuration file.
- Documentation and search engine can be transferred to another location or machine without regenerating the documentation.
- Supports many different character encodings and uses UTF-8 internally and for the generated output.
- Doxygen can generate a layout which you can use and edit to change the layout of each page.
- There more than a 100 configurable options to fine-tune the output.
- Can cope with large projects easily.

Although doxygen can now be used in any project written in a language that is supported by doxygen, initially it was specifically designed to be used for projects that make use of Qt Software's `Qt toolkit`. I have tried to make doxygen 'Qt-compatible'. That is: Doxygen can read the documentation contained in the Qt source code and create a class browser that looks quite similar to the one that is generated by Qt Software. Doxygen understands the C++ extensions used by Qt such as signals and slots and many of the markup commands used in the Qt sources.

Doxygen can also automatically generate links to existing documentation that was generated with doxygen or with Qt's non-public class browser generator. For a Qt based project this means that whenever you refer to members or classes belonging to the Qt toolkit, a link will be generated to the Qt documentation. This is done independent of where this documentation is located!

Chapter 21

Doxygen usage

Doxygen is a command line based utility. Calling `doxygen` with the `--help` option at the command line will give you a brief description of the usage of the program.

All options consist of a leading character `-`, followed by one character and one or more arguments depending on the option.

To generate a manual for your project you typically need to follow these steps:

1. You document your source code with special documentation blocks (see section Special comment blocks).
2. You generate a configuration file (see section Configuration) by calling doxygen with the `-g` option:

   ```
   doxygen -g <config_file>
   ```

3. You edit the configuration file so it matches your project. In the configuration file you can specify the input files and a lot of optional information.
4. You let doxygen generate the documentation, based on the settings in the configuration file:

   ```
   doxygen <config_file>
   ```

If you have a configuration file generated with an older version of doxygen, you can upgrade it to the current version by running doxygen with the -u option.

```
doxygen -u <config_file>
```

All configuration settings in the original configuration file will be copied to the new configuration file. Any new options will have their default value. Note that comments that you may have added in the original configuration file will be lost.

21.1 Fine-tuning the output

If you want to fine-tune the way the output looks, doxygen allows you generate default style sheet, header, and footer files that you can edit afterwards:

- For HTML output, you can generate the default header file (see HTML_HEADER), the default footer (see HTML_FOOTER), and the default style sheet (see HTML_STYLESHEET), using the following command:

  ```
  doxygen -w html header.html footer.html stylesheet.css <config_file>
  ```

  The `config_file` is optional. When omitted doxygen will search for a file named `Doxyfile` and process that. When this is also not found it will used the default settings.

- For LaTeX output, you can generate the first and last part of `refman.tex` (see LATEX_HEADER and LATEX_FOOTER) and the style sheet included by that header (normally `doxygen.sty`), using the following command:

  ```
  doxygen -w latex header.tex footer.tex doxygen.sty <config_file>
  ```

If you need non-default options (for instance to use extra LaTeX packages) you need to make a configuration file with those options set correctly and then specify that configuration file after the generated files (make a backup of the configuration file first so you don't loose it in case you forget to specify one of the output files).

- For RTF output, you can generate the default style sheet file (see RTF_STYLESHEET_FILE) using:

```
doxygen -w rtf rtfstyle.cfg
```

Warning

When using a custom header you are responsible for the proper inclusion of any scripts and style sheets that doxygen needs, which is dependent on the configuration options and may changes when upgrading to a new doxygen release.

Note

- If you do not want documentation for each item inside the configuration file then you can use the optional `-s` option. This can use be used in combination with the `-u` option, to add or strip the documentation from an existing configuration file. Please use the `-s` option if you send me a configuration file as part of a bug report!
- To make doxygen read/write to standard input/output instead of from/to a file, use `-` for the file name.

Chapter 22

Doxywizard usage

Doxywizard is a GUI front-end for configuring and running doxygen.

When starting doxywizard one can specify an existing configuration file to use as argument, otherwise the default settings will be used as a starting point.

When you start doxywizard it will display the main window (the actual look depends on the platform used).

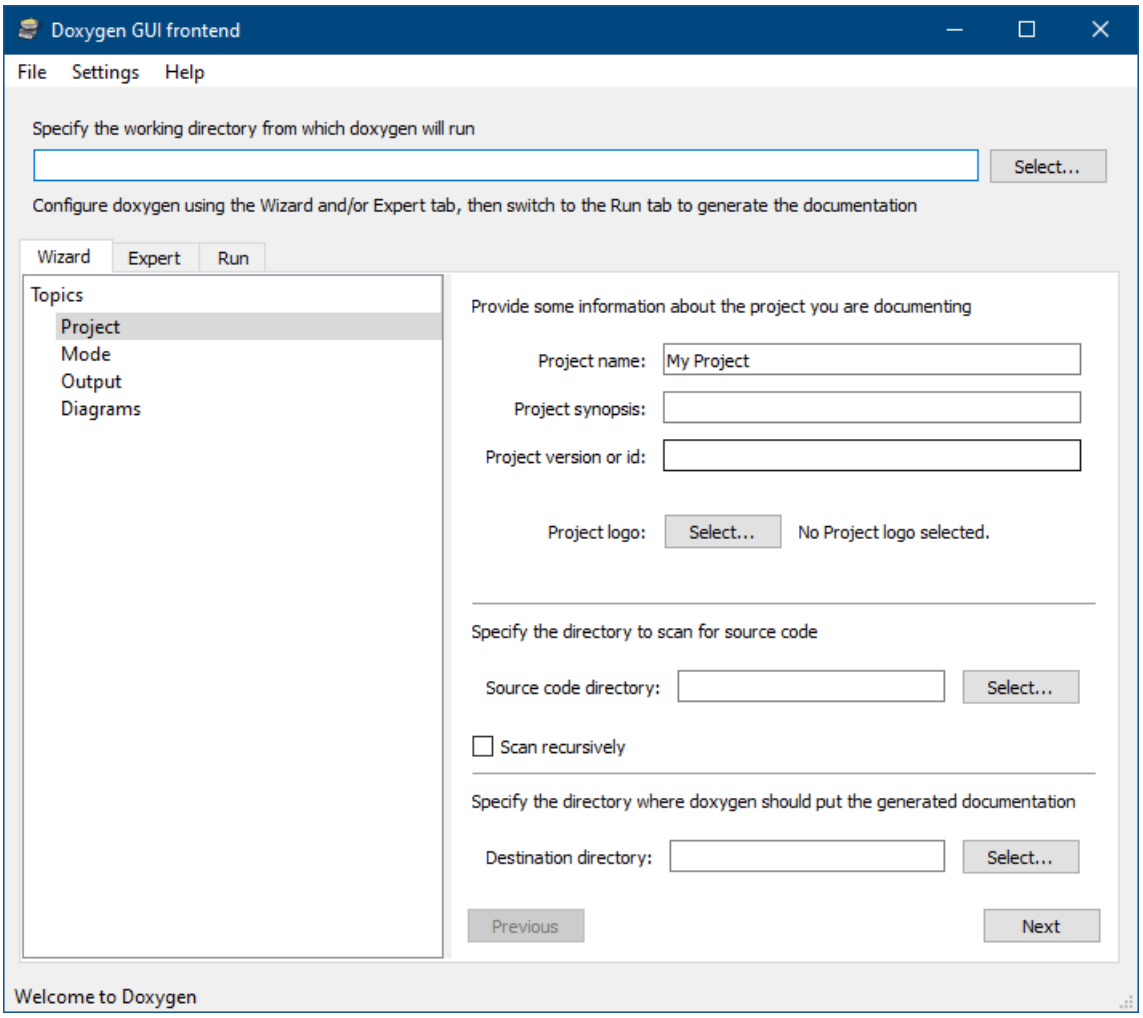


Figure 22.1: Main window

The user interface consists of the following sections:

Menu options In the menu bar the following parts are available: File menu, Settings menu and Help menu.

Specify the working directory from which doxygen will run Using the `Select...` button a directory can be selected. When doxywizard is started with a configuration file or one is loaded using the open command (see: File menu) the directory of this settings file used as the working directory.

Configure doxygen using the Wizard and/or Expert tab...

Wizard tab with this tab it is possible to quickly configure the most important settings and leave the rest of the options to their defaults.

Expert tab with this tab one gains access to the full set of configuration options.

Run tab with this tab it is possible to run doxygen and view the used settings.

Switching between these tabs is possible, e.g you could start with the wizard tab and then fine tune some settings by switching to the expert tab.

After doxygen is configured you need to save (see: File menu) the configuration as a file to disk. This allows doxygen to use the configuration and also allows running doxygen again with the same settings at a later point in time.

Since some configuration options may use relative paths, be sure to select a working directory that is root of those paths. This is often the root of the source tree and will typically be correctly filled in if the configuration file is stored at this location as well.

Once the configuration file is saved and the working directory is set, you can run doxygen based on the selected settings. Do this by switching to the Run tab, and click the "Run doxygen" button.

Once doxygen runs you can cancel it by clicking the same button again. The output produced by doxygen is captured and shown in the "Output produced by doxygen" pane. Once doxygen finishes, the log can be saved as a text file.

22.1 Wizard tab

The Wizard tab is divided into two panes

Left pane The main topics for easy setting up doxygen. By clicking on a topic the corresponding settings will appear in the Right pane.

Right pane The wizard's settings pane, in this pane you will find the settings that are available for the selected topic.

The wizard only gives the possibility to quickly setup doxygen, for full control one should use the Expert tab.

22.1.1 Project settings

The fields in the Project pane speak for themselves. Once doxygen has finished the Destination directory is where to look for the results. Doxygen will put each output format in a separate sub-directory by default.

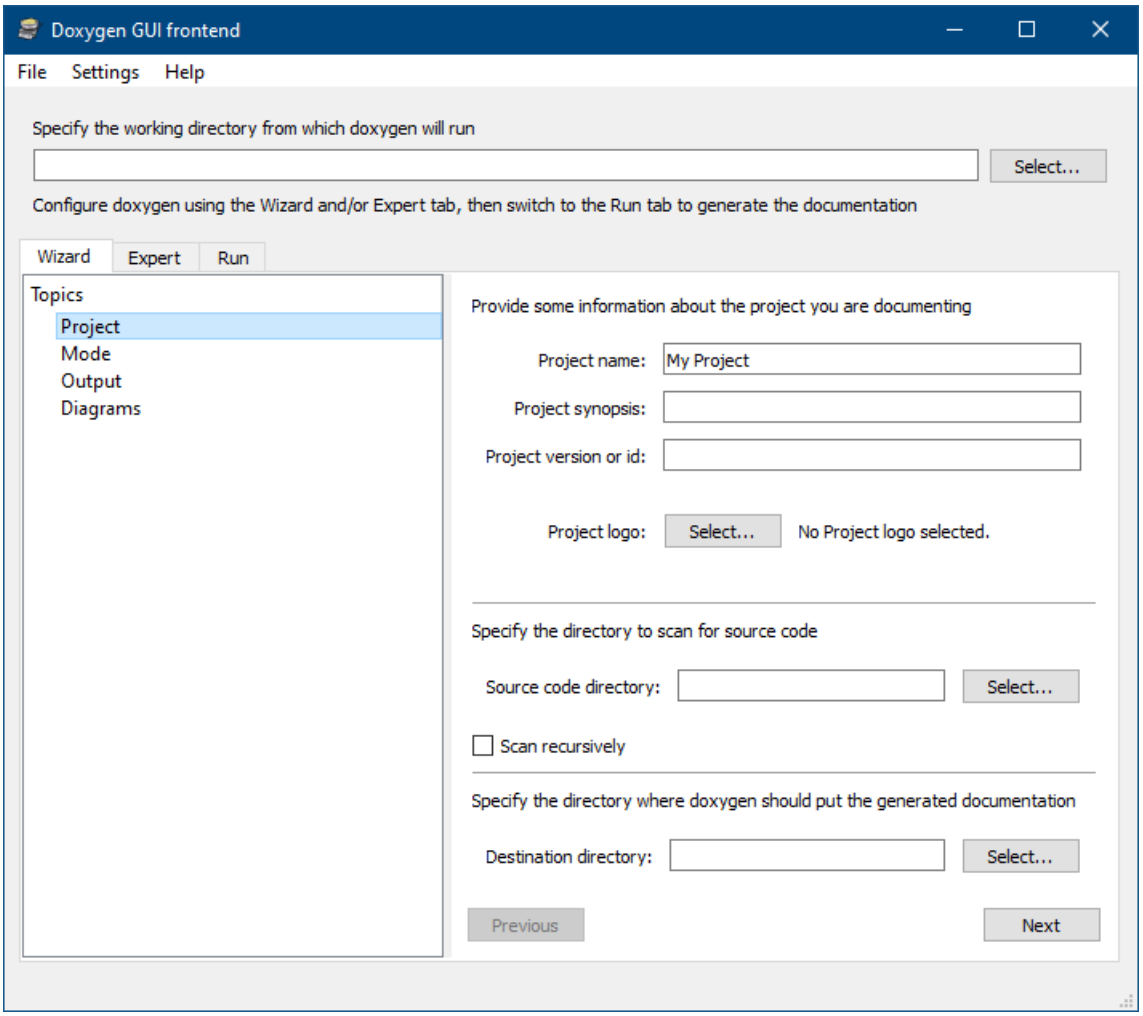


Figure 22.2: Wizard tab: Project settings

22.1.2 Mode of operating

The Mode pane allows you to select how doxygen will look at your sources. The default is to only look for things that have been documented. Furthermore, the terminology used in the output can be changed to better match the main programming language used (this doesn't affect the way doxygen parses your source code).

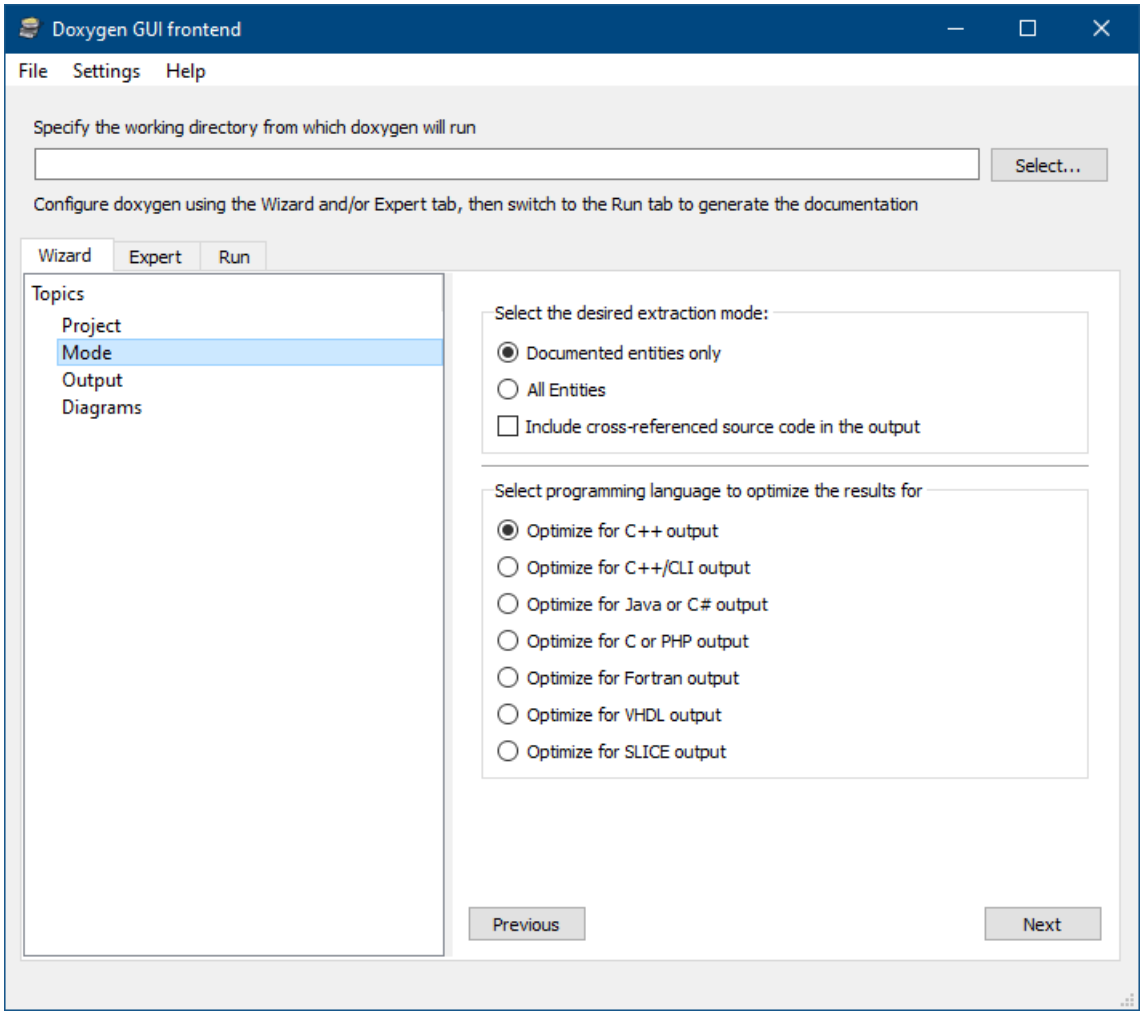


Figure 22.3: Wizard tab: Mode of operating

22.1.3 Output to produce

The Output pane allows you to select what kinds of output doxygen will produce. For HTML and LaTeX there are additional options available.

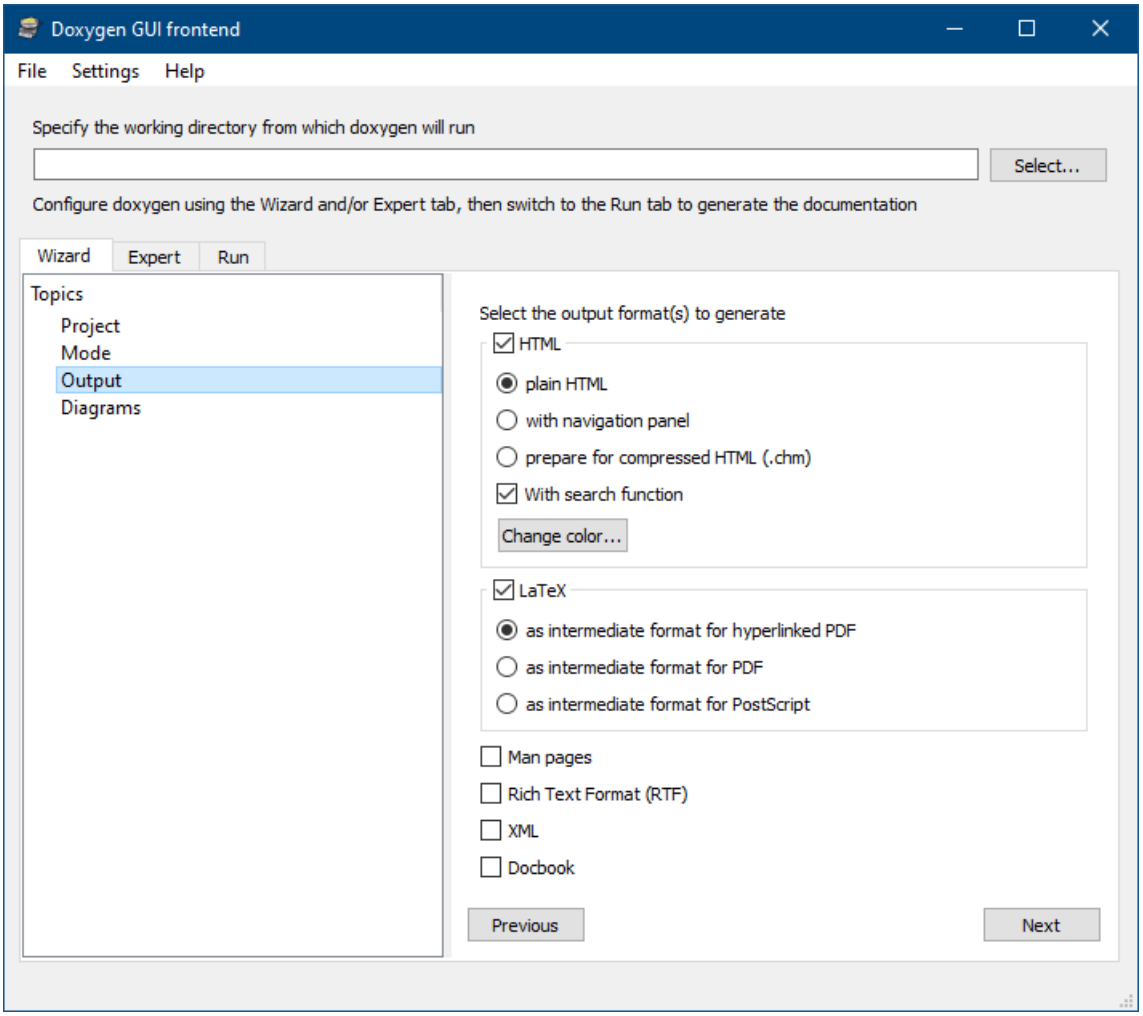


Figure 22.4: Wizard tab: Output to produce

22.1.4 Diagrams to generate

Doxygen can produce a number of diagrams. Using the Diagrams pane you can select which ones to generate. For most diagrams the `dot` tool of the `GraphViz` package is needed. This needs to be installed separately.

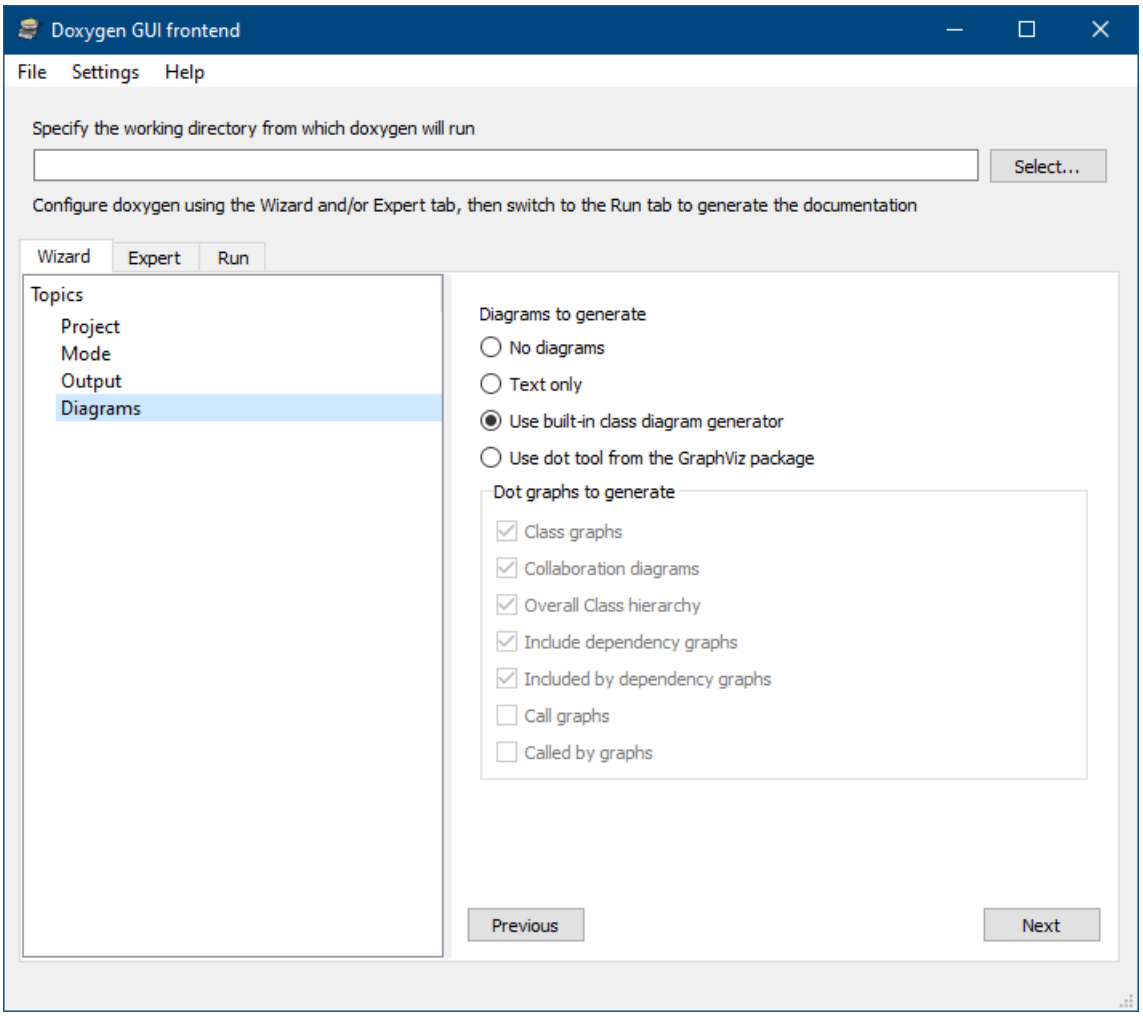


Figure 22.5: Wizard tab: Diagrams to generate

22.2 Expert tab

The Expert tab is divided into a number of panes:

Top left pane The Topics pane (i.e. sections in the configuration file) that are available. By clicking on a topic the corresponding settings will appear in the Right pane.

Bottom left pane The help pane, this will be updated when one hovers over the name of a setting in the Right pane.

Right pane The Settings pane, in this pane you will find the settings that are available for the selected topic. In case the name for a setting is colored red, the setting has a non-default value. In case a setting is grayed out, the setting is depending on another setting that is disabled. Which setting it depends on is indicated in the help pane on the bottom left.

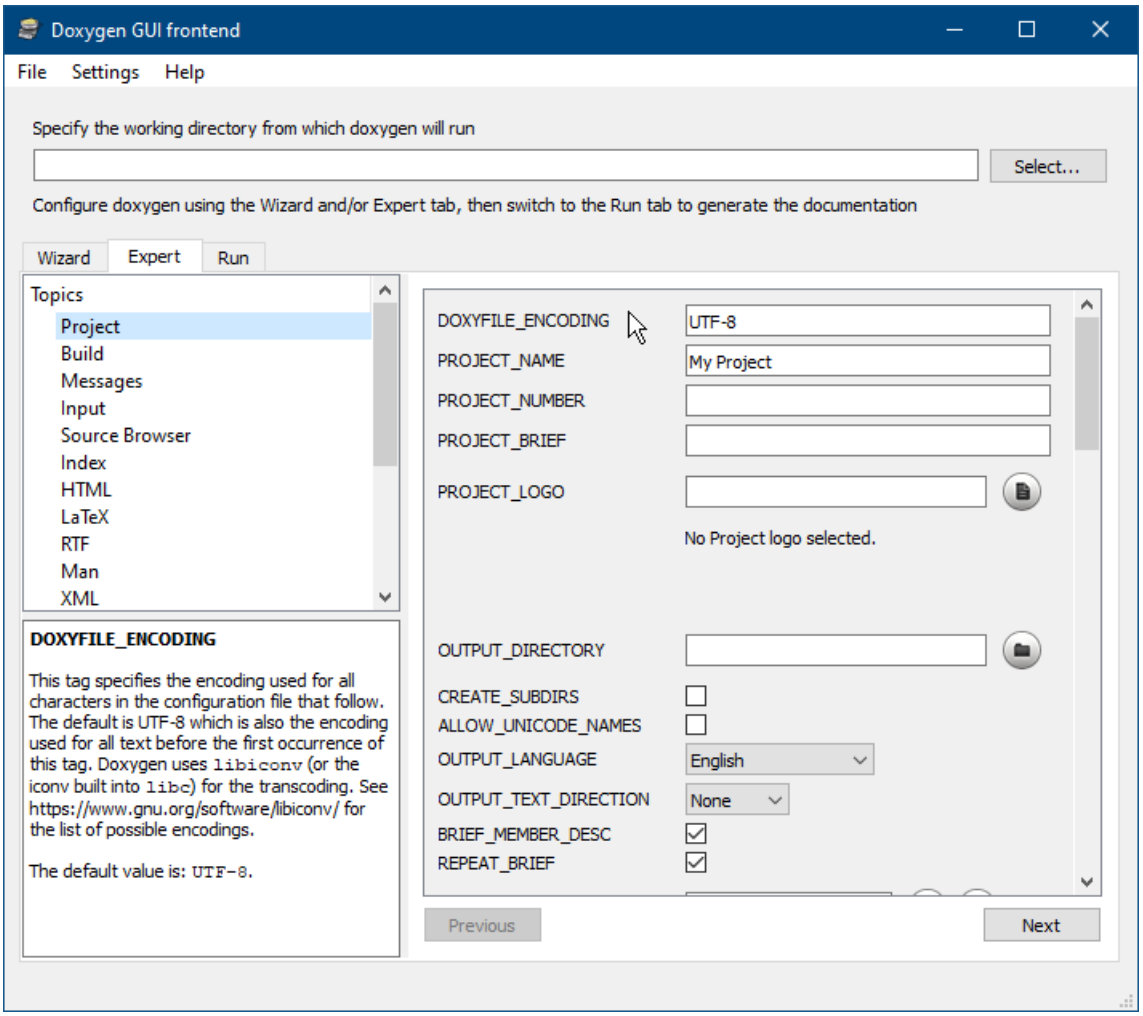
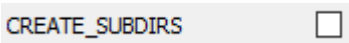


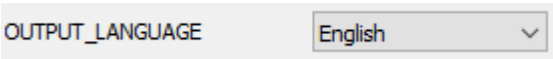
Figure 22.6: Some options from the Expert tab

The representation of the input field depends on the type of the configuration option.

- For each boolean option (those options that are answered with `YES` or `NO` in the configuration file) there is a check-box. A typical field looks like:

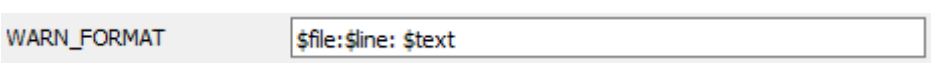
  

- For items taking one of a fixed set of values (like OUTPUT_LANGUAGE) a combo box is used. A typical field looks like:

- For items taking an integer value from a range, a spinbox is used. A typical field looks like:

- For free form string-type options there is a one line edit field. A typical field looks like:

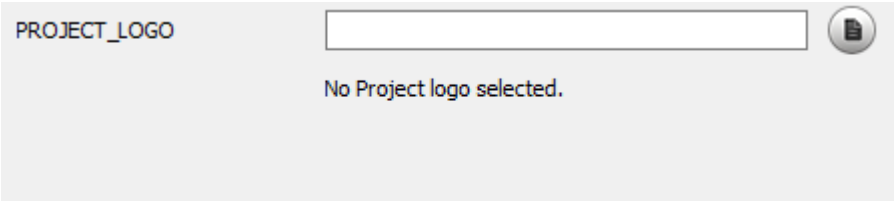
  Additionally, when the string field should contain a file or a folder name, there are the special buttons and

that start a file / folder selection dialog. A typical field for a file looks like:

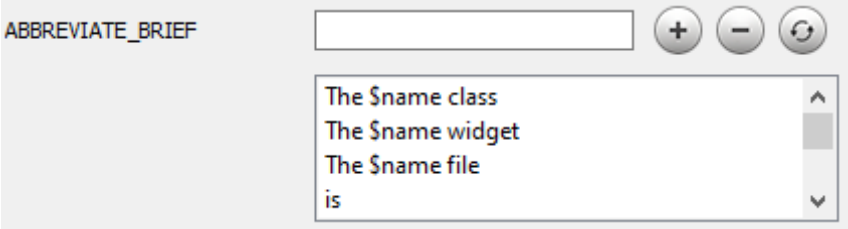
and a folder looks like:

and in case both a file or a folder is allowed, the look is:

In case a file represents an image, doxygen also tries to display the selected image. Then a typical field looks like:



- For options taking a list of strings, an editor field is shown with a non-editable list below it. The button adds the string in the editor field to the list and a the button removes the selected string from the list. The button can be clicked to replace the selected item in the list with the string entered in the editor field. A typical field looks like:



additionally when the list contains file and / or folder names, there are special buttons and that start a file / folder selection dialog. A typical field would for a file looks like:

and for a folder it looks like

and in case both files and folders are allowed, the look is:

22.3 Run tab

The run tab gives the possibility to run doxygen with the given settings, see the HTML results, see the settings used and save the output as displayed in the output pane.

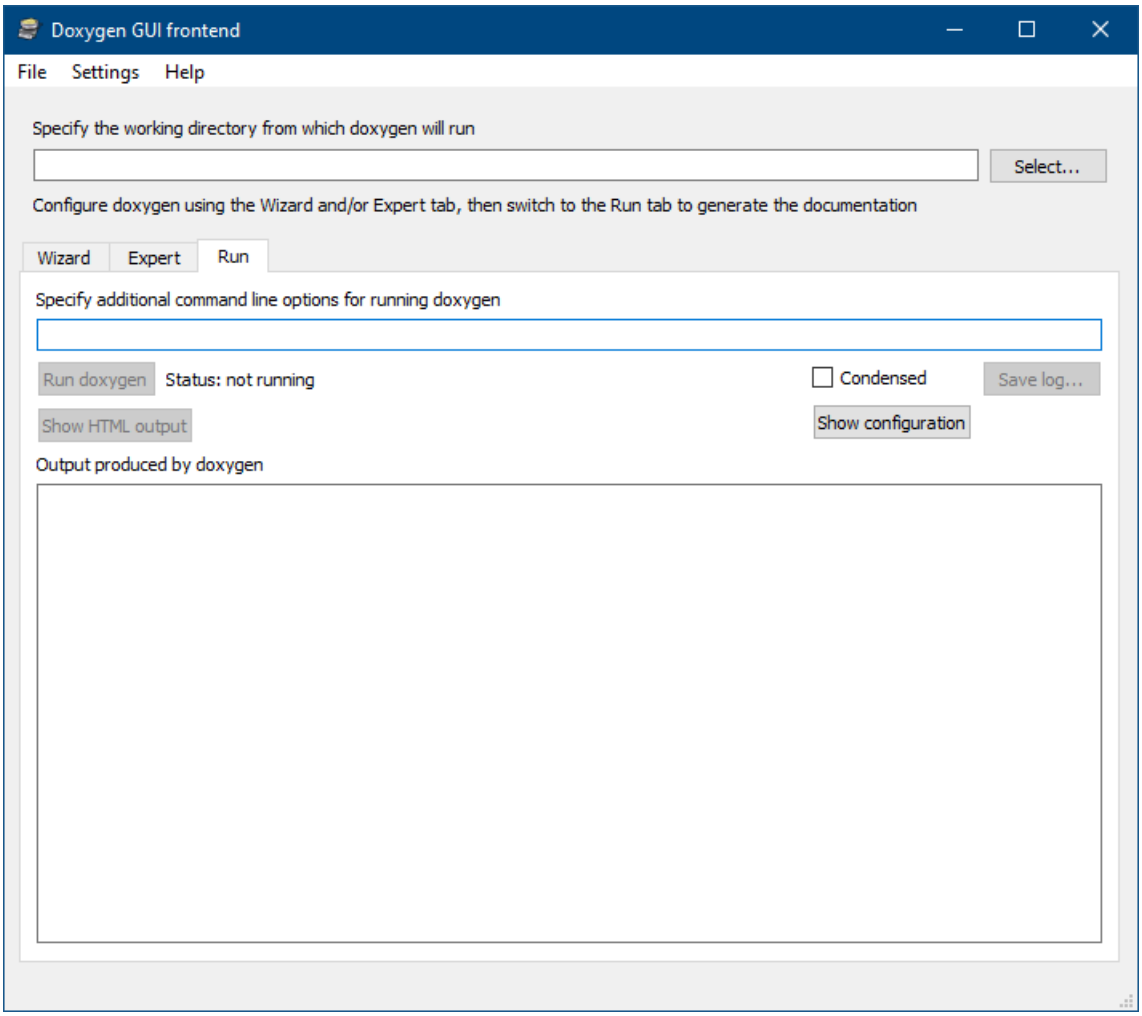


Figure 22.7: Run tab

Specify additional command line options for running doxygen Field to specify extra options used when running doxygen, e.g. for debugging purposes.

Run doxygen When clicked will start running doxygen. The "Output produced by doxygen" pane shows the messages produced by doxygen while it is running. Before being able to run doxygen the settings have to be saved.

Show HTML output Clicking this button will open the main HTML output page in the default browser. The button will be enabled after doxygen has finished.

Show configuration Clicking this button shows the configuration settings that are used when running doxygen. The results will be shown in the "Output produced by doxygen" pane in compact textual form.

Condensed When checked the "Show configuration" button will only list the configuration settings that differ from the default settings (analogous to `doxygen -x`).

Save Log ... Will save the information from the "Output produced by doxygen" pane in a file as specified by the user.

22.4 Menu options

22.4.1 File menu

The file menu with a couple of useful items for loading and saving settings.

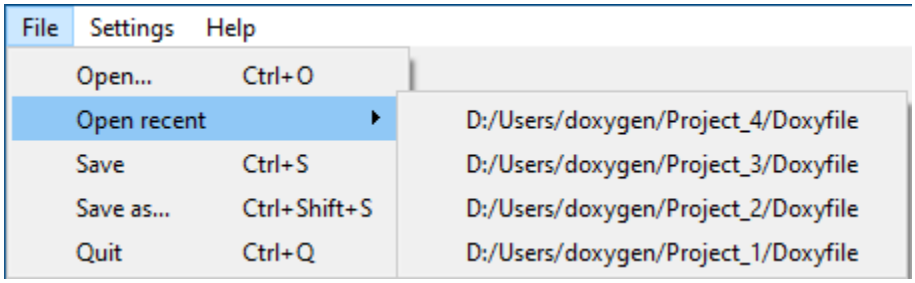


Figure 22.8: File menu

Open... Load a configuration file from disk, based on a file selection dialog. In case unsaved settings exist you will be asked to confirm the action.

Open recent Quickly load a recently saved configuration file. In case unsaved settings exist you will be asked to confirm the action. This menu item is only accessible when there are recent files in the list.

Save Saves a configuration file to disk. In case the configuration file has already been set this file name is used otherwise a selection dialog will appear. In case the file already exists a confirmation is required.

Save as.. Saves the current configuration settings to disk with a specific name. This file name will become the currently set file name.

Quit Leave doxywizard, in case unsaved settings exist you will be asked to confirm the action.

22.4.2 Settings menu

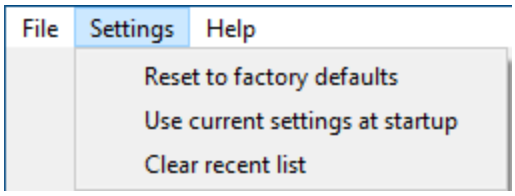


Figure 22.9: Settings menu

Reset to factory defaults Restores the factory defaults as the default settings to use. You will be asked to confirm the action. This menu item is only accessible when the current settings differ from the default settings.

Use current settings at startup Stores the current configuration settings as the default to use next time the GUI is started. You will be asked to confirm the action.

Clear recent list Clears the "Open recent" list in the File menu. This menu item is only accessible when there are recent files in the "Open recent" list.

22.4.3 Help menu

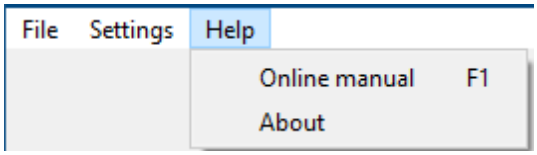


Figure 22.10: Help menu

Online Manual Opens the doxygen manual from the doxygen home page in the system defined default HTML browser.

About Shows an About dialog with version information.

Chapter 23

Configuration

23.1 Format

A configuration file is a free-form ASCII text file with a structure that is similar to that of a `Makefile`, with the default name `Doxyfile`. It is parsed by `doxygen`. The file may contain tabs and newlines for formatting purposes. The statements in the file are case-sensitive. Comments may be placed anywhere within the file (except within quotes). Comments beginning with two hash characters (`##`) are kept when updating the configuration file and are placed in front of the TAG they are in front of. Comments beginning with two hash characters (`##`) at the beginning of the configuration file are also kept and placed at the beginning of the file. Comments beginning with two hash characters (`##`) at the end of the configuration file are also kept and placed at the end of the file. Comments begin with the hash character (`#`) and ends at the end of the line.

The file essentially consists of a list of assignment statements. Each statement consists of a `TAG_NAME` written in capitals, followed by the equal sign (=) and one or more values. If the same tag is assigned more than once, the last assignment overwrites any earlier assignment. For tags that take a list as their argument, the += operator can be used instead of = to append new values to the list. Values are sequences of non-blanks. If the value should contain one or more blanks it must be surrounded by quotes (`"..."`). Multiple lines can be concatenated by inserting a backslash (`\`) as the last character of a line.

Environment variables can be expanded using the pattern `$(ENV_VARIABLE_NAME)`. A small example:

```
DOT_PATH       = $(YOUR_DOT_PATH)
```

You can also include part of a configuration file from another configuration file using a `@INCLUDE` tag as follows:

```
@INCLUDE = config_file_name
```

The include file is searched in the current working directory. You can also specify a list of directories that should be searched before looking in the current working directory. Do this by putting a `@INCLUDE_PATH` tag with these paths before the `@INCLUDE` tag, e.g.:

```
@INCLUDE_PATH = my_config_dir
```

The configuration options can be divided into several categories. Below is an alphabetical index of the tags that are recognized followed by the descriptions of the tags grouped by category.

ABBREVIATE_BRIEF 23.2
ALIASES 23.2
ALLEXTERNALS 23.18
ALLOW_UNICODE_NAMES 23.2
ALPHABETICAL_INDEX 23.7
ALWAYS_DETAILED_SEC 23.2
AUTOLINK_SUPPORT 23.2
BINARY_TOC 23.8
BRIEF_MEMBER_DESC 23.2
BUILTIN_STL_SUPPORT 23.2
CALLER_GRAPH 23.19
CALL_GRAPH 23.19
CASE_SENSE_NAMES 23.3
CHM_FILE 23.8
CHM_INDEX_ENCODING 23.8
CITE_BIB_FILES 23.3
CLANG_ADD_INC_PATHS 23.6
CLANG_ASSISTED_PARSING 23.6
CLANG_DATABASE_PATH 23.6
CLANG_OPTIONS 23.6
CLASS_GRAPH 23.19
COLLABORATION_GRAPH 23.19

COMPACT_LATEX . . . 23.9
COMPACT_RTF . . . 23.10
CPP_CLI_SUPPORT . . . 23.2
CREATE_SUBDIRS . . . 23.2
DIAFILE_DIRS . . . 23.19
DIA_PATH . . . 23.19
DIRECTORY_GRAPH . . . 23.19
DIR_GRAPH_MAX_DEPTH . . . 23.19
DISABLE_INDEX . . . 23.8
DISTRIBUTE_GROUP_DOC . . . 23.2
DOCBOOK_OUTPUT . . . 23.13
DOCSET_BUNDLE_ID . . . 23.8
DOCSET_FEEDNAME . . . 23.8
DOCSET_FEEDURL . . . 23.8
DOCSET_PUBLISHER_ID . . . 23.8
DOCSET_PUBLISHER_NAME . . . 23.8
DOTFILE_DIRS . . . 23.19
DOT_CLEANUP . . . 23.19
DOT_FONTNAME . . . 23.19
DOT_FONTPATH . . . 23.19
DOT_FONTSIZE . . . 23.19
DOT_GRAPH_MAX_NODES . . . 23.19
DOT_IMAGE_FORMAT . . . 23.19
DOT_MULTI_TARGETS . . . 23.19
DOT_NUM_THREADS . . . 23.19
DOT_PATH . . . 23.19
DOT_TRANSPARENT . . . 23.19
DOT_UML_DETAILS . . . 23.19
DOT_WRAP_THRESHOLD . . . 23.19
DOXYFILE_ENCODING . . . 23.2
ECLIPSE_DOC_ID . . . 23.8
ENABLED_SECTIONS . . . 23.3
ENABLE_PREPROCESSING . . . 23.17
ENUM_VALUES_PER_LINE . . . 23.8
EXAMPLE_PATH . . . 23.5
EXAMPLE_PATTERNS . . . 23.5
EXAMPLE_RECURSIVE . . . 23.5
EXCLUDE . . . 23.5
EXCLUDE_PATTERNS . . . 23.5
EXCLUDE_SYMBOLS . . . 23.5
EXCLUDE_SYMLINKS . . . 23.5
EXPAND_AS_DEFINED . . . 23.17
EXPAND_ONLY_PREDEF . . . 23.17
EXTENSION_MAPPING . . . 23.2
EXTERNAL_GROUPS . . . 23.18
EXTERNAL_PAGES . . . 23.18
EXTERNAL_SEARCH . . . 23.8
EXTERNAL_SEARCH_ID . . . 23.8
EXTRACT_ALL . . . 23.3
EXTRACT_ANON_NSPACES . . . 23.3
EXTRACT_LOCAL_CLASSES . . . 23.3
EXTRACT_LOCAL_METHODS . . . 23.3
EXTRACT_PACKAGE . . . 23.3
EXTRACT_PRIVATE . . . 23.3
EXTRACT_PRIV_VIRTUAL . . . 23.3
EXTRACT_STATIC . . . 23.3
EXTRA_PACKAGES . . . 23.9
EXTRA_SEARCH_MAPPINGS . . . 23.8
EXT_LINKS_IN_WINDOW . . . 23.8
FILE_PATTERNS . . . 23.5
FILE_VERSION_FILTER . . . 23.3
FILTER_PATTERNS . . . 23.5
FILTER_SOURCE_FILES . . . 23.5
FILTER_SOURCE_PATTERNS . . . 23.5
FORCE_LOCAL_INCLUDES . . . 23.3
FORMULA_FONTSIZE . . . 23.8
FORMULA_MACROFILE . . . 23.8
FORMULA_TRANSPARENT . . . 23.8
FULL_PATH_NAMES . . . 23.2
FULL_SIDEBAR . . . 23.8
GENERATE_AUTOGEN_DEF . . . 23.14
GENERATE_BUGLIST . . . 23.3
GENERATE_CHI . . . 23.8
GENERATE_DEPRECATEDLIST . . . 23.3
GENERATE_DOCBOOK . . . 23.13
GENERATE_DOCSET . . . 23.8
GENERATE_ECLIPSEHELP . . . 23.8
GENERATE_HTML . . . 23.8
GENERATE_HTMLHELP . . . 23.8
GENERATE_LATEX . . . 23.9
GENERATE_LEGEND . . . 23.19
GENERATE_MAN . . . 23.11
GENERATE_PERLMOD . . . 23.16
GENERATE_QHP . . . 23.8
GENERATE_RTF . . . 23.10
GENERATE_SQLITE3 . . . 23.15
GENERATE_TAGFILE . . . 23.18
GENERATE_TESTLIST . . . 23.3
GENERATE_TODOLIST . . . 23.3
GENERATE_TREEVIEW . . . 23.8
GENERATE_XML . . . 23.12
GRAPHICAL_HIERARCHY . . . 23.19
GROUP_GRAPHS . . . 23.19
GROUP_NESTED_COMPOUNDS . . . 23.2
HAVE_DOT . . . 23.19
HHC_LOCATION . . . 23.8
HIDE_COMPOUND_REFERENCE . . . 23.3
HIDE_FRIEND_COMPOUNDS . . . 23.3
HIDE_IN_BODY_DOCS . . . 23.3
HIDE_SCOPE_NAMES . . . 23.3
HIDE_UNDOC_CLASSES . . . 23.3
HIDE_UNDOC_MEMBERS . . . 23.3
HIDE_UNDOC_RELATIONS . . . 23.19
HTML_COLORSTYLE_GAMMA . . . 23.8
HTML_COLORSTYLE_HUE . . . 23.8
HTML_COLORSTYLE_SAT . . . 23.8
HTML_DYNAMIC_MENUS . . . 23.8
HTML_DYNAMIC_SECTIONS . . . 23.8
HTML_EXTRA_FILES . . . 23.8
HTML_EXTRA_STYLESHEET . . . 23.8
HTML_FILE_EXTENSION . . . 23.8
HTML_FOOTER . . . 23.8
HTML_FORMULA_FORMAT . . . 23.8
HTML_HEADER . . . 23.8
HTML_INDEX_NUM_ENTRIES . . . 23.8
HTML_OUTPUT . . . 23.8
HTML_STYLESHEET . . . 23.8
HTML_TIMESTAMP . . . 23.8
IDL_PROPERTY_SUPPORT . . . 23.2
IGNORE_PREFIX . . . 23.7
IMAGE_PATH . . . 23.5
INCLUDED_BY_GRAPH . . . 23.19
INCLUDE_FILE_PATTERNS . . . 23.17
INCLUDE_GRAPH . . . 23.19
INCLUDE_PATH . . . 23.17
INHERIT_DOCS . . . 23.2
INLINE_GROUPED_CLASSES . . . 23.2
INLINE_INFO . . . 23.3
INLINE_INHERITED_MEMB . . . 23.2
INLINE_SIMPLE_STRUCTS . . . 23.2
INLINE_SOURCES . . . 23.6
INPUT . . . 23.5
INPUT_ENCODING . . . 23.5
INPUT_FILTER . . . 23.5
INTERACTIVE_SVG . . . 23.19
INTERNAL_DOCS . . . 23.3
JAVADOC_AUTOBRIEF . . . 23.2
JAVADOC_BANNER . . . 23.2
LATEX_BATCHMODE . . . 23.9
LATEX_BIB_STYLE . . . 23.9
LATEX_CMD_NAME . . . 23.9
LATEX_EMOJI_DIRECTORY . . . 23.9
LATEX_EXTRA_FILES . . . 23.9
LATEX_EXTRA_STYLESHEET . . . 23.9
LATEX_FOOTER . . . 23.9
LATEX_HEADER . . . 23.9

LATEX_HIDE_INDICES . . . 23.9
LATEX_MAKEINDEX_CMD . . . 23.9
LATEX_OUTPUT . . . 23.9
LATEX_TIMESTAMP . . . 23.9
LAYOUT_FILE . . . 23.3
LOOKUP_CACHE_SIZE . . . 23.2
MACRO_EXPANSION . . . 23.17
MAKEINDEX_CMD_NAME . . . 23.9
MAN_EXTENSION . . . 23.11
MAN_LINKS . . . 23.11
MAN_OUTPUT . . . 23.11
MAN_SUBDIR . . . 23.11
MARKDOWN_SUPPORT . . . 23.2
MATHJAX_CODEFILE . . . 23.8
MATHJAX_EXTENSIONS . . . 23.8
MATHJAX_FORMAT . . . 23.8
MATHJAX_RELPATH . . . 23.8
MATHJAX_VERSION . . . 23.8
MAX_DOT_GRAPH_DEPTH . . . 23.19
MAX_INITIALIZER_LINES . . . 23.3
MSCFILE_DIRS . . . 23.19
MULTILINE_CPP_IS_BRIEF . . . 23.2
NUM_PROC_THREADS . . . 23.2
OBFUSCATE_EMAILS . . . 23.8
OPTIMIZE_FOR_FORTRAN . . . 23.2
OPTIMIZE_OUTPUT_FOR_C . . . 23.2
OPTIMIZE_OUTPUT_JAVA . . . 23.2
OPTIMIZE_OUTPUT_SLICE . . . 23.2
OPTIMIZE_OUTPUT_VHDL . . . 23.2
OUTPUT_DIRECTORY . . . 23.2
OUTPUT_LANGUAGE . . . 23.2
PAPER_TYPE . . . 23.9
PDF_HYPERLINKS . . . 23.9
PERLMOD_LATEX . . . 23.16
PERLMOD_MAKEVAR_PREFIX . . . 23.16
PERLMOD_PRETTY . . . 23.16
PLANTUML_CFG_FILE . . . 23.19
PLANTUML_INCLUDE_PATH . . . 23.19
PLANTUML_JAR_PATH . . . 23.19
PREDEFINED . . . 23.17
PROJECT_BRIEF . . . 23.2
PROJECT_LOGO . . . 23.2
PROJECT_NAME . . . 23.2
PROJECT_NUMBER . . . 23.2
PYTHON_DOCSTRING . . . 23.2
QCH_FILE . . . 23.8
QHG_LOCATION . . . 23.8
QHP_CUST_FILTER_ATTRS . . . 23.8
QHP_CUST_FILTER_NAME . . . 23.8
QHP_NAMESPACE . . . 23.8
QHP_SECT_FILTER_ATTRS . . . 23.8
QHP_VIRTUAL_FOLDER . . . 23.8
QT_AUTOBRIEF . . . 23.2
QUIET . . . 23.4
RECURSIVE . . . 23.5
REFERENCED_BY_RELATION . . . 23.6
REFERENCES_LINK_SOURCE . . . 23.6
REFERENCES_RELATION . . . 23.6
REPEAT_BRIEF . . . 23.2
RESOLVE_UNNAMED_PARAMS . . . 23.3
RTF_EXTENSIONS_FILE . . . 23.10
RTF_HYPERLINKS . . . 23.10
RTF_OUTPUT . . . 23.10
RTF_STYLESHEET_FILE . . . 23.10
SEARCHDATA_FILE . . . 23.8
SEARCHENGINE . . . 23.8
SEARCHENGINE_URL . . . 23.8
SEARCH_INCLUDES . . . 23.17
SEPARATE_MEMBER_PAGES . . . 23.2
SERVER_BASED_SEARCH . . . 23.8
SHORT_NAMES . . . 23.2
SHOW_FILES . . . 23.3
SHOW_GROUPED_MEMB_INC . . . 23.3
SHOW_HEADERFILE . . . 23.3
SHOW_INCLUDE_FILES . . . 23.3
SHOW_NAMESPACES . . . 23.3
SHOW_USED_FILES . . . 23.3
SIP_SUPPORT . . . 23.2
SKIP_FUNCTION_MACROS . . . 23.17
SORT_BRIEF_DOCS . . . 23.3
SORT_BY_SCOPE_NAME . . . 23.3
SORT_GROUP_NAMES . . . 23.3
SORT_MEMBERS_CTORS_1ST . . . 23.3
SORT_MEMBER_DOCS . . . 23.3
SOURCE_BROWSER . . . 23.6
SOURCE_TOOLTIPS . . . 23.6
SQLITE3_OUTPUT . . . 23.15
SQLITE3_RECREATE_DB . . . 23.15
STRICT_PROTO_MATCHING . . . 23.3
STRIP_CODE_COMMENTS . . . 23.6
STRIP_FROM_INC_PATH . . . 23.2
STRIP_FROM_PATH . . . 23.2
SUBGROUPING . . . 23.2
TAB_SIZE . . . 23.2
TAGFILES . . . 23.18
TEMPLATE_RELATIONS . . . 23.19
TOC_EXPAND . . . 23.8
TOC_INCLUDE_HEADINGS . . . 23.2
TREEVIEW_WIDTH . . . 23.8
TYPEDEF_HIDES_STRUCT . . . 23.2
UML_LIMIT_NUM_FIELDS . . . 23.19
UML_LOOK . . . 23.19
USE_HTAGS . . . 23.6
USE_MATHJAX . . . 23.8
USE_MDFILE_AS_MAINPAGE . . . 23.5
USE_PDFLATEX . . . 23.9
VERBATIM_HEADERS . . . 23.6
WARNINGS . . . 23.4
WARN_AS_ERROR . . . 23.4
WARN_FORMAT . . . 23.4
WARN_IF_DOC_ERROR . . . 23.4
WARN_IF_INCOMPLETE_DOC . . . 23.4
WARN_IF_UNDOCUMENTED . . . 23.4
WARN_LOGFILE . . . 23.4
WARN_NO_PARAMDOC . . . 23.4
XML_NS_MEMB_FILE_SCOPE . . . 23.12
XML_OUTPUT . . . 23.12
XML_PROGRAMLISTING . . . 23.12

23.2 Project related configuration options

DOXYFILE_ENCODING This tag specifies the encoding used for all characters in the configuration file that follow. The default is UTF-8 which is also the encoding used for all text before the first occurrence of this tag. Doxygen uses `libiconv` (or the iconv built into `libc`) for the transcoding. See https://www.gnu.org/software/libiconv/ for the list of possible encodings.

The default value is: `UTF-8`.

PROJECT_NAME The `PROJECT_NAME` tag is a single word (or a sequence of words surrounded by double-

quotes, unless you are using Doxywizard) that should identify the project for which the documentation is generated. This name is used in the title of most generated pages and in a few other places.

The default value is: `My Project`.

PROJECT_NUMBER The `PROJECT_NUMBER` tag can be used to enter a project or revision number. This could be handy for archiving the generated documentation or if some version control system is used.

PROJECT_BRIEF Using the `PROJECT_BRIEF` tag one can provide an optional one line description for a project that appears at the top of each page and should give viewer a quick idea about the purpose of the project. Keep the description short.

PROJECT_LOGO With the `PROJECT_LOGO` tag one can specify a logo or an icon that is included in the documentation. The maximum height of the logo should not exceed 55 pixels and the maximum width should not exceed 200 pixels. Doxygen will copy the logo to the output directory.

OUTPUT_DIRECTORY The `OUTPUT_DIRECTORY` tag is used to specify the (relative or absolute) path into which the generated documentation will be written. If a relative path is entered, it will be relative to the location where doxygen was started. If left blank the current directory will be used.

CREATE_SUBDIRS If the `CREATE_SUBDIRS` tag is set to `YES` then doxygen will create 4096 sub-directories (in 2 levels) under the output directory of each output format and will distribute the generated files over these directories. Enabling this option can be useful when feeding doxygen a huge amount of source files, where putting all generated files in the same directory would otherwise causes performance problems for the file system.

The default value is: `NO`.

ALLOW_UNICODE_NAMES If the `ALLOW_UNICODE_NAMES` tag is set to `YES`, doxygen will allow non-ASCII characters to appear in the names of generated files. If set to `NO`, non-ASCII characters will be escaped, for example _xE3_x81_x84 will be used for Unicode U+3044.

The default value is: `NO`.

OUTPUT_LANGUAGE The `OUTPUT_LANGUAGE` tag is used to specify the language in which all documentation generated by doxygen is written. Doxygen will use this information to generate all constant output in the proper language.

Possible values are: `Afrikaans`, `Arabic`, `Armenian`, `Brazilian`, `Catalan`, `Chinese`, `Chinese-Traditional`, `Croatian`, `Czech`, `Danish`, `Dutch`, `English` (United States), `Esperanto`, `Farsi` (Persian), `Finnish`, `French`, `German`, `Greek`, `Hungarian`, `Indonesian`, `Italian`, `Japanese`, `Japanese-en` (Japanese with English messages), `Korean`, `Korean-en` (Korean with English messages), `Latvian`, `Lithuanian`, `Macedonian`, `Norwegian`, `Persian` (Farsi), `Polish`, `Portuguese`, `Romanian`, `Russian`, `Serbian`, `Serbian-Cyrillic`, `Slovak`, `Slovene`, `Spanish`, `Swedish`, `Turkish`, `Ukrainian` and `Vietnamese`.

The default value is: `English`.

BRIEF_MEMBER_DESC If the `BRIEF_MEMBER_DESC` tag is set to `YES`, doxygen will include brief member descriptions after the members that are listed in the file and class documentation (similar to `Javadoc`). Set to `NO` to disable this.

The default value is: `YES`.

REPEAT_BRIEF If the `REPEAT_BRIEF` tag is set to `YES`, doxygen will prepend the brief description of a member or function before the detailed description
Note: If both HIDE_UNDOC_MEMBERS and BRIEF_MEMBER_DESC are set to `NO`, the brief descriptions will be completely suppressed.

The default value is: `YES`.

ABBREVIATE_BRIEF This tag implements a quasi-intelligent brief description abbreviator that is used to form the text in various listings. Each string in this list, if found as the leading text of the brief description, will be stripped from the text and the result, after processing the whole list, is used as the annotated text. Otherwise, the brief description is used as-is. If left blank, the following values are used (`$name` is automatically replaced with the name of the entity): `The $name class`, `The $name widget`, `The $name file`, `is`, `provides`, `specifies`, `contains`, `represents`, `a`, `an` and `the`.

ALWAYS_DETAILED_SEC If the ALWAYS_DETAILED_SEC and REPEAT_BRIEF tags are both set to YES then doxygen will generate a detailed section even if there is only a brief description.

The default value is: NO.

INLINE_INHERITED_MEMB If the INLINE_INHERITED_MEMB tag is set to YES, doxygen will show all inherited members of a class in the documentation of that class as if those members were ordinary class members. Constructors, destructors and assignment operators of the base classes will not be shown.

The default value is: NO.

FULL_PATH_NAMES If the FULL_PATH_NAMES tag is set to YES, doxygen will prepend the full path before files name in the file list and in the header files. If set to NO the shortest path that makes the file name unique will be used

The default value is: YES.

STRIP_FROM_PATH The STRIP_FROM_PATH tag can be used to strip a user-defined part of the path. Stripping is only done if one of the specified strings matches the left-hand part of the path. The tag can be used to show relative paths in the file list. If left blank the directory from which doxygen is run is used as the path to strip.
Note that you can specify absolute paths here, but also relative paths, which will be relative from the directory where doxygen is started.

This tag requires that the tag FULL_PATH_NAMES is set to YES.

STRIP_FROM_INC_PATH The STRIP_FROM_INC_PATH tag can be used to strip a user-defined part of the path mentioned in the documentation of a class, which tells the reader which header file to include in order to use a class. If left blank only the name of the header file containing the class definition is used. Otherwise one should specify the list of include paths that are normally passed to the compiler using the -I flag.

SHORT_NAMES If the SHORT_NAMES tag is set to YES, doxygen will generate much shorter (but less readable) file names. This can be useful is your file systems doesn't support long names like on DOS, Mac, or CD-ROM.

The default value is: NO.

JAVADOC_AUTOBRIEF If the JAVADOC_AUTOBRIEF tag is set to YES then doxygen will interpret the first line (until the first dot) of a Javadoc-style comment as the brief description. If set to NO, the Javadoc-style will behave just like regular Qt-style comments (thus requiring an explicit @brief command for a brief description.)

The default value is: NO.

JAVADOC_BANNER If the JAVADOC_BANNER tag is set to YES then doxygen will interpret a line such as

```
/***************
```

as being the beginning of a Javadoc-style comment "banner". If set to NO, the Javadoc-style will behave just like regular comments and it will not be interpreted by doxygen.

The default value is: NO.

QT_AUTOBRIEF If the QT_AUTOBRIEF tag is set to YES then doxygen will interpret the first line (until the first dot) of a Qt-style comment as the brief description. If set to NO, the Qt-style will behave just like regular Qt-style comments (thus requiring an explicit \brief command for a brief description.)

The default value is: NO.

MULTILINE_CPP_IS_BRIEF The MULTILINE_CPP_IS_BRIEF tag can be set to YES to make doxygen treat a multi-line C++ special comment block (i.e. a block of //! or /// comments) as a brief description. This used to be the default behavior. The new default is to treat a multi-line C++ comment block as a detailed description. Set this tag to YES if you prefer the old behavior instead.
Note that setting this tag to YES also means that rational rose comments are not recognized any more.

The default value is: NO.

PYTHON_DOCSTRING By default Python docstrings are displayed as preformatted text and doxygen's special commands cannot be used. By setting PYTHON_DOCSTRING to NO the doxygen's special commands can be used and the contents of the docstring documentation blocks is shown as doxygen documentation.

The default value is: YES.

INHERIT_DOCS If the INHERIT_DOCS tag is set to YES then an undocumented member inherits the documentation from any documented member that it re-implements.

The default value is: YES.

SEPARATE_MEMBER_PAGES If the SEPARATE_MEMBER_PAGES tag is set to YES then doxygen will produce a new page for each member. If set to NO, the documentation of a member will be part of the file/class/-namespace that contains it.

The default value is: NO.

TAB_SIZE The TAB_SIZE tag can be used to set the number of spaces in a tab. Doxygen uses this value to replace tabs by spaces in code fragments.

Minimum value: 1, maximum value: 16, default value: 4.

ALIASES This tag can be used to specify a number of aliases that act as commands in the documentation. An alias has the form:

```
name=value
```

For example adding

```
"sideeffect=@par Side Effects:^^"
```

will allow you to put the command \sideeffect (or @sideeffect) in the documentation, which will result in a user-defined paragraph with heading "Side Effects:". Note that you cannot put \n's in the value part of an alias to insert newlines (in the resulting output). You can put ^^ in the value part of an alias to insert a newline as if a physical newline was in the original file. When you need a literal { or } or , in the value part of an alias you have to escape them by means of a backslash (\), this can lead to conflicts with the commands \{ and \} for these it is advised to use the version @{ and @} or use a double escape (\\{ and \\})

OPTIMIZE_OUTPUT_FOR_C Set the OPTIMIZE_OUTPUT_FOR_C tag to YES if your project consists of C sources only. Doxygen will then generate output that is more tailored for C. For instance, some of the names that are used will be different. The list of all members will be omitted, etc.

The default value is: NO.

OPTIMIZE_OUTPUT_JAVA Set the OPTIMIZE_OUTPUT_JAVA tag to YES if your project consists of Java or Python sources only. Doxygen will then generate output that is more tailored for that language. For instance, namespaces will be presented as packages, qualified scopes will look different, etc.

The default value is: NO.

OPTIMIZE_FOR_FORTRAN Set the OPTIMIZE_FOR_FORTRAN tag to YES if your project consists of Fortran sources. Doxygen will then generate output that is tailored for Fortran.

The default value is: NO.

OPTIMIZE_OUTPUT_VHDL Set the OPTIMIZE_OUTPUT_VHDL tag to YES if your project consists of VHDL sources. Doxygen will then generate output that is tailored for VHDL.

The default value is: NO.

OPTIMIZE_OUTPUT_SLICE Set the OPTIMIZE_OUTPUT_SLICE tag to YES if your project consists of Slice sources only. Doxygen will then generate output that is more tailored for that language. For instance, namespaces will be presented as modules, types will be separated into more groups, etc.

The default value is: NO.

EXTENSION_MAPPING Doxygen selects the parser to use depending on the extension of the files it parses. With this tag you can assign which parser to use for a given extension. Doxygen has a built-in mapping, but you can override or extend it using this tag. The format is ext=language, where ext is a file extension, and language is one of the parsers supported by doxygen: IDL, Java, JavaScript, Csharp (C#), C, C++, Lex, D, PHP, md (Markdown), Objective-C, Python, Slice, VHDL, Fortran (fixed format Fortran: FortranFixed, free formatted Fortran: FortranFree, unknown formatted Fortran: Fortran. In the later case the parser tries to guess whether the code is fixed or free formatted code, this is the default for Fortran type files).

For instance to make doxygen treat .inc files as Fortran files (default is PHP), and .f files as C (default is Fortran), use: inc=Fortran f=C.

Note: For files without extension you can use `no_extension` as a placeholder.
Note that for custom extensions you also need to set FILE_PATTERNS otherwise the files are not read by doxygen. When specifying `no_extension` you should add `*` to the FILE_PATTERNS.
Note see also the list of default file extension mappings.

MARKDOWN_SUPPORT If the `MARKDOWN_SUPPORT` tag is enabled then doxygen pre-processes all comments according to the Markdown format, which allows for more readable documentation. See https://daringfireball.net/projects/markdown/ for details. The output of markdown processing is further processed by doxygen, so you can mix doxygen, HTML, and XML commands with Markdown formatting. Disable only in case of backward compatibilities issues.

The default value is: `YES`.

TOC_INCLUDE_HEADINGS When the `TOC_INCLUDE_HEADINGS` tag is set to a non-zero value, all headings up to that level are automatically included in the table of contents, even if they do not have an id attribute.

Note

This feature currently applies only to Markdown headings.

Minimum value: `0`, maximum value: `99`, default value: `5`.

This tag requires that the tag MARKDOWN_SUPPORT is set to `YES`.

AUTOLINK_SUPPORT When enabled doxygen tries to link words that correspond to documented classes, or namespaces to their corresponding documentation. Such a link can be prevented in individual cases by putting a `%` sign in front of the word or globally by setting `AUTOLINK_SUPPORT` to `NO`.

The default value is: `YES`.

BUILTIN_STL_SUPPORT If you use STL classes (i.e. `std::string`, `std::vector`, etc.) but do not want to include (a tag file for) the STL sources as input, then you should set this tag to `YES` in order to let doxygen match functions declarations and definitions whose arguments contain STL classes (e.g. `func(std::string)`; versus `func(std::string) {}`). This also make the inheritance and collaboration diagrams that involve STL classes more complete and accurate.

The default value is: `NO`.

CPP_CLI_SUPPORT If you use Microsoft's C++/CLI language, you should set this option to `YES` to enable parsing support.

The default value is: `NO`.

SIP_SUPPORT Set the `SIP_SUPPORT` tag to `YES` if your project consists of `sip` sources only. Doxygen will parse them like normal C++ but will assume all classes use public instead of private inheritance when no explicit protection keyword is present.

The default value is: `NO`.

IDL_PROPERTY_SUPPORT For Microsoft's IDL there are `propget` and `propput` attributes to indicate getter and setter methods for a property. Setting this option to `YES` will make doxygen to replace the get and set methods by a property in the documentation. This will only work if the methods are indeed getting or setting a simple type. If this is not the case, or you want to show the methods anyway, you should set this option to `NO`.

The default value is: `YES`.

DISTRIBUTE_GROUP_DOC If member grouping is used in the documentation and the `DISTRIBUTE_GROUP_DOC` tag is set to `YES` then doxygen will reuse the documentation of the first member in the group (if any) for the other members of the group. By default all members of a group must be documented explicitly.

The default value is: `NO`.

GROUP_NESTED_COMPOUNDS If one adds a struct or class to a group and this option is enabled, then also any nested class or struct is added to the same group. By default this option is disabled and one has to add nested compounds explicitly via \ingroup.

The default value is: `NO`.

SUBGROUPING Set the SUBGROUPING tag to YES to allow class member groups of the same type (for instance a group of public functions) to be put as a subgroup of that type (e.g. under the Public Functions section). Set it to NO to prevent subgrouping. Alternatively, this can be done per class using the \nosubgrouping command.

The default value is: YES.

INLINE_GROUPED_CLASSES When the INLINE_GROUPED_CLASSES tag is set to YES, classes, structs and unions are shown inside the group in which they are included (e.g. using \ingroup) instead of on a separate page (for HTML and Man pages) or section (for LaTeX and RTF).
Note that this feature does not work in combination with SEPARATE_MEMBER_PAGES.

The default value is: NO.

INLINE_SIMPLE_STRUCTS When the INLINE_SIMPLE_STRUCTS tag is set to YES, structs, classes, and unions with only public data fields or simple typedef fields will be shown inline in the documentation of the scope in which they are defined (i.e. file, namespace, or group documentation), provided this scope is documented. If set to NO, structs, classes, and unions are shown on a separate page (for HTML and Man pages) or section (for LaTeX and RTF).

The default value is: NO.

TYPEDEF_HIDES_STRUCT When TYPEDEF_HIDES_STRUCT tag is enabled, a typedef of a struct, union, or enum is documented as struct, union, or enum with the name of the typedef. So `typedef struct TypeS {} TypeT`, will appear in the documentation as a struct with name TypeT. When disabled the typedef will appear as a member of a file, namespace, or class. And the struct will be named TypeS. This can typically be useful for C code in case the coding convention dictates that all compound types are typedef'ed and only the typedef is referenced, never the tag name.

The default value is: NO.

LOOKUP_CACHE_SIZE The size of the symbol lookup cache can be set using LOOKUP_CACHE_SIZE. This cache is used to resolve symbols given their name and scope. Since this can be an expensive process and often the same symbol appears multiple times in the code, doxygen keeps a cache of pre-resolved symbols. If the cache is too small doxygen will become slower. If the cache is too large, memory is wasted. The cache size is given by this formula: $2^{(16+\text{LOOKUP_CACHE_SIZE})}$. The valid range is 0..9, the default is 0, corresponding to a cache size of $2^{16} = 65536$ symbols. At the end of a run doxygen will report the cache usage and suggest the optimal cache size from a speed point of view.

Minimum value: 0, maximum value: 9, default value: 0.

NUM_PROC_THREADS The NUM_PROC_THREADS specifies the number threads doxygen is allowed to use during processing. When set to 0 doxygen will based this on the number of cores available in the system. You can set it explicitly to a value larger than 0 to get more control over the balance between CPU load and processing speed. At this moment only the input processing can be done using multiple threads. Since this is still an experimental feature the default is set to 1, which effectively disables parallel processing. Please report any issues you encounter. Generating dot graphs in parallel is controlled by the DOT_NUM_THREADS setting.

Minimum value: 0, maximum value: 32, default value: 1.

23.3 Build related configuration options

EXTRACT_ALL If the EXTRACT_ALL tag is set to YES, doxygen will assume all entities in documentation are documented, even if no documentation was available. Private class members and static file members will be hidden unless the EXTRACT_PRIVATE respectively EXTRACT_STATIC tags are set to YES.

Note

> This will also disable the warnings about undocumented members that are normally produced when WARNINGS is set to YES.

The default value is: NO.

EXTRACT_PRIVATE If the EXTRACT_PRIVATE tag is set to YES, all private members of a class will be included in the documentation.

The default value is: NO.

EXTRACT_PRIV_VIRTUAL If the EXTRACT_PRIV_VIRTUAL tag is set to YES, documented private virtual methods of a class will be included in the documentation.

The default value is: NO.

EXTRACT_PACKAGE If the EXTRACT_PACKAGE tag is set to YES, all members with package or internal scope will be included in the documentation.

The default value is: NO.

EXTRACT_STATIC If the EXTRACT_STATIC tag is set to YES, all static members of a file will be included in the documentation.

The default value is: NO.

EXTRACT_LOCAL_CLASSES If the EXTRACT_LOCAL_CLASSES tag is set to YES, classes (and structs) defined locally in source files will be included in the documentation. If set to NO, only classes defined in header files are included. Does not have any effect for Java sources.

The default value is: YES.

EXTRACT_LOCAL_METHODS This flag is only useful for Objective-C code. If set to YES, local methods, which are defined in the implementation section but not in the interface are included in the documentation. If set to NO, only methods in the interface are included.

The default value is: NO.

EXTRACT_ANON_NSPACES If this flag is set to YES, the members of anonymous namespaces will be extracted and appear in the documentation as a namespace called 'anonymous_namespace{file}', where file will be replaced with the base name of the file that contains the anonymous namespace. By default anonymous namespace are hidden.

The default value is: NO.

RESOLVE_UNNAMED_PARAMS If this flag is set to YES, the name of an unnamed parameter in a declaration will be determined by the corresponding definition. By default unnamed parameters remain unnamed in the output.

The default value is: YES.

HIDE_UNDOC_MEMBERS If the HIDE_UNDOC_MEMBERS tag is set to YES, doxygen will hide all undocumented members inside documented classes or files. If set to NO these members will be included in the various overviews, but no documentation section is generated. This option has no effect if EXTRACT_ALL is enabled.

The default value is: NO.

HIDE_UNDOC_CLASSES If the HIDE_UNDOC_CLASSES tag is set to YES, doxygen will hide all undocumented classes that are normally visible in the class hierarchy. If set to NO, these classes will be included in the various overviews. This option has no effect if EXTRACT_ALL is enabled.

The default value is: NO.

HIDE_FRIEND_COMPOUNDS If the HIDE_FRIEND_COMPOUNDS tag is set to YES, doxygen will hide all friend declarations. If set to NO, these declarations will be included in the documentation.

The default value is: NO.

HIDE_IN_BODY_DOCS If the HIDE_IN_BODY_DOCS tag is set to YES, doxygen will hide any documentation blocks found inside the body of a function. If set to NO, these blocks will be appended to the function's detailed documentation block.

The default value is: NO.

INTERNAL_DOCS The INTERNAL_DOCS tag determines if documentation that is typed after a \internal command is included. If the tag is set to NO then the documentation will be excluded. Set it to YES to include the internal documentation.

The default value is: NO.

CASE_SENSE_NAMES With the correct setting of option CASE_SENSE_NAMES doxygen will better be able to match the capabilities of the underlying filesystem.

In case the filesystem is case sensitive (i.e. it supports files in the same directory whose names only differ in casing), the option must be set to YES to properly deal with such files in case they appear in the input.

For filesystems that are not case sensitive the option should be be set to NO to properly deal with output files written for symbols that only differ in casing, such as for two classes, one named CLASS and the other named Class, and to also support references to files without having to specify the exact matching casing.

On Windows (including Cygwin) and MacOS, users should typically set this option to NO, whereas on Linux or other Unix flavors it should typically be set to YES.

The default value is: system dependent.

HIDE_SCOPE_NAMES If the HIDE_SCOPE_NAMES tag is set to NO then doxygen will show members with their full class and namespace scopes in the documentation. If set to YES, the scope will be hidden.

The default value is: NO.

HIDE_COMPOUND_REFERENCE If the HIDE_COMPOUND_REFERENCE tag is set to NO (default) then doxygen will append additional text to a page's title, such as Class Reference. If set to YES the compound reference will be hidden.

The default value is: NO.

SHOW_HEADERFILE If the SHOW_HEADERFILE tag is set to YES then the documentation for a class will show which file needs to be included to use the class.

The default value is: YES.

SHOW_INCLUDE_FILES If the SHOW_INCLUDE_FILES tag is set to YES then doxygen will put a list of the files that are included by a file in the documentation of that file.

The default value is: YES.

SHOW_GROUPED_MEMB_INC If the SHOW_GROUPED_MEMB_INC tag is set to YES then Doxygen will add for each grouped member an include statement to the documentation, telling the reader which file to include in order to use the member.

The default value is: NO.

FORCE_LOCAL_INCLUDES If the FORCE_LOCAL_INCLUDES tag is set to YES then doxygen will list include files with double quotes in the documentation rather than with sharp brackets.

The default value is: NO.

INLINE_INFO If the INLINE_INFO tag is set to YES then a tag [inline] is inserted in the documentation for inline members.

The default value is: YES.

SORT_MEMBER_DOCS If the SORT_MEMBER_DOCS tag is set to YES then doxygen will sort the (detailed) documentation of file and class members alphabetically by member name. If set to NO, the members will appear in declaration order.

The default value is: YES.

SORT_BRIEF_DOCS If the SORT_BRIEF_DOCS tag is set to YES then doxygen will sort the brief descriptions of file, namespace and class members alphabetically by member name. If set to NO, the members will appear in declaration order. Note that this will also influence the order of the classes in the class list.

The default value is: NO.

SORT_MEMBERS_CTORS_1ST If the SORT_MEMBERS_CTORS_1ST tag is set to YES then doxygen will sort the (brief and detailed) documentation of class members so that constructors and destructors are listed first. If set to NO the constructors will appear in the respective orders defined by SORT_BRIEF_DOCS and SORT_MEMBER_DOCS.

Note

If SORT_BRIEF_DOCS is set to NO this option is ignored for sorting brief member documentation.

If SORT_MEMBER_DOCS is set to NO this option is ignored for sorting detailed member documentation.

The default value is: NO.

SORT_GROUP_NAMES If the SORT_GROUP_NAMES tag is set to YES then doxygen will sort the hierarchy of group names into alphabetical order. If set to NO the group names will appear in their defined order.

The default value is: NO.

SORT_BY_SCOPE_NAME If the SORT_BY_SCOPE_NAME tag is set to YES, the class list will be sorted by fully-qualified names, including namespaces. If set to NO, the class list will be sorted only by class name, not including the namespace part.

Note

This option is not very useful if HIDE_SCOPE_NAMES is set to YES.

This option applies only to the class list, not to the alphabetical list.

The default value is: NO.

STRICT_PROTO_MATCHING If the STRICT_PROTO_MATCHING option is enabled and doxygen fails to do proper type resolution of all parameters of a function it will reject a match between the prototype and the implementation of a member function even if there is only one candidate or it is obvious which candidate to choose by doing a simple string match. By disabling STRICT_PROTO_MATCHING doxygen will still accept a match between prototype and implementation in such cases.

The default value is: NO.

GENERATE_TODOLIST The GENERATE_TODOLIST tag can be used to enable (YES) or disable (NO) the todo list. This list is created by putting \todo commands in the documentation.

The default value is: YES.

GENERATE_TESTLIST The GENERATE_TESTLIST tag can be used to enable (YES) or disable (NO) the test list. This list is created by putting \test commands in the documentation.

The default value is: YES.

GENERATE_BUGLIST The GENERATE_BUGLIST tag can be used to enable (YES) or disable (NO) the bug list. This list is created by putting \bug commands in the documentation.

The default value is: YES.

GENERATE_DEPRECATEDLIST The GENERATE_DEPRECATEDLIST tag can be used to enable (YES) or disable (NO) the deprecated list. This list is created by putting \deprecated commands in the documentation.

The default value is: YES.

ENABLED_SECTIONS The ENABLED_SECTIONS tag can be used to enable conditional documentation sections, marked by \if <section_label> ... \endif and \cond <section_label> ... \endcond blocks.

MAX_INITIALIZER_LINES The MAX_INITIALIZER_LINES tag determines the maximum number of lines that the initial value of a variable or macro / define can have for it to appear in the documentation. If the initializer consists of more lines than specified here it will be hidden. Use a value of 0 to hide initializers completely. The appearance of the value of individual variables and macros / defines can be controlled using \showinitializer or \hideinitializer command in the documentation regardless of this setting.

Minimum value: 0, maximum value: 10000, default value: 30.

SHOW_USED_FILES Set the SHOW_USED_FILES tag to NO to disable the list of files generated at the bottom of the documentation of classes and structs. If set to YES, the list will mention the files that were used to generate the documentation.

The default value is: YES.

SHOW_FILES Set the SHOW_FILES tag to NO to disable the generation of the Files page. This will remove the Files entry from the Quick Index and from the Folder Tree View (if specified).

The default value is: YES.

SHOW_NAMESPACES Set the SHOW_NAMESPACES tag to NO to disable the generation of the Namespaces page. This will remove the Namespaces entry from the Quick Index and from the Folder Tree View (if specified).

The default value is: YES.

FILE_VERSION_FILTER The FILE_VERSION_FILTER tag can be used to specify a program or script that doxygen should invoke to get the current version for each file (typically from the version control system). Doxygen will invoke the program by executing (via popen()) the command command input-file, where command is the value of the FILE_VERSION_FILTER tag, and input-file is the name of an input file provided by doxygen. Whatever the program writes to standard output is used as the file version.

Example of using a shell script as a filter for Unix:

```
FILE_VERSION_FILTER = "/bin/sh versionfilter.sh"
```

Example shell script for CVS:

```
#!/bin/sh
cvs status $1 | sed -n 's/^[ \]*Working revision:[ \t]*\([0-9][0-9\.]*\).*/\1/p'
```

Example shell script for Subversion:

```
#!/bin/sh
svn stat -v $1 | sed -n 's/^[ A-Z?\*|!]\{1,15\}/r/;s/ \{1,15\}/\/r/;s/ .*//p'
```

Example filter for ClearCase:

```
FILE_VERSION_FILTER = "cleartool desc -fmt \%Vn"
```

LAYOUT_FILE The LAYOUT_FILE tag can be used to specify a layout file which will be parsed by doxygen. The layout file controls the global structure of the generated output files in an output format independent way. To create the layout file that represents doxygen's defaults, run doxygen with the -l option. You can optionally specify a file name after the option, if omitted DoxygenLayout.xml will be used as the name of the layout file. See also section Changing the layout of pages for information.
Note that if you run doxygen from a directory containing a file called DoxygenLayout.xml, doxygen will parse it automatically even if the LAYOUT_FILE tag is left empty.

CITE_BIB_FILES The CITE_BIB_FILES tag can be used to specify one or more bib files containing the reference definitions. This must be a list of .bib files. The .bib extension is automatically appended if omitted. This requires the bibtex tool to be installed. See also https://en.wikipedia.org/wiki/BibTeX for more info. For LaTeX the style of the bibliography can be controlled using LATEX_BIB_STYLE. To use this feature you need bibtex and perl available in the search path. See also \cite for info how to create references.

23.4 Configuration options related to warning and progress messages

QUIET The QUIET tag can be used to turn on/off the messages that are generated to standard output by doxygen. If QUIET is set to YES this implies that the messages are off.

The default value is: NO.

WARNINGS The WARNINGS tag can be used to turn on/off the warning messages that are generated to standard error (stderr) by doxygen. If WARNINGS is set to YES this implies that the warnings are on.
Tip: Turn warnings on while writing the documentation.

The default value is: YES.

WARN_IF_UNDOCUMENTED If the WARN_IF_UNDOCUMENTED tag is set to YES then doxygen will generate warnings for undocumented members. If EXTRACT_ALL is set to YES then this flag will automatically be disabled.

The default value is: YES.

WARN_IF_DOC_ERROR If the WARN_IF_DOC_ERROR tag is set to YES, doxygen will generate warnings for potential errors in the documentation, such as documenting some parameters in a documented function twice, or documenting parameters that don't exist or using markup commands wrongly.

The default value is: YES.

WARN_IF_INCOMPLETE_DOC If WARN_IF_INCOMPLETE_DOC is set to YES, doxygen will warn about incomplete function parameter documentation. If set to NO, doxygen will accept that some parameters have no documentation without warning.

The default value is: YES.

WARN_NO_PARAMDOC This WARN_NO_PARAMDOC option can be enabled to get warnings for functions that are documented, but have no documentation for their parameters or return value. If set to NO, doxygen will only warn about wrong parameter documentation, but not about the absence of documentation. If EXTRACT_ALL is set to YES then this flag will automatically be disabled. See also WARN_IF_INCOMPLETE_DOC

The default value is: NO.

WARN_AS_ERROR If the WARN_AS_ERROR tag is set to YES then doxygen will immediately stop when a warning is encountered. If the WARN_AS_ERROR tag is set to FAIL_ON_WARNINGS then doxygen will continue running as if WARN_AS_ERROR tag is set to NO, but at the end of the doxygen process doxygen will return with a non-zero status.

Possible values are: NO, YES and FAIL_ON_WARNINGS.

The default value is: NO.

WARN_FORMAT The WARN_FORMAT tag determines the format of the warning messages that doxygen can produce. The string should contain the $file, $line, and $text tags, which will be replaced by the file and line number from which the warning originated and the warning text. Optionally the format may contain $version, which will be replaced by the version of the file (if it could be obtained via FILE_VERSION_FILTER)

The default value is: $file:$line: $text.

WARN_LOGFILE The WARN_LOGFILE tag can be used to specify a file to which warning and error messages should be written. If left blank the output is written to standard error (stderr). In case the file specified cannot be opened for writing the warning and error messages are written to standard error. When as file – is specified the warning and error messages are written to standard output (stdout).

23.5 Configuration options related to the input files

INPUT The INPUT tag is used to specify the files and/or directories that contain documented source files. You may enter file names like myfile.cpp or directories like /usr/src/myproject. Separate the files or directories with spaces. See also FILE_PATTERNS and EXTENSION_MAPPING

Note

If this tag is empty the current directory is searched.

INPUT_ENCODING This tag can be used to specify the character encoding of the source files that doxygen parses. Internally doxygen uses the UTF-8 encoding. Doxygen uses libiconv (or the iconv built into libc) for the transcoding. See the libiconv documentation for the list of possible encodings.

The default value is: UTF-8.

FILE_PATTERNS If the value of the INPUT tag contains directories, you can use the FILE_PATTERNS tag to specify one or more wildcard patterns (like *.cpp and *.h) to filter out the source-files in the directories.
Note that for custom extensions or not directly supported extensions you also need to set EXTENSION_MAPPING for the extension otherwise the files are not read by doxygen.
Note the list of default checked file patterns might differ from the list of default file extension mappings.
If left blank the following patterns are tested: *.c, *.cc, *.cxx, *.cpp, *.c++, *.java, *.ii, *.ixx, *.ipp, *.i++, *.inl, *.idl, *.ddl, *.odl, *.h, *.hh, *.hxx, *.hpp, *.h++, *.l, *.cs, *.d, *.php, *.php4, *.php5, *.phtml, *.inc, *.m, *.markdown, *.md, *.mm, *.dox (to be provided as doxygen C comment), *.py, *.pyw, *.f90, *.f95, *.f03, *.f08, *.f18, *.f, *.for, *.vhd, *.vhdl, *.ucf, *.qsf and *.ice.

RECURSIVE The RECURSIVE tag can be used to specify whether or not subdirectories should be searched for input files as well.

The default value is: NO.

EXCLUDE The EXCLUDE tag can be used to specify files and/or directories that should be excluded from the INPUT source files. This way you can easily exclude a subdirectory from a directory tree whose root is specified with the INPUT tag.
Note that relative paths are relative to the directory from which doxygen is run.

EXCLUDE_SYMLINKS The EXCLUDE_SYMLINKS tag can be used to select whether or not files or directories that are symbolic links (a Unix file system feature) are excluded from the input.

The default value is: NO.

EXCLUDE_PATTERNS If the value of the INPUT tag contains directories, you can use the EXCLUDE_↩PATTERNS tag to specify one or more wildcard patterns to exclude certain files from those directories.
Note that the wildcards are matched against the file with absolute path, so to exclude all test directories for example use the pattern */test/*

EXCLUDE_SYMBOLS The EXCLUDE_SYMBOLS tag can be used to specify one or more symbol names (namespaces, classes, functions, etc.) that should be excluded from the output. The symbol name can be a fully qualified name, a word, or if the wildcard * is used, a substring. Examples: ANamespace, AClass, ANamespace::AClass, ANamespace::*Test
Note that the wildcards are matched against the file with absolute path, so to exclude all test directories use the pattern */test/*

EXAMPLE_PATH The EXAMPLE_PATH tag can be used to specify one or more files or directories that contain example code fragments that are included (see the \include command).

EXAMPLE_PATTERNS If the value of the EXAMPLE_PATH tag contains directories, you can use the EXAMPLE↩_PATTERNS tag to specify one or more wildcard pattern (like *.cpp and *.h) to filter out the source-files in the directories. If left blank all files are included.

EXAMPLE_RECURSIVE If the EXAMPLE_RECURSIVE tag is set to YES then subdirectories will be searched for input files to be used with the \include or \dontinclude commands irrespective of the value of the RECURSIVE tag.

The default value is: NO.

IMAGE_PATH The IMAGE_PATH tag can be used to specify one or more files or directories that contain images that are to be included in the documentation (see the \image command).

INPUT_FILTER The INPUT_FILTER tag can be used to specify a program that doxygen should invoke to filter for each input file. Doxygen will invoke the filter program by executing (via popen()) the command:
<filter> <input-file>
where <filter> is the value of the INPUT_FILTER tag, and <input-file> is the name of an input file. Doxygen will then use the output that the filter program writes to standard output. If FILTER_PATTERNS is specified, this tag will be ignored.
Note that the filter must not add or remove lines; it is applied before the code is scanned, but not when the output code is generated. If lines are added or removed, the anchors will not be placed correctly.
Note that for custom extensions or not directly supported extensions you also need to set EXTENSION_MAPPING for the extension otherwise the files are not properly processed by doxygen.

FILTER_PATTERNS The FILTER_PATTERNS tag can be used to specify filters on a per file pattern basis. Doxygen will compare the file name with each pattern and apply the filter if there is a match. The filters are a list of the form: pattern=filter (like *.cpp=my_cpp_filter). See INPUT_FILTER for further information on how filters are used. If the FILTER_PATTERNS tag is empty or if none of the patterns match the file name, INPUT_FILTER is applied.
Note that for custom extensions or not directly supported extensions you also need to set EXTENSION_MAPPING for the extension otherwise the files are not properly processed by doxygen.

FILTER_SOURCE_FILES If the FILTER_SOURCE_FILES tag is set to YES, the input filter (if set using INPUT_FILTER) will also be used to filter the input files that are used for producing the source files to browse (i.e. when SOURCE_BROWSER is set to YES).

The default value is: NO.

FILTER_SOURCE_PATTERNS The FILTER_SOURCE_PATTERNS tag can be used to specify source filters per file pattern. A pattern will override the setting for FILTER_PATTERN (if any) and it is also possible to disable source filtering for a specific pattern using *.ext= (so without naming a filter).

This tag requires that the tag FILTER_SOURCE_FILES is set to YES.

USE_MDFILE_AS_MAINPAGE If the USE_MDFILE_AS_MAINPAGE tag refers to the name of a markdown file that is part of the input, its contents will be placed on the main page (index.html). This can be useful if you have a project on for instance GitHub and want to reuse the introduction page also for the doxygen output.

23.6 Configuration options related to source browsing

SOURCE_BROWSER If the SOURCE_BROWSER tag is set to YES then a list of source files will be generated. Documented entities will be cross-referenced with these sources.
Note: To get rid of all source code in the generated output, make sure that also VERBATIM_HEADERS is set to NO.

The default value is: NO.

INLINE_SOURCES Setting the INLINE_SOURCES tag to YES will include the body of functions, classes and enums directly into the documentation.

The default value is: NO.

STRIP_CODE_COMMENTS Setting the STRIP_CODE_COMMENTS tag to YES will instruct doxygen to hide any special comment blocks from generated source code fragments. Normal C, C++ and Fortran comments will always remain visible.

The default value is: YES.

REFERENCED_BY_RELATION If the REFERENCED_BY_RELATION tag is set to YES then for each documented entity all documented functions referencing it will be listed.

The default value is: NO.

REFERENCES_RELATION If the REFERENCES_RELATION tag is set to YES then for each documented function all documented entities called/used by that function will be listed.

The default value is: NO.

REFERENCES_LINK_SOURCE If the REFERENCES_LINK_SOURCE tag is set to YES and SOURCE_BROWSER tag is set to YES then the hyperlinks from functions in REFERENCES_RELATION and REFERENCED_BY_RELATION lists will link to the source code. Otherwise they will link to the documentation.

The default value is: YES.

SOURCE_TOOLTIPS If SOURCE_TOOLTIPS is enabled (the default) then hovering a hyperlink in the source code will show a tooltip with additional information such as prototype, brief description and links to the definition and documentation. Since this will make the HTML file larger and loading of large files a bit slower, you can opt to disable this feature.

The default value is: YES.

This tag requires that the tag SOURCE_BROWSER is set to YES.

USE_HTAGS If the USE_HTAGS tag is set to YES then the references to source code will point to the HTML generated by the htags(1) tool instead of doxygen built-in source browser. The htags tool is part of GNU's global source tagging system (see https://www.gnu.org/software/global/global.html). You will need version 4.8.6 or higher.
To use it do the following:

1. Install the latest version of global
2. Enable SOURCE_BROWSER and USE_HTAGS in the configuration file
3. Make sure the INPUT points to the root of the source tree
4. Run doxygen as normal
   Doxygen will invoke htags (and that will in turn invoke gtags), so these tools must be available from the command line (i.e. in the search path).
   The result: instead of the source browser generated by doxygen, the links to source code will now point to the output of htags.

The default value is: NO.

This tag requires that the tag SOURCE_BROWSER is set to YES.

VERBATIM_HEADERS If the VERBATIM_HEADERS tag is set the YES then doxygen will generate a verbatim copy of the header file for each class for which an include is specified. Set to NO to disable this.

See also

Section \class.

The default value is: YES.

CLANG_ASSISTED_PARSING If the CLANG_ASSISTED_PARSING tag is set to YES then doxygen will use the clang parser for more accurate parsing at the cost of reduced performance. This can be particularly helpful with template rich C++ code for which doxygen's built-in parser lacks the necessary type information.

Note

The availability of this option depends on whether or not doxygen was generated with the -Duse_libclang=ON option for CMake.

The default value is: NO.

CLANG_ADD_INC_PATHS If the CLANG_ASSISTED_PARSING tag is set to YES and the CLANG_ADD_INC_PATHS tag is set to YES then doxygen will add the directory of each input to the include path.

The default value is: YES.

This tag requires that the tag CLANG_ASSISTED_PARSING is set to YES.

CLANG_OPTIONS If clang assisted parsing is enabled you can provide the compiler with command line options that you would normally use when invoking the compiler. Note that the include paths will already be set by doxygen for the files and directories specified with INPUT and INCLUDE_PATH.

This tag requires that the tag CLANG_ASSISTED_PARSING is set to YES.

CLANG_DATABASE_PATH If clang assisted parsing is enabled you can provide the clang parser with the path to the directory containing a file called compile_commands.json. This file is the compilation database containing the options used when the source files were built. This is equivalent to specifying the -p option to a clang tool, such as clang-check. These options will then be passed to the parser. Any options specified with CLANG_OPTIONS will be added as well.

Note

The availability of this option depends on whether or not doxygen was generated with the -Duse_libclang=ON option for CMake.

23.7 Configuration options related to the alphabetical class index

ALPHABETICAL_INDEX If the ALPHABETICAL_INDEX tag is set to YES, an alphabetical index of all compounds will be generated. Enable this if the project contains a lot of classes, structs, unions or interfaces.

The default value is: YES.

IGNORE_PREFIX In case all classes in a project start with a common prefix, all classes will be put under the same header in the alphabetical index. The IGNORE_PREFIX tag can be used to specify a prefix (or a list of prefixes) that should be ignored while generating the index headers.

This tag requires that the tag ALPHABETICAL_INDEX is set to YES.

23.8 Configuration options related to the HTML output

GENERATE_HTML If the GENERATE_HTML tag is set to YES, doxygen will generate HTML output

The default value is: YES.

HTML_OUTPUT The HTML_OUTPUT tag is used to specify where the HTML docs will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it.

The default directory is: html.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_FILE_EXTENSION The HTML_FILE_EXTENSION tag can be used to specify the file extension for each generated HTML page (for example: .htm, .php, .asp).

The default value is: .html.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_HEADER The HTML_HEADER tag can be used to specify a user-defined HTML header file for each generated HTML page. If the tag is left blank doxygen will generate a standard header.
To get valid HTML the header file that includes any scripts and style sheets that doxygen needs, which is dependent on the configuration options used (e.g. the setting GENERATE_TREEVIEW). It is highly recommended to start with a default header using

```
doxygen -w html new_header.html new_footer.html new_stylesheet.css YourConfigFile
```

and then modify the file new_header.html.

See also section Doxygen usage for information on how to generate the default header that doxygen normally uses.

Note

The header is subject to change so you typically have to regenerate the default header when upgrading to a newer version of doxygen. The following markers have a special meaning inside the header and footer:

$title will be replaced with the title of the page.

$datetime will be replaced with current the date and time.

$date will be replaced with the current date.

$year will be replaces with the current year.

$doxygenversion will be replaced with the version of doxygen

$projectname will be replaced with the name of the project (see PROJECT_NAME)

$projectnumber will be replaced with the project number (see PROJECT_NUMBER)

$projectbrief will be replaced with the project brief description (see PROJECT_BRIEF)

$projectlogo will be replaced with the project logo (see PROJECT_LOGO)

$generatedby will be replaced with the output language dependent version of the text "Generated by" or when the HTML_TIMESTAMP is set by the output language dependent version of the text "Generated on $datetime for $projectname by".

$stylesheet will be replaced with the setting of HTML_STYLESHEET unless it is empty or the file in which case it is replaced by the default setting doxygen.css.

$extrastylesheet will be replaced with the setting of HTML_EXTRA_STYLESHEET including the required HTML tags for each extra stylesheet.

$treeview will be replaced with links to the javascript and style sheets needed for the navigation tree (or an empty string when GENERATE_TREEVIEW is disabled).

$search will be replaced with a links to the javascript and style sheets needed for the search engine (or an empty string when SEARCHENGINE is disabled).

$searchbox will be replaced with the HTML code needed for the search box to be shown (or an empty string when SEARCHENGINE is disabled).

$mathjax will be replaced with a links to the javascript and style sheets needed for the MathJax feature (or an empty string when USE_MATHJAX is disabled).

$relpath^ If CREATE_SUBDIRS is enabled, the command `$relpath^` can be used to produce a relative path to the root of the HTML output directory, e.g. use `$relpath^doxygen.css`, to refer to the standard style sheet.

$navpath will be replaced with a path as required by GENERATE_TREEVIEW

To cope with differences in the layout of the header and footer that depend on configuration settings, the header can also contain special blocks that will be copied to the output or skipped depending on the configuration. Such blocks have the following form:

```
<!--BEGIN BLOCKNAME-->
Some context copied when condition BLOCKNAME holds
<!--END BLOCKNAME-->
<!--BEGIN !BLOCKNAME-->
Some context copied when condition BLOCKNAME does not hold
<!--END !BLOCKNAME-->
```

The following block names are supported:

DISABLE_INDEX Content within this block is copied to the output if the DISABLE_INDEX option is enabled (so when the index is disabled).

GENERATE_TREEVIEW Content within this block is copied to the output if the GENERATE_TREEVIEW option is enabled.

SEARCHENGINE Content within this block is copied to the output if the SEARCHENGINE option is enabled.

PROJECT_NAME Content within the block is copied to the output if the PROJECT_NAME option is not empty.

PROJECT_NUMBER Content within the block is copied to the output if the PROJECT_NUMBER option is not empty.

PROJECT_BRIEF Content within the block is copied to the output if the PROJECT_BRIEF option is not empty.

PROJECT_LOGO Content within the block is copied to the output if the PROJECT_LOGO option is not empty.

FULL_SIDEBAR Content within the block is copied to the output if the FULL_SIDEBAR, DISABLE_INDEX and GENERATE_TREEVIEW options are all enabled.

TITLEAREA Content within this block is copied to the output if a title is visible at the top of each page. This is the case if either PROJECT_NAME, PROJECT_BRIEF, PROJECT_LOGO is filled in or if both DISABLE_INDEX and SEARCHENGINE are enabled.

This tag requires that the tag GENERATE_HTML is set to `YES`.

HTML_FOOTER The `HTML_FOOTER` tag can be used to specify a user-defined HTML footer for each generated HTML page. If the tag is left blank doxygen will generate a standard footer.

See HTML_HEADER for more information on how to generate a default footer and what special commands can be used inside the footer.

See also section Doxygen usage for information on how to generate the default footer that doxygen normally uses.

This tag requires that the tag GENERATE_HTML is set to `YES`.

HTML_STYLESHEET The HTML_STYLESHEET tag can be used to specify a user-defined cascading style sheet that is used by each HTML page. It can be used to fine-tune the look of the HTML output. If left blank doxygen will generate a default style sheet.

See also section Doxygen usage for information on how to generate the style sheet that doxygen normally uses.

Note

It is recommended to use HTML_EXTRA_STYLESHEET instead of this tag, as it is more robust and this tag (HTML_STYLESHEET) will in the future become obsolete.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_EXTRA_STYLESHEET The HTML_EXTRA_STYLESHEET tag can be used to specify additional user-defined cascading style sheets that are included after the standard style sheets created by doxygen. Using this option one can overrule certain style aspects. This is preferred over using HTML_STYLESHEET since it does not replace the standard style sheet and is therefore more robust against future updates. Doxygen will copy the style sheet files to the output directory.

Note

The order of the extra style sheet files is of importance (e.g. the last style sheet in the list overrules the setting of the previous ones in the list). Here is an example style sheet that gives the contents area a fixed width:

```
body {
        background-color: #CCC;
        color: black;
        margin: 0;
}

div.contents {
        margin-bottom: 10px;
        padding: 12px;
        margin-left: auto;
        margin-right: auto;
        width: 960px;
        background-color: white;
        border-radius: 8px;
}

#titlearea {
        background-color: white;
}

hr.footer {
        display: none;
}

.footer {
        background-color: #AAA;
}
```

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_EXTRA_FILES The HTML_EXTRA_FILES tag can be used to specify one or more extra images or other source files which should be copied to the HTML output directory. Note that these files will be copied to the base HTML output directory. Use the $relpath^ marker in the HTML_HEADER and/or HTML_FOOTER files to load these files. In the HTML_STYLESHEET file, use the file name only. Also note that the files will be copied as-is; there are no commands or markers available.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_COLORSTYLE_HUE The HTML_COLORSTYLE_HUE tag controls the color of the HTML output. Doxygen will adjust the colors in the style sheet and background images according to this color. Hue is specified as an angle on a color-wheel, see https://en.wikipedia.org/wiki/Hue for more information. For instance the value 0 represents red, 60 is yellow, 120 is green, 180 is cyan, 240 is blue, 300 purple, and 360 is red again.

Minimum value: 0, maximum value: 359, default value: 220.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_COLORSTYLE_SAT The HTML_COLORSTYLE_SAT tag controls the purity (or saturation) of the colors in the HTML output. For a value of 0 the output will use gray-scales only. A value of 255 will produce the most vivid colors.

Minimum value: 0, maximum value: 255, default value: 100.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_COLORSTYLE_GAMMA The HTML_COLORSTYLE_GAMMA tag controls the gamma correction applied to the luminance component of the colors in the HTML output. Values below 100 gradually make the output lighter, whereas values above 100 make the output darker. The value divided by 100 is the actual gamma applied, so 80 represents a gamma of 0.8, The value 220 represents a gamma of 2.2, and 100 does not change the gamma.

Minimum value: 40, maximum value: 240, default value: 80.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_TIMESTAMP If the HTML_TIMESTAMP tag is set to YES then the footer of each generated HTML page will contain the date and time when the page was generated. Setting this to YES can help to show when doxygen was last run and thus if the documentation is up to date.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_DYNAMIC_MENUS If the HTML_DYNAMIC_MENUS tag is set to YES then the generated HTML documentation will contain a main index with vertical navigation menus that are dynamically created via Java↩ Script. If disabled, the navigation index will consists of multiple levels of tabs that are statically embedded in every HTML page. Disable this option to support browsers that do not have JavaScript, like the Qt help browser.

The default value is: YES.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_DYNAMIC_SECTIONS If the HTML_DYNAMIC_SECTIONS tag is set to YES then the generated HTML documentation will contain sections that can be hidden and shown after the page has loaded.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_INDEX_NUM_ENTRIES With HTML_INDEX_NUM_ENTRIES one can control the preferred number of entries shown in the various tree structured indices initially; the user can expand and collapse entries dynamically later on. Doxygen will expand the tree to such a level that at most the specified number of entries are visible (unless a fully collapsed tree already exceeds this amount). So setting the number of entries 1 will produce a full collapsed tree by default. 0 is a special value representing an infinite number of entries and will result in a full expanded tree by default.

Minimum value: 0, maximum value: 9999, default value: 100.

This tag requires that the tag GENERATE_HTML is set to YES.

GENERATE_DOCSET If the GENERATE_DOCSET tag is set to YES, additional index files will be generated that can be used as input for Apple's Xcode 3 integrated development environment, introduced with OSX 10.5 (Leopard). To create a documentation set, doxygen will generate a Makefile in the HTML output directory. Running make will produce the docset in that directory and running make install will install the docset in ~/Library/Developer/Shared/↩ Documentation/DocSets so that Xcode will find it at startup. See https://developer.↩ apple.com/library/archive/featuredarticles/DoxygenXcode/_index.html for more information.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

DOCSET_FEEDNAME This tag determines the name of the docset feed. A documentation feed provides an umbrella under which multiple documentation sets from a single provider (such as a company or product suite) can be grouped.

The default value is: `Doxygen generated docs`.

This tag requires that the tag GENERATE_DOCSET is set to `YES`.

DOCSET_FEEDURL This tag determines the URL of the docset feed. A documentation feed provides an umbrella under which multiple documentation sets from a single provider (such as a company or product suite) can be grouped.

This tag requires that the tag GENERATE_DOCSET is set to `YES`.

DOCSET_BUNDLE_ID This tag specifies a string that should uniquely identify the documentation set bundle. This should be a reverse domain-name style string, e.g. `com.mycompany.MyDocSet`. Doxygen will append `.docset` to the name.

The default value is: `org.doxygen.Project`.

This tag requires that the tag GENERATE_DOCSET is set to `YES`.

DOCSET_PUBLISHER_ID The `DOCSET_PUBLISHER_ID` tag specifies a string that should uniquely identify the documentation publisher. This should be a reverse domain-name style string, e.g. `com.mycompany.↩MyDocSet.documentation`.

The default value is: `org.doxygen.Publisher`.

This tag requires that the tag GENERATE_DOCSET is set to `YES`.

DOCSET_PUBLISHER_NAME The `DOCSET_PUBLISHER_NAME` tag identifies the documentation publisher.

The default value is: `Publisher`.

This tag requires that the tag GENERATE_DOCSET is set to `YES`.

GENERATE_HTMLHELP If the `GENERATE_HTMLHELP` tag is set to `YES` then doxygen generates three additional HTML index files: `index.hhp`, `index.hhc`, and `index.hhk`. The `index.hhp` is a project file that can be read by Microsoft's HTML Help Workshop on Windows. In the beginning of 2021 Microsoft took the original page, with a.o. the download links, offline the HTML help workshop was already many years in maintenance mode). You can download the HTML help workshop from the web archives at `Installation executable`.
The HTML Help Workshop contains a compiler that can convert all HTML output generated by doxygen into a single compiled HTML file (`.chm`). Compiled HTML files are now used as the Windows 98 help format, and will replace the old Windows help format (`.hlp`) on all Windows platforms in the future. Compressed HTML files also contain an index, a table of contents, and you can search for words in the documentation. The HTML workshop also contains a viewer for compressed HTML files.

The default value is: `NO`.

This tag requires that the tag GENERATE_HTML is set to `YES`.

CHM_FILE The `CHM_FILE` tag can be used to specify the file name of the resulting `.chm` file. You can add a path in front of the file if the result should not be written to the html output directory.

This tag requires that the tag GENERATE_HTMLHELP is set to `YES`.

HHC_LOCATION The `HHC_LOCATION` tag can be used to specify the location (absolute path including file name) of the HTML help compiler (`hhc.exe`). If non-empty, doxygen will try to run the HTML help compiler on the generated `index.hhp`.

The file has to be specified with full path.

This tag requires that the tag GENERATE_HTMLHELP is set to `YES`.

GENERATE_CHI The `GENERATE_CHI` flag controls if a separate `.chi` index file is generated (`YES`) or that it should be included in the main `.chm` file (`NO`).

The default value is: `NO`.

This tag requires that the tag GENERATE_HTMLHELP is set to `YES`.

CHM_INDEX_ENCODING The CHM_INDEX_ENCODING is used to encode HtmlHelp index (hhk), content (hhc) and project file content.

This tag requires that the tag GENERATE_HTMLHELP is set to YES.

BINARY_TOC The BINARY_TOC flag controls whether a binary table of contents is generated (YES) or a normal table of contents (NO) in the .chm file. Furthermore it enables the Previous and Next buttons.

The default value is: NO.

This tag requires that the tag GENERATE_HTMLHELP is set to YES.

TOC_EXPAND The TOC_EXPAND flag can be set to YES to add extra items for group members to the table of contents of the HTML help documentation and to the tree view.

The default value is: NO.

This tag requires that the tag GENERATE_HTMLHELP is set to YES.

GENERATE_QHP If the GENERATE_QHP tag is set to YES and both QHP_NAMESPACE and QHP_VIRTUAL_FOLDER are set, an additional index file will be generated that can be used as input for Qt's qhelpgenerator to generate a Qt Compressed Help (.qch) of the generated HTML documentation.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

QCH_FILE If the QHG_LOCATION tag is specified, the QCH_FILE tag can be used to specify the file name of the resulting .qch file. The path specified is relative to the HTML output folder.

This tag requires that the tag GENERATE_QHP is set to YES.

QHP_NAMESPACE The QHP_NAMESPACE tag specifies the namespace to use when generating Qt Help Project output. For more information please see Qt Help Project / Namespace.

The default value is: org.doxygen.Project.

This tag requires that the tag GENERATE_QHP is set to YES.

QHP_VIRTUAL_FOLDER The QHP_VIRTUAL_FOLDER tag specifies the namespace to use when generating Qt Help Project output. For more information please see Qt Help Project / Virtual Folders.

The default value is: doc.

This tag requires that the tag GENERATE_QHP is set to YES.

QHP_CUST_FILTER_NAME If the QHP_CUST_FILTER_NAME tag is set, it specifies the name of a custom filter to add. For more information please see Qt Help Project / Custom Filters.

This tag requires that the tag GENERATE_QHP is set to YES.

QHP_CUST_FILTER_ATTRS The QHP_CUST_FILTER_ATTRS tag specifies the list of the attributes of the custom filter to add. For more information please see Qt Help Project / Custom Filters.

This tag requires that the tag GENERATE_QHP is set to YES.

QHP_SECT_FILTER_ATTRS The QHP_SECT_FILTER_ATTRS tag specifies the list of the attributes this project's filter section matches. Qt Help Project / Filter Attributes.

This tag requires that the tag GENERATE_QHP is set to YES.

QHG_LOCATION The QHG_LOCATION tag can be used to specify the location (absolute path including file name) of Qt's qhelpgenerator. If non-empty doxygen will try to run qhelpgenerator on the generated .qhp file.

This tag requires that the tag GENERATE_QHP is set to YES.

GENERATE_ECLIPSEHELP If the GENERATE_ECLIPSEHELP tag is set to YES, additional index files will be generated, together with the HTML files, they form an Eclipse help plugin.

To install this plugin and make it available under the help contents menu in Eclipse, the contents of the directory containing the HTML and XML files needs to be copied into the plugins directory of eclipse. The name of the directory within the plugins directory should be the same as the ECLIPSE_DOC_ID value.

After copying Eclipse needs to be restarted before the help appears.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

ECLIPSE_DOC_ID A unique identifier for the Eclipse help plugin. When installing the plugin the directory name containing the HTML and XML files should also have this name. Each documentation set should have its own identifier.

The default value is: org.doxygen.Project.

This tag requires that the tag GENERATE_ECLIPSEHELP is set to YES.

DISABLE_INDEX If you want full control over the layout of the generated HTML pages it might be necessary to disable the index and replace it with your own. The DISABLE_INDEX tag can be used to turn on/off the condensed index (tabs) at top of each HTML page. A value of NO enables the index and the value YES disables it. Since the tabs in the index contain the same information as the navigation tree, you can set this option to YES if you also set GENERATE_TREEVIEW to YES.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

GENERATE_TREEVIEW The GENERATE_TREEVIEW tag is used to specify whether a tree-like index structure should be generated to display hierarchical information. If the tag value is set to YES, a side panel will be generated containing a tree-like index structure (just like the one that is generated for HTML Help). For this to work a browser that supports JavaScript, DHTML, CSS and frames is required (i.e. any modern browser). Windows users are probably better off using the HTML help feature.

Via custom style sheets (see HTML_EXTRA_STYLESHEET) one can further fine tune the look of the index (see Fine-tuning the output). As an example, the default style sheet generated by doxygen has an example that shows how to put an image at the root of the tree instead of the PROJECT_NAME.

Since the tree basically has the same information as the tab index, you could consider setting DISABLE_INDEX to YES when enabling this option.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

FULL_SIDEBAR When both GENERATE_TREEVIEW and DISABLE_INDEX are set to YES, then the FULL↩_SIDEBAR option determines if the side bar is limited to only the treeview area (value NO) or if it should extend to the full height of the window (value YES). Setting this to YES gives a layout similar to https↩://docs.readthedocs.io with more room for contents, but less room for the project logo, title, and description.

If either GENERATE_TREEVIEW or DISABLE_INDEX is set to NO, this option has no effect.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

ENUM_VALUES_PER_LINE The ENUM_VALUES_PER_LINE tag can be used to set the number of enum values that doxygen will group on one line in the generated HTML documentation.
Note that a value of 0 will completely suppress the enum values from appearing in the overview section.

Minimum value: 0, maximum value: 20, default value: 4.

This tag requires that the tag GENERATE_HTML is set to YES.

TREEVIEW_WIDTH If the treeview is enabled (see GENERATE_TREEVIEW) then this tag can be used to set the initial width (in pixels) of the frame in which the tree is shown.

Minimum value: 0, maximum value: 1500, default value: 250.

This tag requires that the tag GENERATE_HTML is set to YES.

EXT_LINKS_IN_WINDOW If the EXT_LINKS_IN_WINDOW option is set to YES, doxygen will open links to external symbols imported via tag files in a separate window.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

OBFUSCATE_EMAILS If the OBFUSCATE_EMAILS tag is set to YES, doxygen will obfuscate email addresses.

The default value is: YES.

This tag requires that the tag GENERATE_HTML is set to YES.

HTML_FORMULA_FORMAT If the HTML_FORMULA_FORMAT option is set to svg, doxygen will use the pdf2svg tool (see https://github.com/dawbarton/pdf2svg) or inkscape (see https://inkscape.org) to generate formulas as SVG images instead of PNGs for the HTML output. These images will generally look nicer at scaled resolutions.

Possible values are: png (the default) and svg (looks nicer but requires the pdf2svg or inkscape tool).

The default value is: png.

This tag requires that the tag GENERATE_HTML is set to YES.

FORMULA_FONTSIZE Use this tag to change the font size of LaTeX formulas included as images in the HTML documentation. When you change the font size after a successful doxygen run you need to manually remove any form_*.png images from the HTML output directory to force them to be regenerated.

Minimum value: 8, maximum value: 50, default value: 10.

This tag requires that the tag GENERATE_HTML is set to YES.

FORMULA_TRANSPARENT Use the FORMULA_TRANSPARENT tag to determine whether or not the images generated for formulas are transparent PNGs. Transparent PNGs are not supported properly for IE 6.0, but are supported on all modern browsers.
Note that when changing this option you need to delete any form_*.png files in the HTML output directory before the changes have effect.

The default value is: YES.

This tag requires that the tag GENERATE_HTML is set to YES.

FORMULA_MACROFILE The FORMULA_MACROFILE can contain LaTeX \newcommand and \renewcommand commands to create new LaTeX commands to be used in formulas as building blocks. See the section Including formulas for details.

USE_MATHJAX Enable the USE_MATHJAX option to render LaTeX formulas using MathJax (see https://www.mathjax.org) which uses client side JavaScript for the rendering instead of using pre-rendered bitmaps. Use this if you do not have LaTeX installed or if you want to formulas look prettier in the HTML output. When enabled you may also need to install MathJax separately and configure the path to it using the MATHJAX_RELPATH option.

The default value is: NO.

This tag requires that the tag GENERATE_HTML is set to YES.

MATHJAX_VERSION With MATHJAX_VERSION it is possible to specify the MathJax version to be used. Note that the different versions of MathJax have different requirements with regards to the different settings, so it is possible that also other MathJax settings have to be changed when switching between the different MathJax versions.

Possible values are: MathJax_2 and MathJax_3.

The default value is: MathJax_2.

This tag requires that the tag USE_MATHJAX is set to YES.

MATHJAX_FORMAT When MathJax is enabled you can set the default output format to be used for the MathJax output. For more details about the output format see MathJax version 2 and MathJax version 3.

Possible values are: HTML-CSS (which is slower, but has the best compatibility. This is the name for Mathjax version 2, for MathJax version 3 this will be translated into chtml), NativeMML (i.e. MathML. Only supported for NathJax 2. For MathJax version 3 chtml will be used instead.), chtml (This is the name for Mathjax version 3, for MathJax version 2 this will be translated into HTML-CSS) and SVG.

The default value is: HTML-CSS.

This tag requires that the tag USE_MATHJAX is set to YES.

MATHJAX_RELPATH When MathJax is enabled you need to specify the location relative to the HTML output directory using the MATHJAX_RELPATH option. The destination directory should contain the MathJax.js script. For instance, if the mathjax directory is located at the same level as the HTML output directory, then MATHJAX_RELPATH should be ../mathjax. The default value points to the MathJax Content Delivery Network so you can quickly see the result without installing MathJax. However, it is strongly recommended to install a local copy of MathJax from https://www.mathjax.org before deployment.

The default value is:

- in case of MathJax version 2: https://cdn.jsdelivr.net/npm/mathjax@2
- in case of MathJax version 3: https://cdn.jsdelivr.net/npm/mathjax@3

This tag requires that the tag USE_MATHJAX is set to YES.

MATHJAX_EXTENSIONS The MATHJAX_EXTENSIONS tag can be used to specify one or more MathJax extension names that should be enabled during MathJax rendering. For example for MathJax version 2 (see https://docs.mathjax.org/en/v2.7-latest/tex.html#tex-and-latex-extensions)↩ :

```
MATHJAX_EXTENSIONS     = TeX/AMSmath TeX/AMSsymbols
```

For example for MathJax version 3 (see http://docs.mathjax.org/en/latest/input/tex/extensions/in
html):

```
MATHJAX_EXTENSIONS     = ams
```

This tag requires that the tag USE_MATHJAX is set to YES.

MATHJAX_CODEFILE The MATHJAX_CODEFILE tag can be used to specify a file with javascript pieces of code that will be used on startup of the MathJax code. See the MathJax site for more details. As an example to disable the "Math Renderer" menu item in the "Math Settings" menu of MathJax:

```
MATHJAX_CODEFILE = disableRenderer.js
```

with in the file disableRenderer.js:

```
MathJax.Hub.Config({
 menuSettings: {
  showRenderer: false,
 }
});
```

This tag requires that the tag USE_MATHJAX is set to YES.

SEARCHENGINE When the SEARCHENGINE tag is enabled doxygen will generate a search box for the HTML output. The underlying search engine uses javascript and DHTML and should work on any modern browser. Note that when using HTML help (GENERATE_HTMLHELP), Qt help (GENERATE_QHP), or docsets (GENERATE_DOCSET) there is already a search function so this one should typically be disabled. For large projects the javascript based search engine can be slow, then enabling SERVER_BASED_SEARCH may provide a better solution.

It is possible to search using the keyboard; to jump to the search box use <access key> + S (what the <access key> is depends on the OS and browser, but it is typically <CTRL>, <ALT>/<option>, or both). Inside the search box use the <cursor down key> to jump into the search results window, the results can be navigated using the <cursor keys>. Press <Enter> to select an item or <escape> to cancel the search. The filter options can be selected when the cursor is inside the search box by pressing <Shift>+<cursor down>. Also here use the <cursor keys> to select a filter and <Enter> or <escape> to activate or cancel the filter option.

The default value is: YES.

This tag requires that the tag GENERATE_HTML is set to YES.

SERVER_BASED_SEARCH When the SERVER_BASED_SEARCH tag is enabled the search engine will be implemented using a web server instead of a web client using JavaScript.

There are two flavors of web server based searching depending on the EXTERNAL_SEARCH setting. When disabled, doxygen will generate a PHP script for searching and an index file used by the script. When EXTERNAL_SEARCH is enabled the indexing and searching needs to be provided by external tools. See the section External Indexing and Searching for details.

The default value is: NO.

This tag requires that the tag SEARCHENGINE is set to YES.

EXTERNAL_SEARCH When EXTERNAL_SEARCH tag is enabled doxygen will no longer generate the PHP script for searching. Instead the search results are written to an XML file which needs to be processed by an external indexer. Doxygen will invoke an external search engine pointed to by the SEARCHENGINE_URL option to obtain the search results.
Doxygen ships with an example indexer (doxyindexer) and search engine (doxysearch.cgi) which are based on the open source search engine library Xapian.
See the section External Indexing and Searching for details.

The default value is: NO.

This tag requires that the tag SEARCHENGINE is set to YES.

SEARCHENGINE_URL The SEARCHENGINE_URL should point to a search engine hosted by a web server which will return the search results when EXTERNAL_SEARCH is enabled.
Doxygen ships with an example indexer (doxyindexer) and search engine (doxysearch.↩cgi) which are based on the open source search engine library Xapian. See the section External Indexing and Searching for details.

This tag requires that the tag SEARCHENGINE is set to YES.

SEARCHDATA_FILE When SERVER_BASED_SEARCH and EXTERNAL_SEARCH are both enabled the unindexed search data is written to a file for indexing by an external tool. With the SEARCHDATA_FILE tag the name of this file can be specified.

The default file is: searchdata.xml.

This tag requires that the tag SEARCHENGINE is set to YES.

EXTERNAL_SEARCH_ID When SERVER_BASED_SEARCH and EXTERNAL_SEARCH are both enabled the EXTERNAL_SEARCH_ID tag can be used as an identifier for the project. This is useful in combination with EXTRA_SEARCH_MAPPINGS to search through multiple projects and redirect the results back to the right project.

This tag requires that the tag SEARCHENGINE is set to YES.

EXTRA_SEARCH_MAPPINGS The EXTRA_SEARCH_MAPPINGS tag can be used to enable searching through doxygen projects other than the one defined by this configuration file, but that are all added to the same external search index. Each project needs to have a unique id set via EXTERNAL_SEARCH_ID. The search mapping then maps the id of to a relative location where the documentation can be found.
The format is:

```
EXTRA_SEARCH_MAPPINGS = tagname1=loc1 tagname2=loc2 ...
```

This tag requires that the tag SEARCHENGINE is set to YES.

23.9 Configuration options related to the LaTeX output

GENERATE_LATEX If the GENERATE_LATEX tag is set to YES, doxygen will generate LaTeX output.

The default value is: YES.

LATEX_OUTPUT The LATEX_OUTPUT tag is used to specify where the LaTeX docs will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it.

The default directory is: latex.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_CMD_NAME The LATEX_CMD_NAME tag can be used to specify the LaTeX command name to be invoked.
Note that when not enabling USE_PDFLATEX the default is latex when enabling USE_PDFLATEX the default is pdflatex and when in the later case latex is chosen this is overwritten by pdflatex. For specific output languages the default can have been set differently, this depends on the implementation of the output language.

This tag requires that the tag GENERATE_LATEX is set to YES.

MAKEINDEX_CMD_NAME The MAKEINDEX_CMD_NAME tag can be used to specify the command name to generate index for LaTeX.

Note

This tag is used in the Makefile / make.bat.

See also

LATEX_MAKEINDEX_CMD for the part in the generated output file (.tex).

The default file is: makeindex.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_MAKEINDEX_CMD The LATEX_MAKEINDEX_CMD tag can be used to specify the command name to generate index for LaTeX. In case there is no backslash (\) as first character it will be automatically added in the LaTeX code.

Note

This tag is used in the generated output file (.tex).

See also

MAKEINDEX_CMD_NAME for the part in the Makefile / make.bat.

The default value is: makeindex.

This tag requires that the tag GENERATE_LATEX is set to YES.

COMPACT_LATEX If the COMPACT_LATEX tag is set to YES, doxygen generates more compact LaTeX documents. This may be useful for small projects and may help to save some trees in general.

The default value is: NO.

This tag requires that the tag GENERATE_LATEX is set to YES.

PAPER_TYPE The PAPER_TYPE tag can be used to set the paper type that is used by the printer.

Possible values are: a4 (210 x 297 mm), letter (8.5 x 11 inches), legal (8.5 x 14 inches) and executive (7.25 x 10.5 inches).

The default value is: a4.

This tag requires that the tag GENERATE_LATEX is set to YES.

EXTRA_PACKAGES The EXTRA_PACKAGES tag can be used to specify one or more LaTeX package names that should be included in the LaTeX output. The package can be specified just by its name or with the correct syntax as to be used with the LaTeX \usepackage command.

To get the times font for instance you can specify :

```
  EXTRA_PACKAGES=times
or
  EXTRA_PACKAGES={times}
```

To use the option intlimits with the amsmath package you can specify:

```
   EXTRA_PACKAGES=[intlimits]{amsmath}
```

If left blank no extra packages will be included.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_HEADER The LATEX_HEADER tag can be used to specify a user-defined LaTeX header for the generated LaTeX document. The header should contain everything until the first chapter. If it is left blank doxygen will generate a standard header.

It is highly recommended to start with a default header using

```
doxygen -w latex new_header.tex new_footer.tex new_stylesheet.sty
```

and then modify the file `new_header.tex`.

See also section Doxygen usage for information on how to generate the default header that doxygen normally uses.

Note: Only use a user-defined header if you know what you are doing!

Note

The header is subject to change so you typically have to regenerate the default header when upgrading to a newer version of doxygen. The following commands have a special meaning inside the header (and footer):

$title will be replaced with the project name.

$datetime will be replaced with current the date and time.

$date will be replaced with the current date.

$year will be replaces with the current year.

$doxygenversion will be replaced with the version of doxygen

$projectname will be replaced with the name of the project (see PROJECT_NAME)

$projectnumber will be replaced with the project number (see PROJECT_NUMBER)

$projectbrief will be replaced with the project brief description (see PROJECT_BRIEF)

$projectlogo will be replaced with the project logo (see PROJECT_LOGO)

$latexdocumentpre will be replaced by an output language dependent setting e.g. embed the entire document in a special environment (for Chinese, Japanese etc.) Commonly used together with `$latexdocumentpost` in the footer.

$latexdocumentpost will be replaced by an output language dependent setting e.g. embed the entire document in a special environment (for Chinese, Japanese etc.) Commonly used together with `$latexdocumentpre` in the header.

$generatedby will be replaced with the output language dependent version of the text "Generated by" or when the LATEX_TIMESTAMP is set by the output language dependent version of the text "Generated on `$datetime` for `$projectname` by".

$latexcitereference will be replaced by the output language dependent$ version of the word "Bibliography". This setting is typically used in combination with the block name `CITATIONS_PRESENT`.

$latexbibstyle will be replaced with the latex bib style to be used as as set by LATEX_BIB_STYLE, in case nothing is set the bib style `plain` is used. This setting is typically used in combination with the block name `CITATIONS_PRESENT`.

$latexbibfiles will be replaced by the comma separated list of `bib`. files as set by CITE_BIB_FILES (when necessary a missing `.bib` is automatically added). This setting is typically used in combination with the block name `CITATIONS_PRESENT`.

$papertype will be replaced by the paper type as set in PAPER_TYPE and the word "paper" is directly appended to it to have a correct LaTeX paper type.

$languagesupport will be replaced by an output language dependent setting of packages required for translating terms of the specified language.

$latexfontenc will be replaced by an output language dependent setting of the fontencoding to be used. This setting is typically used in combination with the block name `LATEX_FONTENC`.

$latexfont will be replaced by an output language dependent setting of the fonts to be used.

$latexemojidirectory will be replaced by the directory as set in LATEX_EMOJI_DIRECTORY with the backslashes replaced by forward slashes (so usable by LaTeX). In case the LATEX_EMOJI_DIRECTORY is empty, the current directory will be used.

$makeindex will be replaced by the command as set in LATEX_MAKEINDEX_CMD. Then the command doesn't start with a backslash, a backslash is automatically prepended. In case the setting is empty the command `\makeindex` is used.

$extralatexpackages will be replaced by commands for using the packages set in EXTRA_PACKAGES.

$extralatexstylesheet will be replaced by commands for using the packages set in LATEX_EXTRA_STYLESHEET (when the extension is the default extension, `.sty`, this extension is stripped for the package name).

$latexspecialformulachars will be replaced by the code for some special unicode characters that are commonly used (i.e. superscript minus, superscript 2 and superscript 3)

$formulamacrofile will be replaced by the name of the file as set in FORMULA_MACROFILE. This setting is typically used in combination with the block name `FORMULA_MACROFILE`.

To cope with differences in the layout of the header and footer that depend on configuration settings, the header and footer can also contain special blocks that will be copied to the output or skipped depending on the configuration. Such blocks have the following form:

```
%%BEGIN BLOCKNAME
Some context copied when condition BLOCKNAME holds
%%END BLOCKNAME
%%BEGIN !BLOCKNAME
Some context copied when condition BLOCKNAME does not hold
%%END !BLOCKNAME
```

The following block names are set based on the used settings in the configuration file:

COMPACT_LATEX Content within this block is copied to the output when the COMPACT_LATEX option is enabled.

PDF_HYPERLINKS Content within this block is copied to the output when the PDF_HYPERLINKS option is enabled.

USE_PDFLATEX Content within this block is copied to the output when the USE_PDFLATEX option is enabled.

LATEX_BATCHMODE Content within this block is copied to the output when the LATEX_BATCHMODE option is enabled.

LATEX_TIMESTAMP Content within this block is copied to the output when the LATEX_TIMESTAMP option is enabled.

The following block names are set based on the fact whether or not the tag has a value in the used configuration file:

LATEX_FONTENC Content within this block is copied to the output when the doxygen latex translator function returns a value for the font encoding to be used. It is to be used in combination with the above mentioned `$latexfontenc`.

FORMULA_MACROFILE Content within this block is copied to the output when the FORMULA_MACROFILE option is not empty. It is to be used in combination with the above mentioned `$formulamacrofile`.

The following block name is set based on whether or not a feature is used in the documentation:

CITATIONS_PRESENT Content within this block is copied to the output when in the documentation citations are present and the relevant .. are present. It is to be used in combination with the above mentioned `$latexcitereference`, `$latexbibstyle` and `$latexbibfiles`.

This tag requires that the tag GENERATE_LATEX is set to `YES`.

LATEX_FOOTER The `LATEX_FOOTER` tag can be used to specify a user-defined LaTeX footer for the generated LaTeX document. The footer should contain everything after the last chapter. If it is left blank doxygen will generate a standard footer.

See LATEX_HEADER for more information on how to generate a default footer and what special commands can be used inside the footer.

See also section Doxygen usage for information on how to generate the default footer that doxygen normally uses.

Note: Only use a user-defined footer if you know what you are doing!

This tag requires that the tag GENERATE_LATEX is set to `YES`.

LATEX_EXTRA_STYLESHEET The `LATEX_EXTRA_STYLESHEET` tag can be used to specify additional user-defined LaTeX style sheets that are included after the standard style sheets created by doxygen. Using this option one can overrule certain style aspects. Doxygen will copy the style sheet files to the output directory.

Note

The order of the extra style sheet files is of importance (e.g. the last style sheet in the list overrules the setting of the previous ones in the list).

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_EXTRA_FILES The LATEX_EXTRA_FILES tag can be used to specify one or more extra images or other source files which should be copied to the LATEX_OUTPUT output directory. Note that the files will be copied as-is; there are no commands or markers available.

This tag requires that the tag GENERATE_LATEX is set to YES.

PDF_HYPERLINKS If the PDF_HYPERLINKS tag is set to YES, the LaTeX that is generated is prepared for conversion to PDF (using ps2pdf or pdflatex). The PDF file will contain links (just like the HTML output) instead of page references. This makes the output suitable for online browsing using a PDF viewer.

The default value is: YES.

This tag requires that the tag GENERATE_LATEX is set to YES.

USE_PDFLATEX If the USE_PDFLATEX tag is set to YES, doxygen will use the engine as specified with LATEX_CMD_NAME to generate the PDF file directly from the LaTeX files. Set this option to YES, to get a higher quality PDF documentation.
See also section LATEX_CMD_NAME for selecting the engine.

The default value is: YES.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_BATCHMODE If the LATEX_BATCHMODE tag is set to YES, doxygen will add the \batchmode command to the generated LaTeX files. This will instruct LaTeX to keep running if errors occur, instead of asking the user for help.

The default value is: NO.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_HIDE_INDICES If the LATEX_HIDE_INDICES tag is set to YES then doxygen will not include the index chapters (such as File Index, Compound Index, etc.) in the output.

The default value is: NO.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_BIB_STYLE The LATEX_BIB_STYLE tag can be used to specify the style to use for the bibliography, e.g. plainnat, or ieeetr. See https://en.wikipedia.org/wiki/BibTeX and \cite for more info.

The default value is: plain.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_TIMESTAMP If the LATEX_TIMESTAMP tag is set to YES then the footer of each generated page will contain the date and time when the page was generated. Setting this to NO can help when comparing the output of multiple runs.

The default value is: NO.

This tag requires that the tag GENERATE_LATEX is set to YES.

LATEX_EMOJI_DIRECTORY The LATEX_EMOJI_DIRECTORY tag is used to specify the (relative or absolute) path from which the emoji images will be read. If a relative path is entered, it will be relative to the LATEX_OUTPUT directory. If left blank the LATEX_OUTPUT directory will be used.

This tag requires that the tag GENERATE_LATEX is set to YES.

23.10 Configuration options related to the RTF output

GENERATE_RTF If the GENERATE_RTF tag is set to YES, doxygen will generate RTF output. The RTF output is optimized for Word 97 and may not look too pretty with other RTF readers/editors.

The default value is: NO.

RTF_OUTPUT The RTF_OUTPUT tag is used to specify where the RTF docs will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it.

The default directory is: rtf.

This tag requires that the tag GENERATE_RTF is set to YES.

COMPACT_RTF If the COMPACT_RTF tag is set to YES, doxygen generates more compact RTF documents. This may be useful for small projects and may help to save some trees in general.

The default value is: NO.

This tag requires that the tag GENERATE_RTF is set to YES.

RTF_HYPERLINKS If the RTF_HYPERLINKS tag is set to YES, the RTF that is generated will contain hyperlink fields. The RTF file will contain links (just like the HTML output) instead of page references. This makes the output suitable for online browsing using Word or some other Word compatible readers that support those fields.

Note: WordPad (write) and others do not support links.

The default value is: NO.

This tag requires that the tag GENERATE_RTF is set to YES.

RTF_STYLESHEET_FILE Load stylesheet definitions from file. Syntax is similar to doxygen's configuration file, i.e. a series of assignments. You only have to provide replacements, missing definitions are set to their default value.
See also section Doxygen usage for information on how to generate the default style sheet that doxygen normally uses.

This tag requires that the tag GENERATE_RTF is set to YES.

RTF_EXTENSIONS_FILE Set optional variables used in the generation of an RTF document. Syntax is similar to doxygen's configuration file. A template extensions file can be generated using doxygen -e rtf extensionFile.

This tag requires that the tag GENERATE_RTF is set to YES.

23.11 Configuration options related to the man page output

GENERATE_MAN If the GENERATE_MAN tag is set to YES, doxygen will generate man pages for classes and files.

The default value is: NO.

MAN_OUTPUT The MAN_OUTPUT tag is used to specify where the man pages will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it. A directory man3 will be created inside the directory specified by MAN_OUTPUT.

The default directory is: man.

This tag requires that the tag GENERATE_MAN is set to YES.

MAN_EXTENSION The MAN_EXTENSION tag determines the extension that is added to the generated man pages. In case the manual section does not start with a number, the number 3 is prepended. The dot (.) at the beginning of the MAN_EXTENSION tag is optional.

The default value is: .3.

This tag requires that the tag GENERATE_MAN is set to YES.

MAN_SUBDIR The MAN_SUBDIR tag determines the name of the directory created within MAN_OUTPUT in which the man pages are placed. If defaults to man followed by MAN_EXTENSION with the initial . removed.

This tag requires that the tag GENERATE_MAN is set to YES.

MAN_LINKS If the MAN_LINKS tag is set to YES and doxygen generates man output, then it will generate one additional man file for each entity documented in the real man page(s). These additional files only source the real man page, but without them the man command would be unable to find the correct page.

The default value is: NO.

This tag requires that the tag GENERATE_MAN is set to YES.

23.12 Configuration options related to the XML output

GENERATE_XML If the GENERATE_XML tag is set to YES, doxygen will generate an XML file that captures the structure of the code including all documentation.

The default value is: NO.

XML_OUTPUT The XML_OUTPUT tag is used to specify where the XML pages will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it.

The default directory is: xml.

This tag requires that the tag GENERATE_XML is set to YES.

XML_PROGRAMLISTING If the XML_PROGRAMLISTING tag is set to YES, doxygen will dump the program listings (including syntax highlighting and cross-referencing information) to the XML output. Note that enabling this will significantly increase the size of the XML output.

The default value is: YES.

This tag requires that the tag GENERATE_XML is set to YES.

XML_NS_MEMB_FILE_SCOPE If the XML_NS_MEMB_FILE_SCOPE tag is set to YES, doxygen will include namespace members in file scope as well, matching the HTML output.

The default value is: NO.

This tag requires that the tag GENERATE_XML is set to YES.

23.13 Configuration options related to the DOCBOOK output

GENERATE_DOCBOOK If the GENERATE_DOCBOOK tag is set to YES, doxygen will generate Docbook files that can be used to generate PDF.

The default value is: NO.

DOCBOOK_OUTPUT The DOCBOOK_OUTPUT tag is used to specify where the Docbook pages will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it.

The default directory is: docbook.

This tag requires that the tag GENERATE_DOCBOOK is set to YES.

23.14 Configuration options for the AutoGen Definitions output

GENERATE_AUTOGEN_DEF If the GENERATE_AUTOGEN_DEF tag is set to YES, doxygen will generate an AutoGen Definitions (see http://autogen.sourceforge.net/) file that captures the structure of the code including all documentation. Note that this feature is still experimental and incomplete at the moment.

The default value is: NO.

23.15 Configuration options related to Sqlite3 output

GENERATE_SQLITE3 If the GENERATE_SQLITE3 tag is set to YES doxygen will generate a Sqlite3 database with symbols found by doxygen stored in tables.

Note

The availability of this option depends on whether or not doxygen was generated with the -Duse_↩ sqlite3=ON option for CMake.

The default value is: NO.

SQLITE3_OUTPUT The SQLITE3_OUTPUT tag is used to specify where the Sqlite3 database will be put. If a relative path is entered the value of OUTPUT_DIRECTORY will be put in front of it.

Note

The availability of this option depends on whether or not doxygen was generated with the -Duse_↩ sqlite3=ON option for CMake.

The default directory is: sqlite3.

This tag requires that the tag GENERATE_SQLITE3 is set to YES.

SQLITE3_RECREATE_DB The SQLITE3_OVERWRITE_DB tag is set to YES, the existing doxygen_sqlite3.db database file will be recreated with each doxygen run. If set to NO, doxygen will warn if an a database file is already found and not modify it.

Note

The availability of this option depends on whether or not doxygen was generated with the -Duse_↩ sqlite3=ON option for CMake.

The default value is: YES.

This tag requires that the tag GENERATE_SQLITE3 is set to YES.

23.16 Configuration options related to the Perl module output

GENERATE_PERLMOD If the GENERATE_PERLMOD tag is set to YES, doxygen will generate a Perl module file that captures the structure of the code including all documentation.
Note that this feature is still experimental and incomplete at the moment.

The default value is: NO.

PERLMOD_LATEX If the PERLMOD_LATEX tag is set to YES, doxygen will generate the necessary Makefile rules, Perl scripts and LaTeX code to be able to generate PDF and DVI output from the Perl module output.

The default value is: NO.

This tag requires that the tag GENERATE_PERLMOD is set to YES.

PERLMOD_PRETTY If the PERLMOD_PRETTY tag is set to YES, the Perl module output will be nicely formatted so it can be parsed by a human reader. This is useful if you want to understand what is going on. On the other hand, if this tag is set to NO, the size of the Perl module output will be much smaller and Perl will parse it just the same.

The default value is: YES.

This tag requires that the tag GENERATE_PERLMOD is set to YES.

PERLMOD_MAKEVAR_PREFIX The names of the make variables in the generated doxyrules.make file are prefixed with the string contained in PERLMOD_MAKEVAR_PREFIX. This is useful so different doxyrules.make files included by the same Makefile don't overwrite each other's variables.

This tag requires that the tag GENERATE_PERLMOD is set to YES.

23.17 Configuration options related to the preprocessor

ENABLE_PREPROCESSING If the ENABLE_PREPROCESSING tag is set to YES, doxygen will evaluate all C-preprocessor directives found in the sources and include files.

The default value is: YES.

MACRO_EXPANSION If the MACRO_EXPANSION tag is set to YES, doxygen will expand all macro names in the source code. If set to NO, only conditional compilation will be performed. Macro expansion can be done in a controlled way by setting EXPAND_ONLY_PREDEF to YES.

The default value is: NO.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

EXPAND_ONLY_PREDEF If the EXPAND_ONLY_PREDEF and MACRO_EXPANSION tags are both set to YES then the macro expansion is limited to the macros specified with the PREDEFINED and EXPAND_AS_DEFINED tags.

The default value is: NO.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

SEARCH_INCLUDES If the SEARCH_INCLUDES tag is set to YES, the include files in the INCLUDE_PATH will be searched if a #include is found.

The default value is: YES.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

INCLUDE_PATH The INCLUDE_PATH tag can be used to specify one or more directories that contain include files that are not input files but should be processed by the preprocessor.

This tag requires that the tag SEARCH_INCLUDES is set to YES.

INCLUDE_FILE_PATTERNS You can use the INCLUDE_FILE_PATTERNS tag to specify one or more wildcard patterns (like *.h and *.hpp) to filter out the header-files in the directories. If left blank, the patterns specified with FILE_PATTERNS will be used.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

PREDEFINED The PREDEFINED tag can be used to specify one or more macro names that are defined before the preprocessor is started (similar to the -D option of e.g. gcc). The argument of the tag is a list of macros of the form: name or name=definition (no spaces). If the definition and the "=" are omitted, "=1" is assumed. To prevent a macro definition from being undefined via #undef or recursively expanded use the := operator instead of the = operator.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

EXPAND_AS_DEFINED If the MACRO_EXPANSION and EXPAND_ONLY_PREDEF tags are set to YES then this tag can be used to specify a list of macro names that should be expanded. The macro definition that is found in the sources will be used. Use the PREDEFINED tag if you want to use a different macro definition that overrules the definition found in the source code.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

SKIP_FUNCTION_MACROS If the SKIP_FUNCTION_MACROS tag is set to YES then doxygen's preprocessor will remove all references to function-like macros that are alone on a line, have an all uppercase name, and do not end with a semicolon. Such function macros are typically used for boiler-plate code, and will confuse the parser if not removed.

The default value is: YES.

This tag requires that the tag ENABLE_PREPROCESSING is set to YES.

23.18 Configuration options related to external references

TAGFILES The TAGFILES tag can be used to specify one or more tag files.

For each tag file the location of the external documentation should be added. The format of a tag file without this location is as follows:

```
TAGFILES = file1 file2 ...
```

Adding location for the tag files is done as follows:

```
TAGFILES = file1=loc1 "file2 = loc2" ...
```

where loc1 and loc2 can be relative or absolute paths or URLs. See the section Linking to external documentation for more information about the use of tag files.

Note

Each tag file must have a unique name (where the name does *NOT* include the path). If a tag file is not located in the directory in which doxygen is run, you must also specify the path to the tagfile here.

GENERATE_TAGFILE When a file name is specified after GENERATE_TAGFILE, doxygen will create a tag file that is based on the input files it reads. See section Linking to external documentation for more information about the usage of tag files.

ALLEXTERNALS If the ALLEXTERNALS tag is set to YES, all external class will be listed in the class index. If set to NO, only the inherited external classes will be listed.

The default value is: NO.

EXTERNAL_GROUPS If the EXTERNAL_GROUPS tag is set to YES, all external groups will be listed in the modules index. If set to NO, only the current project's groups will be listed.

The default value is: YES.

EXTERNAL_PAGES If the EXTERNAL_PAGES tag is set to YES, all external pages will be listed in the related pages index. If set to NO, only the current project's pages will be listed.

The default value is: YES.

23.19 Configuration options related to the dot tool

DIA_PATH You can include diagrams made with dia in doxygen documentation. Doxygen will then run dia to produce the diagram and insert it in the documentation. The DIA_PATH tag allows you to specify the directory where the dia binary resides. If left empty dia is assumed to be found in the default search path.

HIDE_UNDOC_RELATIONS If set to YES the inheritance and collaboration graphs will hide inheritance and usage relations if the target is undocumented or is not a class.

The default value is: YES.

HAVE_DOT If you set the HAVE_DOT tag to YES then doxygen will assume the dot tool is available from the path. This tool is part of Graphviz, a graph visualization toolkit from AT&T and Lucent Bell Labs. The other options in this section have no effect if this option is set to NO

The default value is: NO.

DOT_NUM_THREADS The DOT_NUM_THREADS specifies the number of dot invocations doxygen is allowed to run in parallel. When set to 0 doxygen will base this on the number of processors available in the system. You can set it explicitly to a value larger than 0 to get control over the balance between CPU load and processing speed.

Minimum value: 0, maximum value: 32, default value: 0.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_FONTNAME When you want a differently looking font in the dot files that doxygen generates you can specify the font name using DOT_FONTNAME. You need to make sure dot is able to find the font, which can be done by putting it in a standard location or by setting the DOTFONTPATH environment variable or by setting DOT_FONTPATH to the directory containing the font.

The default value is: Helvetica.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_FONTSIZE The DOT_FONTSIZE tag can be used to set the size (in points) of the font of dot graphs.

Minimum value: 4, maximum value: 24, default value: 10.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_FONTPATH By default doxygen will tell dot to use the default font as specified with DOT_FONTNAME. If you specify a different font using DOT_FONTNAME you can set the path where dot can find it using this tag.

This tag requires that the tag HAVE_DOT is set to YES.

CLASS_GRAPH If the CLASS_GRAPH tag is set to YES (or GRAPH) then doxygen will generate a graph for each documented class showing the direct and indirect inheritance relations. In case HAVE_DOT is set as well dot will be used to draw the graph, otherwise the built-in generator will be used. If the CLASS_GRAPH tag is set to TEXT the direct and indirect inheritance relations will be shown as texts / links.

Possible values are: NO, YES, TEXT and GRAPH.

The default value is: YES.

COLLABORATION_GRAPH If the COLLABORATION_GRAPH tag is set to YES then doxygen will generate a graph for each documented class showing the direct and indirect implementation dependencies (inheritance, containment, and class references variables) of the class with other documented classes.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

GROUP_GRAPHS If the GROUP_GRAPHS tag is set to YES then doxygen will generate a graph for groups, showing the direct groups dependencies.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

UML_LOOK If the UML_LOOK tag is set to YES, doxygen will generate inheritance and collaboration diagrams in a style similar to the OMG's Unified Modeling Language.

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

UML_LIMIT_NUM_FIELDS If the UML_LOOK tag is enabled, the fields and methods are shown inside the class node. If there are many fields or methods and many nodes the graph may become too big to be useful. The UML_LIMIT_NUM_FIELDS threshold limits the number of items for each type to make the size more manageable. Set this to 0 for no limit. Note that the threshold may be exceeded by 50% before the limit is enforced. So when you set the threshold to 10, up to 15 fields may appear, but if the number exceeds 15, the total amount of fields shown is limited to 10.

Minimum value: 0, maximum value: 100, default value: 10.

This tag requires that the tag UML_LOOK is set to YES.

DOT_UML_DETAILS If the DOT_UML_DETAILS tag is set to NO, doxygen will show attributes and methods without types and arguments in the UML graphs. If the DOT_UML_DETAILS tag is set to YES, doxygen will add type and arguments for attributes and methods in the UML graphs. If the DOT_UML_DETAILS tag is set to NONE, doxygen will not generate fields with class member information in the UML graphs. The class diagrams will look similar to the default class diagrams but using UML notation for the relationships.

Possible values are: NO, YES and NONE.

The default value is: NO.

This tag requires that the tag UML_LOOK is set to YES.

DOT_WRAP_THRESHOLD The DOT_WRAP_THRESHOLD tag can be used to set the maximum number of characters to display on a single line. If the actual line length exceeds this threshold significantly it will wrapped across multiple lines. Some heuristics are apply to avoid ugly line breaks.

Minimum value: 0, maximum value: 1000, default value: 17.

This tag requires that the tag HAVE_DOT is set to YES.

TEMPLATE_RELATIONS If the TEMPLATE_RELATIONS tag is set to YES then the inheritance and collaboration graphs will show the relations between templates and their instances.

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

INCLUDE_GRAPH If the INCLUDE_GRAPH, ENABLE_PREPROCESSING and SEARCH_INCLUDES tags are set to YES then doxygen will generate a graph for each documented file showing the direct and indirect include dependencies of the file with other documented files.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

INCLUDED_BY_GRAPH If the INCLUDED_BY_GRAPH, ENABLE_PREPROCESSING and SEARCH_INCLUDES tags are set to YES then doxygen will generate a graph for each documented file showing the direct and indirect include dependencies of the file with other documented files.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

CALL_GRAPH If the CALL_GRAPH tag is set to YES then doxygen will generate a call dependency graph for every global function or class method.
Note that enabling this option will significantly increase the time of a run. So in most cases it will be better to enable call graphs for selected functions only using the \callgraph command. Disabling a call graph can be accomplished by means of the command \hidecallgraph.

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

CALLER_GRAPH If the CALLER_GRAPH tag is set to YES then doxygen will generate a caller dependency graph for every global function or class method.
Note that enabling this option will significantly increase the time of a run. So in most cases it will be better to enable caller graphs for selected functions only using the \callergraph command. Disabling a caller graph can be accomplished by means of the command \hidecallergraph.

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

GRAPHICAL_HIERARCHY If the GRAPHICAL_HIERARCHY tag is set to YES then doxygen will graphical hierarchy of all classes instead of a textual one.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

DIRECTORY_GRAPH If the DIRECTORY_GRAPH tag is set to YES then doxygen will show the dependencies a directory has on other directories in a graphical way. The dependency relations are determined by the #include relations between the files in the directories.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

DIR_GRAPH_MAX_DEPTH The DIR_GRAPH_MAX_DEPTH tag can be used to limit the maximum number of levels of child directories generated in directory dependency graphs by dot.

Minimum value: 1, maximum value: 25, default value: 1.

This tag requires that the tag DIRECTORY_GRAPH is set to YES.

DOT_IMAGE_FORMAT The DOT_IMAGE_FORMAT tag can be used to set the image format of the images generated by dot. For an explanation of the image formats see the section output formats in the documentation of the dot tool (Graphviz).

Note

If you choose svg you need to set HTML_FILE_EXTENSION to xhtml in order to make the SVG files visible in IE 9+ (other browsers do not have this requirement).

Possible values are: png, jpg, gif, svg, png:gd, png:gd:gd, png:cairo, png:cairo:gd, png:cairo:cairo, png:cairo:gdiplus, png:gdiplus and png:gdiplus:gdiplus.

The default value is: png.

This tag requires that the tag HAVE_DOT is set to YES.

INTERACTIVE_SVG If DOT_IMAGE_FORMAT is set to svg, then this option can be set to YES to enable generation of interactive SVG images that allow zooming and panning.
Note that this requires a modern browser other than Internet Explorer. Tested and working are Firefox, Chrome, Safari, and Opera.

Note

For IE 9+ you need to set HTML_FILE_EXTENSION to xhtml in order to make the SVG files visible. Older versions of IE do not have SVG support.

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_PATH The DOT_PATH tag can be used to specify the path where the dot tool can be found. If left blank, it is assumed the dot tool can be found in the path.

This tag requires that the tag HAVE_DOT is set to YES.

DOTFILE_DIRS The DOTFILE_DIRS tag can be used to specify one or more directories that contain dot files that are included in the documentation (see the \dotfile command).

This tag requires that the tag HAVE_DOT is set to YES.

MSCFILE_DIRS The MSCFILE_DIRS tag can be used to specify one or more directories that contain msc files that are included in the documentation (see the \mscfile command).

DIAFILE_DIRS The DIAFILE_DIRS tag can be used to specify one or more directories that contain dia files that are included in the documentation (see the \diafile command).

PLANTUML_JAR_PATH When using plantuml, the PLANTUML_JAR_PATH tag should be used to specify the path where java can find the plantuml.jar file or to the filename of jar file to be used. If left blank, it is assumed PlantUML is not used or called during a preprocessing step. Doxygen will generate a warning when it encounters a \startuml command in this case and will not generate output for the diagram.

PLANTUML_CFG_FILE When using plantuml, the PLANTUML_CFG_FILE tag can be used to specify a configuration file for plantuml.

PLANTUML_INCLUDE_PATH When using plantuml, the specified paths are searched for files specified by the !include statement in a plantuml block.

DOT_GRAPH_MAX_NODES The DOT_GRAPH_MAX_NODES tag can be used to set the maximum number of nodes that will be shown in the graph. If the number of nodes in a graph becomes larger than this value, doxygen will truncate the graph, which is visualized by representing a node as a red box. Note that doxygen if the number of direct children of the root node in a graph is already larger than DOT_GRAPH_MAX_↩NODES then the graph will not be shown at all. Also note that the size of a graph can be further restricted by MAX_DOT_GRAPH_DEPTH.

Minimum value: 0, maximum value: 10000, default value: 50.

This tag requires that the tag HAVE_DOT is set to YES.

MAX_DOT_GRAPH_DEPTH The MAX_DOT_GRAPH_DEPTH tag can be used to set the maximum depth of the graphs generated by dot. A depth value of 3 means that only nodes reachable from the root by following a path via at most 3 edges will be shown. Nodes that lay further from the root node will be omitted. Note that setting this option to 1 or 2 may greatly reduce the computation time needed for large code bases. Also note that the size of a graph can be further restricted by DOT_GRAPH_MAX_NODES. Using a depth of 0 means no depth restriction.

Minimum value: 0, maximum value: 1000, default value: 0.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_TRANSPARENT Set the DOT_TRANSPARENT tag to YES to generate images with a transparent background. This is disabled by default, because dot on Windows does not seem to support this out of the box. Warning: Depending on the platform used, enabling this option may lead to badly anti-aliased labels on the edges of a graph (i.e. they become hard to read).

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_MULTI_TARGETS Set the DOT_MULTI_TARGETS tag to YES to allow dot to generate multiple output files in one run (i.e. multiple -o and -T options on the command line). This makes dot run faster, but since only newer versions of dot (>1.8.10) support this, this feature is disabled by default.

The default value is: NO.

This tag requires that the tag HAVE_DOT is set to YES.

GENERATE_LEGEND If the GENERATE_LEGEND tag is set to YES doxygen will generate a legend page explaining the meaning of the various boxes and arrows in the dot generated graphs.

Note

> This tag requires that UML_LOOK isn't set, i.e. the doxygen internal graphical representation for inheritance and collaboration diagrams is used.

The default value is: YES.

This tag requires that the tag HAVE_DOT is set to YES.

DOT_CLEANUP If the DOT_CLEANUP tag is set to YES, doxygen will remove the intermediate files that are used to generate the various graphs.
Note: This setting is not only used for dot files but also for msc temporary files.

The default value is: YES.

23.20 Examples

Suppose you have a simple project consisting of two files: a source file example.cc and a header file example.h. Then a minimal configuration file is as simple as:

```
INPUT            = example.cc example.h
```

Assuming the example makes use of Qt classes and perl is located in /usr/bin, a more realistic configuration file would be:

```
PROJECT_NAME     = Example
INPUT            = example.cc example.h
WARNINGS         = YES
TAGFILES         = qt.tag
SEARCHENGINE     = NO
```

To generate the documentation for the QdbtTabular package I have used the following configuration file:

```
PROJECT_NAME     = QdbtTabular
OUTPUT_DIRECTORY = html
WARNINGS         = YES
INPUT            = examples/examples.doc src
FILE_PATTERNS    = *.cc *.h
INCLUDE_PATH     = examples
TAGFILES         = qt.tag
SEARCHENGINE     = YES
```

To regenerate the Qt-1.44 documentation from the sources, you could use the following configuration file:

```
PROJECT_NAME         = Qt
OUTPUT_DIRECTORY     = qt_docs
HIDE_UNDOC_MEMBERS   = YES
HIDE_UNDOC_CLASSES   = YES
ENABLE_PREPROCESSING = YES
MACRO_EXPANSION      = YES
EXPAND_ONLY_PREDEF   = YES
SEARCH_INCLUDES      = YES
FULL_PATH_NAMES      = YES
STRIP_FROM_PATH      = $(QTDIR)/
PREDEFINED           = USE_TEMPLATECLASS Q_EXPORT= \
                       QArrayT:=QArray \
                       QListT:=QList \
                       QDictT:=QDict \
                       QQueueT:=QQueue \
                       QVectorT:=QVector \
                       QPtrDictT:=QPtrDict \
                       QIntDictT:=QIntDict \
                       QStackT:=QStack \
                       QDictIteratorT:=QDictIterator \
                       QListIteratorT:=QListIterator \
                       QCacheT:=QCache \
                       QCacheIteratorT:=QCacheIterator \
                       QIntCacheT:=QIntCache \
                       QIntCacheIteratorT:=QIntCacheIterator \
                       QIntDictIteratorT:=QIntDictIterator \
                       QPtrDictIteratorT:=QPtrDictIterator
INPUT                = $(QTDIR)/doc \
                       $(QTDIR)/src/widgets \
                       $(QTDIR)/src/kernel \
                       $(QTDIR)/src/dialogs \
                       $(QTDIR)/src/tools
FILE_PATTERNS        = *.cpp *.h q*.doc
INCLUDE_PATH         = $(QTDIR)/include
RECURSIVE            = YES
```

For the Qt-2.1 sources I recommend to use the following settings:

```
PROJECT_NAME          = Qt
PROJECT_NUMBER        = 2.1
HIDE_UNDOC_MEMBERS    = YES
HIDE_UNDOC_CLASSES    = YES
SOURCE_BROWSER        = YES
INPUT                 = $(QTDIR)/src
FILE_PATTERNS         = *.cpp *.h q*.doc
RECURSIVE             = YES
EXCLUDE_PATTERNS      = *codec.cpp moc_* */compat/* */3rdparty/*
ALPHABETICAL_INDEX    = YES
IGNORE_PREFIX         = Q
ENABLE_PREPROCESSING  = YES
MACRO_EXPANSION       = YES
INCLUDE_PATH          = $(QTDIR)/include
PREDEFINED            = Q_PROPERTY(x)= \
                        Q_OVERRIDE(x)= \
                        Q_EXPORT= \
                        Q_ENUMS(x)= \
                        "QT_STATIC_CONST=static const " \
                        _WS_X11_ \
                        INCLUDE_MENUITEM_DEF
EXPAND_ONLY_PREDEF    = YES
EXPAND_AS_DEFINED     = Q_OBJECT_FAKE Q_OBJECT ACTIVATE_SIGNAL_WITH_PARAM \
                        Q_VARIANT_AS
```

Here doxygen's preprocessor is used to substitute some macro names that are normally substituted by the C preprocessor, but without doing full macro expansion.

Chapter 24

Special Commands

24.1 Introduction

All commands in the documentation start with a backslash (\) or an at-sign (@). If you prefer you can replace all commands starting with a backslash below by their counterparts that start with an at-sign.

Some commands have one or more arguments. Each argument has a certain range:

- If <sharp> braces are used the argument is a single word.
- If (round) braces are used the argument extends until the end of the line on which the command was found.
- If {curly} braces are used the argument extends until the next paragraph. Paragraphs are delimited by a blank line or by a section indicator. Note that {curly} braces are also used for command options, here the braces are mandatory and just 'normal' characters. The starting curly brace has to directly follow the command, so without whitespace.

If in addition to the above argument specifiers [square] brackets are used the argument is optional, unless they are placed between quotes in that case they are a mandatory part of the command argument.

Here is an alphabetically sorted list of all commands with references to their documentation:

\a . . . 24.137
\addindex . . . 24.104
\addtogroup . . . 24.2
\anchor . . . 24.105
\arg . . . 24.138
\attention . . . 24.59
\author . . . 24.60
\authors . . . 24.61
\b . . . 24.139
\brief . . . 24.62
\bug . . . 24.63
\c . . . 24.140
\callergraph . . . 24.5
\callgraph . . . 24.3
\category . . . 24.11
\cite . . . 24.106
\class . . . 24.12
\code . . . 24.141
\concept . . . 24.13
\cond . . . 24.64
\copybrief . . . 24.143
\copydetails . . . 24.144
\copydoc . . . 24.142
\copyright . . . 24.65
\date . . . 24.66
\def . . . 24.14
\defgroup . . . 24.15
\deprecated . . . 24.67
\details . . . 24.68
\diafile . . . 24.152
\dir . . . 24.16
\docbookinclude . . . 24.135
\docbookonly . . . 24.145
\dontinclude . . . 24.119
\dot . . . 24.146
\dotfile . . . 24.150
\e . . . 24.153
\else . . . 24.71
\elseif . . . 24.72
\em . . . 24.154
\emoji . . . 24.147
\endcode . . . 24.155
\endcond . . . 24.73
\enddocbookonly . . . 24.156
\enddot . . . 24.157
\endhtmlonly . . . 24.160
\endif . . . 24.74
\endinternal . . . 24.19
\endlatexonly . . . 24.161
\endlink . . . 24.107
\endmanonly . . . 24.162
\endmsc . . . 24.158
\endparblock . . . 24.83
\endrtfonly . . . 24.163
\endsecreflist . . . 24.112
\endverbatim . . . 24.164

\enduml . . . 24.159
\endxmlonly . . . 24.165
\enum . . . 24.17
\example . . . 24.18
\exception . . . 24.75
\extends . . . 24.20
\f(. . . 24.167
\f) . . . 24.168
\f$ . . . 24.166
\f[. . . 24.169
\f] . . . 24.170
\f{ . . . 24.171
\f} . . . 24.172
\file . . . 24.21
\fn . . . 24.22
\headerfile . . . 24.23
\hidecallergraph . . . 24.6
\hidecallgraph . . . 24.4
\hiderefby . . . 24.8
\hiderefs . . . 24.10
\hideinitializer . . . 24.24
\htmlinclude . . . 24.131
\htmlonly . . . 24.173
\idlexcept . . . 24.25
\if . . . 24.76
\ifnot . . . 24.77
\image . . . 24.174
\implements . . . 24.26
\include . . . 24.120
\includedoc . . . 24.122
\includelineno . . . 24.121
\ingroup . . . 24.27
\internal . . . 24.29
\invariant . . . 24.78
\interface . . . 24.28
\latexinclude . . . 24.132
\latexonly . . . 24.175
\li . . . 24.177
\line . . . 24.123
\link . . . 24.108
\mainpage . . . 24.30
\maninclude . . . 24.134
\manonly . . . 24.176
\memberof . . . 24.31
\msc . . . 24.148
\mscfile . . . 24.151
\n . . . 24.178
\name . . . 24.32
\namespace . . . 24.33
\noop . . . 24.69
\nosubgrouping . . . 24.34
\note . . . 24.79
\overload . . . 24.35
\p . . . 24.179
\package . . . 24.36
\page . . . 24.37
\par . . . 24.80
\paragraph . . . 24.118
\param . . . 24.81
\parblock . . . 24.82
\post . . . 24.85
\pre . . . 24.86
\private . . . 24.38
\privatesection . . . 24.39
\property . . . 24.40
\protected . . . 24.41
\protectedsection . . . 24.42
\protocol . . . 24.43
\public . . . 24.44
\publicsection . . . 24.45
\pure . . . 24.46
\raisewarning . . . 24.70
\ref . . . 24.109
\refitem . . . 24.110
\related . . . 24.48
\relates . . . 24.47
\relatedalso . . . 24.50
\relatesalso . . . 24.49
\remark . . . 24.87
\remarks . . . 24.88
\result . . . 24.89
\return . . . 24.90
\returns . . . 24.91
\retval . . . 24.92
\rtfinclude . . . 24.133
\rtfonly . . . 24.180
\sa . . . 24.93
\secreflist . . . 24.111
\section . . . 24.115
\see . . . 24.94
\short . . . 24.95
\showinitializer . . . 24.51
\showrefby . . . 24.7
\showrefs . . . 24.9
\since . . . 24.96
\skip . . . 24.124
\skipline . . . 24.125
\snippet . . . 24.126
\snippetdoc . . . 24.128
\snippetlineno . . . 24.127
\static . . . 24.52
\startuml . . . 24.149
\struct . . . 24.53
\subpage . . . 24.113
\subsection . . . 24.116
\subsubsection . . . 24.117
\tableofcontents . . . 24.114
\test . . . 24.97
\throw . . . 24.98
\throws . . . 24.99
\todo . . . 24.100
\tparam . . . 24.84
\typedef . . . 24.54
\union . . . 24.55
\until . . . 24.129
\var . . . 24.56
\verbatim . . . 24.181
\verbinclude . . . 24.130
\version . . . 24.101
\vhdlflow . . . 24.57
\warning . . . 24.102
\weakgroup . . . 24.58
\xmlinclude . . . 24.136
\xmlonly . . . 24.182
\xrefitem . . . 24.103
\$ . . . 24.187
\@ . . . 24.184
\\ . . . 24.183
\& . . . 24.186
\~ . . . 24.185
\< . . . 24.189
\= . . . 24.194
\> . . . 24.190
\# . . . 24.188
\% . . . 24.191
\" . . . 24.192
\. . . 24.193
\:: . . . 24.195
\| . . . 24.196
\-- . . . 24.197
\--- . . . 24.198

The following subsections provide a list of all commands that are recognized by doxygen. Unrecognized commands

are treated as normal text.

Structural indicators

24.2 \addtogroup <name> [(title)]

Defines a group just like \defgroup, but in contrast to that command using the same <name> more than once will not result in a warning, but rather one group with a merged documentation and the first title found in any of the commands.

The title is optional, so this command can also be used to add a number of entities to an existing group using `@{` and `@}` like this:

```
/*! \addtogroup mygrp
 *  Additional documentation for group 'mygrp'
 *  @{
 */

/*!
 *  A function
 */
void func1()
{
}

/*! Another function */
void func2()
{
}

/*! @} */
```

See also

page Grouping, sections \defgroup, \ingroup, and \weakgroup.

24.3 \callgraph

When this command is put in a comment block of a function or method and HAVE_DOT is set to `YES`, then doxygen will generate a call graph for that function (provided the implementation of the function or method calls other documented functions). The call graph will be generated regardless of the value of CALL_GRAPH.

Note

The completeness (and correctness) of the call graph depends on the doxygen code parser which is not perfect.

See also

section \callergraph, section \hidecallgraph, section \hidecallergraph and option CALL_GRAPH

24.4 \hidecallgraph

When this command is put in a comment block of a function or method and then doxygen will not generate a call graph for that function. The call graph will not be generated regardless of the value of CALL_GRAPH.

Note

The completeness (and correctness) of the call graph depends on the doxygen code parser which is not perfect.

See also

section \callergraph, section \callgraph, section \hidecallergraph and option CALL_GRAPH

24.5 \callergraph

When this command is put in a comment block of a function or method and HAVE_DOT is set to `YES`, then doxygen will generate a caller graph for that function (provided the implementation of the function or method is called by other documented functions). The caller graph will be generated regardless of the value of CALLER_GRAPH.

Note

The completeness (and correctness) of the caller graph depends on the doxygen code parser which is not perfect.

See also

section \callgraph, section \hidecallgraph, section \hidecallergraph and option CALLER_GRAPH

24.6 \hidecallergraph

When this command is put in a comment block of a function or method and then doxygen will not generate a caller graph for that function. The caller graph will not be generated regardless of the value of CALLER_GRAPH.

Note

The completeness (and correctness) of the caller graph depends on the doxygen code parser which is not perfect.

See also

section \callergraph, section \callgraph, section \hidecallgraph and option CALLER_GRAPH

24.7 \showrefby

When this command is put in a comment block of a function, method or variable, then doxygen will generate an overview for that function, method, variable of the, documented, functions and methods that call / use it. The overview will be generated regardless of the value of REFERENCED_BY_RELATION.

Note

The completeness (and correctness) of the overview depends on the doxygen code parser which is not perfect.

See also

section \showrefs, section \hiderefby, section \hiderefs and option REFERENCED_BY_RELATION

24.8 \hiderefby

When this command is put in a comment block of a function, method or variable then doxygen will not generate an overview for that function, method or variable of the functions and methods that call / use it. The overview will not be generated regardless of the value of REFERENCED_BY_RELATION.

Note

The completeness (and correctness) of the overview depends on the doxygen code parser which is not perfect.

See also

section \showrefs, section \showrefby, section \hiderefs and option REFERENCED_BY_RELATION

24.9 \showrefs

When this command is put in a comment block of a function or method, then doxygen will generate an overview for that function or method of the functions and methods that call it. The overview will be generated regardless of the value of REFERENCES_RELATION.

Note

The completeness (and correctness) of the overview depends on the doxygen code parser which is not perfect.

See also

section \showrefby, section \hiderefby, section \hiderefs and option REFERENCES_RELATION

24.10 \hiderefs

When this command is put in a comment block of a function or method and then doxygen will not generate an overview for that function or method of the functions and methods that call it. The overview will not be generated regardless of the value of REFERENCES_RELATION.

Note

The completeness (and correctness) of the overview depends on the doxygen code parser which is not perfect.

See also

section \showrefs, section \showrefby, section \hiderefby and option REFERENCES_RELATION

24.11 \category <name> [<header-file>] [<header-name>]

For Objective-C only: Indicates that a comment block contains documentation for a class category with name <name>. The arguments are equal to the \class command.

See also

section \class.

24.12 \class <name> [<header-file>] [<header-name>]

Indicates that a comment block contains documentation for a class with name <name>. Optionally a header file and a header name can be specified. If the header-file is specified, a link to a verbatim copy of the header will be included in the HTML documentation. The <header-name> argument can be used to overwrite the name of the link that is used in the class documentation to something other than <header-file>. This can be useful if the include name is not located on the default include path (like <X11/X.h>). With the <header-name> argument you can also specify how the include statement should look like, by adding either quotes or sharp brackets around the name. Sharp brackets are used if just the name is given. Note that the last two arguments can also be specified using the \headerfile command.

Example:

```
/* A dummy class */
class Test
{
};

/*! \class Test class.h "inc/class.h"
 *  \brief This is a test class.
 *
 * Some details about the Test class.
 */
```

See Class example for the corresponding LaTeX documentation that is generated by doxygen.

24.13 \concept <name>

Indicates that a comment block contains documentation for a C++20 concept with name <name>. See also the \headerfile command to specify the header a user should be included to use the concept.

24.14 \def <name>

Indicates that a comment block contains documentation for a `#define` macro.
Example:

```
/*! \file define.h
    \brief testing defines

    This is to test the documentation of defines.
*/

/*!
  \def MAX(x,y)
  Computes the maximum of \a x and \a y.
*/

/*!
   \brief Computes the absolute value of its argument \a x.
   \param x input value.
   \returns absolute value of \a x.
*/
#define ABS(x) (((x)>0)?(x):-(x))
#define MAX(x,y) ((x)>(y)?(x):(y))
#define MIN(x,y) ((x)>(y)?(y):(x))
        /*!< Computes the minimum of \a x and \a y. */
```

See Define example for the corresponding LaTeX documentation that is generated by doxygen.

24.15 \defgroup <name> (group title)

Indicates that a comment block contains documentation for a group of classes, files or namespaces. This can be used to categorize classes, files or namespaces, and document those categories. You can also use groups as members of other groups, thus building a hierarchy of groups.
The <name> argument should be a single-word identifier.

See also

page Grouping, sections \ingroup, \addtogroup, and \weakgroup.

24.16 \dir [<path fragment>]

Indicates that a comment block contains documentation for a directory. The "path fragment" argument should include the directory name and enough of the path to be unique with respect to the other directories in the project. The STRIP_FROM_PATH option determines what is stripped from the full path before it appears in the output.

24.17 \enum <name>

Indicates that a comment block contains documentation for an enumeration, with name <name>. If the enum is a member of a class and the documentation block is located outside the class definition, the scope of the class should be specified as well. If a comment block is located directly in front of an enum declaration, the `\enum` comment may be omitted.

Note:

The type of an anonymous enum cannot be documented, but the values of an anonymous enum can.

Example:

```
class Enum_Test
{
  public:
    enum TEnum { Val1, Val2 };

    /*! Another enum, with inline docs */
    enum AnotherEnum
    {
      V1, /*!< value 1 */
      V2  /*!< value 2 */
    };
};

/*! \class Enum_Test
 * The class description.
 */

/*! \enum Enum_Test::TEnum
 * A description of the enum type.
 */

/*! \var Enum_Test::TEnum Enum_Test::Val1
 * The description of the first enum value.
 */
```

See Enum example for the corresponding LaTeX documentation that is generated by doxygen.

24.18 \example['{lineno}'] <file-name>

Indicates that a comment block contains documentation for a source code example. The name of the source file is <file-name>. The contents of this file will be included in the documentation, just after the documentation contained in the comment block. You can add option `{lineno}` to enable line numbers for the example if desired. All examples are placed in a list. The source code is scanned for documented members and classes. If any are found, the names are cross-referenced with the documentation. Source files or directories can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.
If <file-name> itself is not unique for the set of example files specified by the EXAMPLE_PATH tag, you can include part of the absolute path to disambiguate it.
If more than one source file is needed for the example, the \include command can be used.

Example:

```
/** A Example_Test class.
 *  More details about this class.
 */
class Example_Test
{
  public:
    /** An example member function.
     *  More details about this function.
     */
    void example();
};
void Example_Test::example() {}

/** \example example_test.cpp
 * This is an example of how to use the Example_Test class.
 * More details about this example.
 */
```

Where the example file `example_test.cpp` looks as follows:

```
void main()
{
  Example_Test t;
  t.example();
}
```

See Example example for the corresponding LaTeX documentation that is generated by doxygen.

See also

section \include.

24.19 \endinternal

This command ends a documentation fragment that was started with a \internal command. The text between \internal and `\endinternal` will only be visible if INTERNAL_DOCS is set to `YES`.

24.20 \extends <name>

This command can be used to manually indicate an inheritance relation, when the programming language does not support this concept natively (e.g. C).
The file `manual.c` in the example directory shows how to use this command.
See Extends example for the corresponding LaTeX documentation that is generated by doxygen.

See also

section \implements and section \memberof

24.21 \file [<name>]

Indicates that a comment block contains documentation for a source or header file with name <name>. The file name may include (part of) the path if the file-name alone is not unique. If the file name is omitted (i.e. the line after `\file` is left blank) then the documentation block that contains the `\file` command will belong to the file it is located in.

Important:

The documentation of global functions, variables, typedefs, and enums will only be included in the output if the file they are in is documented as well or if EXTRACT_ALL is set to `YES`.

Example:

```
/** \file file.h
 * A brief file description.
 * A more elaborated file description.
 */

/**
 * A global integer value.
 * More details about this value.
 */
extern int globalValue;
```

See File example for the corresponding LaTeX documentation that is generated by doxygen.

Note

In the above example JAVADOC_AUTOBRIEF has been set to `YES` in the configuration file.

24.22 \fn (function declaration)

Indicates that a comment block contains documentation for a function (either global or as a member of a class). This command is *only* needed if a comment block is *not* placed in front (or behind) the function declaration or definition. If your comment block *is* in front of the function declaration or definition this command can (and to avoid redundancy should) be omitted.
A full function declaration including arguments should be specified after the `\fn` command on a *single* line, since the argument ends at the end of the line!
This command is equivalent to \var, \typedef, and \property.

Warning

Do not use this command if it is not absolutely needed, since it will lead to duplication of information and thus to errors.

Example:

```
class Fn_Test
{
  public:
    const char *member(char,int) throw(std::out_of_range);
};
const char *Fn_Test::member(char c,int n) throw(std::out_of_range) {}

/*! \class Fn_Test
 * \brief Fn_Test class.
 *
 * Details about Fn_Test.
 */

/*! \fn const char *Fn_Test::member(char c,int n)
 *  \brief A member function.
 *  \param c a character.
 *  \param n an integer.
 *  \exception std::out_of_range parameter is out of range.
 *  \return a character pointer.
 */
```

See Fn example for the corresponding LaTeX documentation that is generated by doxygen.

See also

sections \var, \property, and \typedef.

24.23 \headerfile <header-file> [<header-name>]

Intended to be used for class, struct, or union documentation, where the documentation is in front of the definition. The arguments of this command are the same as the second and third argument of \class. The <header-file> name refers to the file that should be included by the application to obtain the definition of the class, struct, or union. The <header-name> argument can be used to overwrite the name of the link that is used in the class documentation to something other than <header-file>. This can be useful if the include name is not located on the default include path (like <X11/X.h>).
With the <header-name> argument you can also specify how the include statement should look like, by adding either double quotes or sharp brackets around the name. By default sharp brackets are used if just the name is given.
If a pair of double quotes is given for either the <header-file> or <header-name> argument, the current file (in which the command was found) will be used but with quotes. So for a comment block with a `\headerfile` command inside a file `test.h`, the following three commands are equivalent:

```
\headerfile test.h "test.h"
\headerfile test.h ""
\headerfile ""
```

To get sharp brackets you do not need to specify anything, but if you want to be explicit you could use any of the following:

```
\headerfile test.h <test.h>
\headerfile test.h <>
\headerfile <>
```

To globally reverse the default include representation to local includes you can set FORCE_LOCAL_INCLUDES to `YES`.
To disable the include information altogether set SHOW_HEADERFILE to `NO`.

24.24 \hideinitializer

By default the value of a define and the initializer of a variable are displayed unless they are longer than 30 lines. By putting this command in a comment block of a define or variable, the initializer is always hidden. The maximum number of initialization lines can be changed by means of the configuration parameter MAX_INITIALIZER_LINES, the default value is 30.

See also

section \showinitializer.

24.25 \idlexcept <name>

Indicates that a comment block contains documentation for a IDL exception with name <name>.

24.26 \implements <name>

This command can be used to manually indicate an inheritance relation, when the programming language does not support this concept natively (e.g. C).
The file `manual.c` in the example directory shows how to use this command.
See Implements example for the corresponding LaTeX documentation that is generated by doxygen.

See also

section \extends and section \memberof

24.27 \ingroup (<groupname> [<groupname> <groupname>])

If the `\ingroup` command is placed in a comment block of a class, file or namespace, then it will be added to the group or groups identified by <groupname>.

See also

page Grouping, sections \defgroup, \addtogroup, and \weakgroup

24.28 \interface <name> [<header-file>] [<header-name>]

Indicates that a comment block contains documentation for an interface with name <name>. The arguments are equal to the arguments of the \class command.

See also

section \class.

24.29 \internal

This command starts a documentation fragment that is meant for internal use only. The fragment naturally ends at the end of the comment block. You can also force the internal section to end earlier by using the \endinternal command.
If the `\internal` command is put inside a section (see for example \section) all subsections after the command are considered to be internal as well. Only a new section at the same level will end the fragment that is considered internal.
You can use INTERNAL_DOCS in the configuration file to show (`YES`) or hide (`NO`) the internal documentation.

See also

section \endinternal.

24.30 \mainpage [(title)]

If the `\mainpage` command is placed in a comment block the block is used to customize the index page (in HTML) or the first chapter (in LaTeX).
The title argument is optional and replaces the default title that doxygen normally generates. If you do not want any title you can specify `notitle` as the argument of `\mainpage`.
Here is an example:

```
/*! \mainpage My Personal Index Page
 *
 * \section intro_sec Introduction
 *
 * This is the introduction.
```

```
 *
 * \section install_sec Installation
 *
 * \subsection step1 Step 1: Opening the box
 *
 * etc...
 */
```

You can refer to the main page using: `\ref index`.

See also

section \section, section \subsection, and section \page.

24.31 \memberof <name>

This command makes a function a member of a class in a similar way as \relates does, only with this command the function is represented as a real member of the class. This can be useful when the programming language does not support the concept of member functions natively (e.g. C).
It is also possible to use this command together with \public, \protected or \private.
The file `manual.c` in the example directory shows how to use this command.

See also

sections \extends, \implements, \public, \protected and \private.

24.32 \name [(header)]

This command turns a comment block into a header definition of a member group. The comment block should be followed by a `///@{ ... ///@}` block containing the members of the group.
See section Member Groups for an example.

24.33 \namespace <name>

Indicates that a comment block contains documentation for a namespace with name <name>.

24.34 \nosubgrouping

This command can be put in the documentation of a class. It can be used in combination with member grouping to avoid that doxygen puts a member group as a subgroup of a Public/Protected/Private/... section.

See also

sections \publicsection, \protectedsection and \privatesection.

24.35 \overload [(function declaration)]

This command can be used to generate the following standard text for an overloaded member function:

> This is an overloaded member function, provided for convenience. It differs from the above function only in what argument(s) it accepts.

If the documentation for the overloaded member function is not located in front of the function declaration or definition, the optional argument should be used to specify the correct function.
Any other documentation that is inside the documentation block will by appended after the generated message.

Note 1:

> You are responsible that there is indeed an earlier documented member that is overloaded by this one. To prevent that document reorders the documentation you should set SORT_MEMBER_DOCS to `NO` in this case.

Note 2:

The `\overload` command does not work inside a one-line comment.

Example:

```
class Overload_Test
{
  public:
    void drawRect(int,int,int,int);
    void drawRect(const Rect &r);
};
void Overload_Test::drawRect(int x,int y,int w,int h) {}
void Overload_Test::drawRect(const Rect &r) {}

/*! \class Overload_Test
 *  \brief A short description.
 *
 *  More text.
 */

/*! \fn void Overload_Test::drawRect(int x,int y,int w,int h)
 * This command draws a rectangle with a left upper corner at ( \a x , \a y ),
 * width \a w and height \a h.
 */

/*!
 * \overload void Overload_Test::drawRect(const Rect &r)
 */
```

See Overload example for the corresponding LaTeX documentation that is generated by doxygen.

24.36 \package <name>

Indicates that a comment block contains documentation for a Java package with name <name>.

24.37 \page <name> (title)

Indicates that a comment block contains a piece of documentation that is not directly related to one specific class, file or member. The HTML generator creates a page containing the documentation. The LaTeX generator starts a new section in the chapter 'Page documentation'.

Example:

```
/*! \page page1 A documentation page
  \tableofcontents
  Leading text.
  \section sec An example section
  This page contains the subsections \ref subsection1 and \ref subsection2.
  For more info see page \ref page2.
  \subsection subsection1 The first subsection
  Text.
  \subsection subsection2 The second subsection
  More text.
*/

/*! \page page2 Another page
  Even more info.
*/
```

See Page example for the corresponding LaTeX documentation that is generated by doxygen.

Note:

The <name> argument consists of a combination of letters and number digits. If you wish to use upper case letters (e.g. `MYPAGE1`), or mixed case letters (e.g. `MyPage1`) in the <name> argument, you should set CASE_SENSE_NAMES to `YES`. However, this is advisable only if your file system is case sensitive. Otherwise (and for better portability) you should use all lower case letters (e.g. `mypage1`) for <name> in all references to the page.

See also

section \section, section \subsection, and section \ref.

24.38 \private

Indicates that the member documented by the comment block is private, i.e., should only be accessed by other members in the same class.
Note that doxygen automatically detects the protection level of members in object-oriented languages. This command is intended for use only when the language does not support the concept of protection level natively (e.g. C, PHP 4).
For starting a section of private members, in a way similar to the "private:" class marker in C++, use \privatesection.

See also

sections \memberof, \public, \protected and \privatesection.

24.39 \privatesection

Starting a section of private members, in a way similar to the "private:" class marker in C++. Indicates that the member documented by the comment block is private, i.e., should only be accessed by other members in the same class.

See also

sections \memberof, \public, \protected and \private.

24.40 \property (qualified property name)

Indicates that a comment block contains documentation for a property (either global or as a member of a class). This command is equivalent to \fn, \typedef, and \var.

See also

sections \fn, \typedef, and \var.

24.41 \protected

Indicates that the member documented by the comment block is protected, i.e., should only be accessed by other members in the same or derived classes.
Note that doxygen automatically detects the protection level of members in object-oriented languages. This command is intended for use only when the language does not support the concept of protection level natively (e.g. C, PHP 4).
For starting a section of protected members, in a way similar to the "protected:" class marker in C++, use \protectedsection.

See also

sections \memberof, \public, \private and \protectedsection.

24.42 \protectedsection

Starting a section of protected members, in a way similar to the "protected:" class marker in C++. Indicates that the member documented by the comment block is protected, i.e., should only be accessed by other members in the same or derived classes.

See also

sections \memberof, \public, \private and \protected.

24.43 \protocol <name> [<header-file>] [<header-name>]

Indicates that a comment block contains documentation for a protocol in Objective-C with name <name>. The arguments are equal to the \class command.

See also

section \class.

24.44 \public

Indicates that the member documented by the comment block is public, i.e., can be accessed by any other class or function.
Note that doxygen automatically detects the protection level of members in object-oriented languages. This command is intended for use only when the language does not support the concept of protection level natively (e.g. C, PHP 4).
For starting a section of public members, in a way similar to the "public:" class marker in C++, use \publicsection.

See also

sections \memberof, \protected, \private and \publicsection.

24.45 \publicsection

Starting a section of public members, in a way similar to the "public:" class marker in C++. Indicates that the member documented by the comment block is public, i.e., can be accessed by any other class or function.

See also

sections \memberof, \protected, \private and \public.

24.46 \pure

Indicates that the member documented by the comment block is pure virtual, i.e., it is abstract and has no implementation associated with it.
This command is intended for use only when the language does not support the concept of pure virtual methods natively (e.g. C, PHP 4).

24.47 \relates <name>

This command can be used in the documentation of a non-member function <name>. It puts the function inside the 'related function' section of the class documentation. This command is useful for documenting non-friend functions that are nevertheless strongly coupled to a certain class. It prevents the need of having to document a file, but only works for functions.
Example:

```
/*!
 * A String class.
 */

class String
{
  friend int strcmp(const String &,const String &);
};

/*!
 * Compares two strings.
 */
int strcmp(const String &s1,const String &s2)
{
}

/*! \relates String
 * A string debug function.
```

```
 */
void stringDebug()
{
}
```

See Relates example for the corresponding LaTeX documentation that is generated by doxygen.

24.48 \related <name>

Equivalent to \relates

24.49 \relatesalso <name>

This command can be used in the documentation of a non-member function <name>. It puts the function both inside the 'related function' section of the class documentation as well as leaving it at its normal file documentation location. This command is useful for documenting non-friend functions that are nevertheless strongly coupled to a certain class. It only works for functions.

24.50 \relatedalso <name>

Equivalent to \relatesalso

24.51 \showinitializer

By default the value of a define and the initializer of a variable are only displayed if they are less than 30 lines long. By putting this command in a comment block of a define or variable, the initializer is shown unconditionally. The maximum number of initialization lines can be changed by means of the configuration parameter MAX_INITIALIZER_LINES, the default value is 30.

See also

section \hideinitializer.

24.52 \static

Indicates that the member documented by the comment block is static, i.e., it works on a class, instead of on an instance of the class.
This command is intended for use only when the language does not support the concept of static methods natively (e.g. C).

24.53 \struct <name> [<header-file>] [<header-name>]

Indicates that a comment block contains documentation for a struct with name <name>. The arguments are equal to the arguments of the \class command.

See also

section \class.

24.54 \typedef (typedef declaration)

Indicates that a comment block contains documentation for a typedef (either global or as a member of a class). This command is equivalent to \fn, \property, and \var.

See also

section \fn, \property, and \var.

24.55 \union <name> [<header-file>] [<header-name>]

Indicates that a comment block contains documentation for a union with name <name>. The arguments are equal to the arguments of the \class command.

See also

section \class.

24.56 \var (variable declaration)

Indicates that a comment block contains documentation for a variable or enum value (either global or as a member of a class). This command is equivalent to \fn, \property, and \typedef.
Note that for PHP one can also specify the type of the variable. The syntax is similar as for the `phpDocumentor` but the description has to start at the next line, i.e.

```
@var  datatype $varname
Description
```

See also

section \fn, \property, and \typedef.

24.57 \vhdlflow [(title for the flow chart)]

This is a VHDL specific command, which can be put in the documentation of a process to produce a flow chart of the logic in the process. Optionally a title for the flow chart can be given.

Note

Currently the flow chart will only appear in the HTML output.

24.58 \weakgroup <name> [(title)]

Can be used exactly like \addtogroup, but has a lower priority when it comes to resolving conflicting grouping definitions.

See also

page Grouping and section \addtogroup.

Section indicators

24.59 \attention { attention text }

Starts a paragraph where a message that needs attention may be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\attention` commands will be joined into a single paragraph. The `\attention` command ends when a blank line or some other sectioning command is encountered.

24.60 \author { list of authors }

Starts a paragraph where one or more author names may be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\author` commands will be joined into a single paragraph. Each author description will start a new line. Alternatively, one `\author` command may mention several authors. The `\author` command ends when a blank line or some other sectioning command is encountered.

Example:

```
/*!
 *  \brief     Pretty nice class.
 *  \details   This class is used to demonstrate a number of section commands.
 *  \author    John Doe
 *  \author    Jan Doe
 *  \version   4.1a
 *  \date      1990-2011
 *  \pre       First initialize the system.
 *  \bug       Not all memory is freed when deleting an object of this class.
 *  \warning   Improper use can crash your application
 *  \copyright GNU Public License.
 */
class SomeNiceClass {};
```

See Author example for the corresponding LaTeX documentation that is generated by doxygen.

24.61 \authors { list of authors }

Equivalent to \author.

24.62 \brief { brief description }

Starts a paragraph that serves as a brief description. For classes and files the brief description will be used in lists and at the start of the documentation page. For class and file members, the brief description will be placed at the declaration of the member and prepended to the detailed description. A brief description may span several lines (although it is advised to keep it brief!). A brief description ends when a blank line or another sectioning command is encountered. If multiple `\brief` commands are present they will be joined. See section \author for an example. Synonymous to \short.

24.63 \bug { bug description }

Starts a paragraph where one or more bugs may be reported. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\bug` commands will be joined into a single paragraph. Each bug description will start on a new line. Alternatively, one `\bug` command may mention several bugs. The `\bug` command ends when a blank line or some other sectioning command is encountered. See section \author for an example.

24.64 \cond [(section-label)]

Starts a conditional section that ends with a corresponding \endcond command, which is typically found in another comment block. The main purpose of this pair of commands is to (conditionally) exclude part of a file from processing (in older version of doxygen this could only be achieved using C preprocessor commands).
The section between `\cond` and \endcond can be included by adding its section label to the ENABLED_SECTIONS configuration option. If the section label is omitted, the section will be excluded from processing unconditionally. The section label can be a logical expression build of section labels, round brackets, && (AND), || (OR) and ! (NOT). If you use an expression you need to wrap it in round brackets, i.e `\cond (!LABEL1 && LABEL2)`.
For conditional sections within a comment block one should use a \if ... \endif block. When using `\cond` and the condition is not satisfied the current comment block is ended and everything until the matching \endcond is removed and a new command block is started there.
Conditional sections can be nested. In this case a nested section will only be shown if it and its containing section are included.
Here is an example showing the commands in action:

```
/** An interface */
class Intf
{
  public:
    /** A method */
    virtual void func() = 0;

    /// @cond TEST
```

```
    /** A method used for testing */
    virtual void test() = 0;

    /// @endcond
};

/// @cond DEV
/*
 *  The implementation of the interface
 */
class Implementation : public Intf
{
  public:
    void func();

    /// @cond TEST
    void test();
    /// @endcond

    /// @cond
    /** This method is obsolete and does
     *  not show up in the documentation.
     */
    void obsolete();
    /// @endcond
};

/// @endcond
```

The output will be different depending on whether or not ENABLED_SECTIONS contains `TEST`, or `DEV`

See also

sections \if, \ifnot, \else, \elseif, \endif, \endcond, and ENABLED_SECTIONS.

Note

Due to the moment of parsing the `\cond` and \endcond commands cannot be used in ALIASES.

24.65 \copyright { copyright description }

Starts a paragraph where the copyright of an entity can be described. This paragraph will be indented. The text of the paragraph has no special internal structure. See section \author for an example.

24.66 \date { date description }

Starts a paragraph where one or more dates may be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\date` commands will be joined into a single paragraph. Each date description will start on a new line. Alternatively, one `\date` command may mention several dates. The `\date` command ends when a blank line or some other sectioning command is encountered. See section \author for an example.

24.67 \deprecated { description }

Starts a paragraph indicating that this documentation block belongs to a deprecated entity. Can be used to describe alternatives, expected life span, etc.

24.68 \details { detailed description }

Just like \brief starts a brief description, `\details` starts the detailed description. You can also start a new paragraph (blank line) then the `\details` command is not needed.

24.69 \noop (text to be ignored)

All the text, including the command, till the end of the line is ignored. The command will most commonly be used in combination with ALIASES to ignore not supported commands that are present for e.g. other processing tools.

24.70 \raisewarning (text to be shown as warning)

All the text, excluding the command, till the end of the line is is literally shown as a documentation warning. The text, including the command, is removed from the output. The command will most commonly be used in combination with ALIASES to show a specific warning.

Example:

```
\raisewarning My specific warnning

\warnNoDoc

\warnNoDoc{My specific warnning}
```

together with:

```
ALIASES  = warnNoDoc="\raisewarning Missing documentation"
ALIASES += warnNoDoc{1}="\raisewarning Incomplete documentation: \1"
```

will result in:

```
ex_1.md:1: warning: My specific warnning
ex_1.md:3: warning: Missing documentation
ex_1.md:5: warning: Incomplete documentation: My specific warnning
```

24.71 \else

Starts a conditional section if the previous conditional section was not enabled. The previous section should have been started with a \if, \ifnot, or \elseif command.

See also

sections \if, \ifnot, \elseif, \endif.

24.72 \elseif (section-label)

Starts a conditional documentation section if the previous section was not enabled. A conditional section is disabled by default. To enable it you must put the section-label after the ENABLED_SECTIONS tag in the configuration file. The section label can be a logical expression build of section names, round brackets, && (AND), || (OR) and ! (NOT). Conditional blocks can be nested. A nested section is only enabled if all enclosing sections are enabled as well.

See also

sections \if, \ifnot, \else, \endif.

24.73 \endcond

Ends a conditional section that was started by \cond.

See also

section \cond.

Note

Due to the moment of parsing the `\endcond` and \cond commands cannot be used in ALIASES.

24.74 \endif

Ends a conditional section that was started by \if or \ifnot For each \if or \ifnot one and only one matching \endif must follow.

See also

sections \if, \ifnot, \else, \elseif.

24.75 \exception <exception-object> { exception description }

Starts an exception description for an exception object with name <exception-object>. Followed by a description of the exception. The existence of the exception object is not checked. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\exception` commands will be joined into a single paragraph. Each exception description will start on a new line. The `\exception` description ends when a blank line or some other sectioning command is encountered. See section \fn for an example.

24.76 \if (section-label)

Starts a conditional documentation section. The section ends with a matching \endif command. A conditional section is disabled by default. To enable it you must put the section-label after the ENABLED_SECTIONS tag in the configuration file.
The section label can be a logical expression build of section names, round brackets, && (AND), || (OR) and ! (NOT). If you use an expression you need to wrap it in round brackets, i.e `\if (!LABEL1 && LABEL2)`.
Conditional blocks can be nested. A nested section is only enabled if all enclosing sections are enabled as well.
The `\if` and corresponding \endif have to be in the same comment block. When a conditional block needs to span more than one comment block one has to use \cond ... \endcond.

Example:

```
/*! Unconditionally shown documentation.
 *  \if Cond1
 *    Only included if Cond1 is set.
 *  \endif
 *  \if Cond2
 *    Only included if Cond2 is set.
 *    \if Cond3
 *      Only included if Cond2 and Cond3 are set.
 *    \endif
 *    More text.
 *  \endif
 *  Unconditional text.
 */
```

You can also use conditional commands inside aliases. To document a class in two languages you could for instance use:

Example 2:

```
/*! \english
 *  This is English.
 *  \endenglish
 *  \dutch
 *  Dit is Nederlands.
 *  \enddutch
 */
class Example
{
};
```

Where the following aliases are defined in the configuration file:

```
ALIASES  = "english=\if english" \
           "endenglish=\endif" \
           "dutch=\if dutch" \
           "enddutch=\endif"
```

and ENABLED_SECTIONS can be used to enable either `english` or `dutch`.

See also

sections \endif, \ifnot, \else, \elseif, \cond, \endcond, and ENABLED_SECTIONS.

24.77 \ifnot (section-label)

Starts a conditional documentation section. The section ends with a matching \endif command. This conditional section is enabled by default. To disable it you must put the section-label after the ENABLED_SECTIONS tag in the configuration file. The section label can be a logical expression build of section names, round brackets, && (AND), || (OR) and ! (NOT).

See also

sections \endif, \if, \else, and \elseif, \cond, \endcond, and ENABLED_SECTIONS.

24.78 \invariant { description of invariant }

Starts a paragraph where the invariant of an entity can be described. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\invariant` commands will be joined into a single paragraph. Each invariant description will start on a new line. Alternatively, one `\invariant` command may mention several invariants. The `\invariant` command ends when a blank line or some other sectioning command is encountered.

24.79 \note { text }

Starts a paragraph where a note can be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\note` commands will be joined into a single paragraph. Each note description will start on a new line. Alternatively, one `\note` command may mention several notes. The `\note` command ends when a blank line or some other sectioning command is encountered. See section \par for an example.

24.80 \par [(paragraph title)] { paragraph }

If a paragraph title is given this command starts a paragraph with a user defined heading. The heading extends until the end of the line. The paragraph following the command will be indented.
If no paragraph title is given this command will start a new paragraph. This will also work inside other paragraph commands (like \param or \warning) without ending that command.
The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. The `\par` command ends when a blank line or some other sectioning command is encountered.
Example:

```
/*! \class Par_Test
 * Normal text.
 *
 * \par User defined paragraph:
 * Contents of the paragraph.
 *
 * \par
 * New paragraph under the same heading.
 *
 * \note
 * This note consists of two paragraphs.
 * This is the first paragraph.
 *
 * \par
 * And this is the second paragraph.
 *
 * More normal text.
 */

class Par_Test {};
```

See Par example for the corresponding LaTeX documentation that is generated by doxygen.

24.81 \param ['dir']' <parameter-name> { parameter description }

Starts a parameter description for a function parameter with name <parameter-name>, followed by a description of the parameter. The existence of the parameter is checked and a warning is given if the documentation of this (or any other) parameter is missing or not present in the function declaration or definition.
The `\param` command has an optional attribute, `dir`, specifying the direction of the parameter. Possible values are "[in]", "[in,out]", and "[out]", note the [square] brackets in this description. When a parameter is both input and output, [in,out] is used as attribute. Here is an example for the function `memcpy`:

```
/*!
 * Copies bytes from a source memory area to a destination memory area,
 * where both areas may not overlap.
 * @param[out] dest The memory area to copy to.
 * @param[in]  src  The memory area to copy from.
 * @param[in]  n    The number of bytes to copy
 */
void memcpy(void *dest, const void *src, size_t n);
```

The parameter description is a paragraph with no special internal structure. All visual enhancement commands may be used inside the paragraph.
Multiple adjacent `\param` commands will be joined into a single paragraph. Each parameter description will start on a new line. The `\param` description ends when a blank line or some other sectioning command is encountered. See section \fn for an example.
Note that you can also document multiple parameters with a single `\param` command using a comma separated list. Here is an example:

```
/** Sets the position.
 *  @param x,y,z Coordinates of the position in 3D space.
 */
void setPosition(double x,double y,double z,double t)
{
}
```

Note that for PHP one can also specify the type (or types if you separate them with a pipe symbol) which are allowed for a parameter (as this is not part of the definition). The syntax is the same as for the `phpDocumentor`, i.e.

```
@param  datatype1|datatype2 $paramname description
```

24.82 \parblock

For commands that expect a single paragraph as argument (such as \par, \param and \warning), the \parblock command allows to start a description that covers multiple paragraphs, which then ends with \endparblock.
Example:

```
/** Example of a param command with a description consisting of two paragraphs
 *  \param p
 *  \parblock
 *  First paragraph of the param description.
 *
 *  Second paragraph of the param description.
 *  \endparblock
 *  Rest of the comment block continues.
 */
```

Note that the `\parblock` command may also appear directly after \param's first argument.

24.83 \endparblock

This ends a block of paragraphs started with \parblock.

24.84 \tparam <template-parameter-name> { description }

Starts a template parameter for a class or function template parameter with name <template-parameter-name>, followed by a description of the template parameter.
Otherwise similar to \param.

24.85 \post { description of the postcondition }

Starts a paragraph where the postcondition of an entity can be described. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the

paragraph. Multiple adjacent \post commands will be joined into a single paragraph. Each postcondition will start on a new line. Alternatively, one \post command may mention several postconditions. The \post command ends when a blank line or some other sectioning command is encountered.

24.86 \pre { description of the precondition }

Starts a paragraph where the precondition of an entity can be described. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent \pre commands will be joined into a single paragraph. Each precondition will start on a new line. Alternatively, one \pre command may mention several preconditions. The \pre command ends when a blank line or some other sectioning command is encountered.

24.87 \remark { remark text }

Starts a paragraph where one or more remarks may be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent \remark commands will be joined into a single paragraph. Each remark will start on a new line. Alternatively, one \remark command may mention several remarks. The \remark command ends when a blank line or some other sectioning command is encountered.

24.88 \remarks { remark text }

Equivalent to \remark.

24.89 \result { description of the result value }

Equivalent to \return.

24.90 \return { description of the return value }

Starts a return value description for a function. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent \return commands will be joined into a single paragraph. The \return description ends when a blank line or some other sectioning command is encountered. See section \fn for an example.

24.91 \returns { description of the return value }

Equivalent to \return.

24.92 \retval <return value> { description }

Starts a description for a function's return value with name <return value>, followed by a description of the return value. The text of the paragraph that forms the description has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent \retval commands will be joined into a single paragraph. Each return value description will start on a new line. The \retval description ends when a blank line or some other sectioning command is encountered.

24.93 \sa { references }

Starts a paragraph where one or more cross-references to classes, functions, methods, variables, files or URL may be specified. Two names joined by either :: or # are understood as referring to a class and one of its members. One of several overloaded methods or constructors may be selected by including a parenthesized list of argument types after the method name.
Synonymous to \see.

See also

section autolink for information on how to create links to objects.

24.94 \see { references }

Equivalent to \sa. Introduced for compatibility with Javadoc.

24.95 \short { short description }

Equivalent to \brief.

24.96 \since { text }

This command can be used to specify since when (version or time) an entity is available. The paragraph that follows `\since` does not have any special internal structure. All visual enhancement commands may be used inside the paragraph. The `\since` description ends when a blank line or some other sectioning command is encountered.

24.97 \test { paragraph describing a test case }

Starts a paragraph where a test case can be described. The description will also add the test case to a separate test list. The two instances of the description will be cross-referenced. Each test case in the test list will be preceded by a header that indicates the origin of the test case.

24.98 \throw <exception-object> { exception description }

Synonymous \exception.

Note:

the command \throws is a synonym for this command.

See also

section \exception

24.99 \throws <exception-object> { exception description }

Equivalent to \throw.

24.100 \todo { paragraph describing what is to be done }

Starts a paragraph where a TODO item is described. The description will also add an item to a separate TODO list. The two instances of the description will be cross-referenced. Each item in the TODO list will be preceded by a header that indicates the origin of the item.

24.101 \version { version number }

Starts a paragraph where one or more version strings may be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\version` commands will be joined into a single paragraph. Each version description will start on a new line. Alternatively, one `\version` command may mention several version strings. The \version command ends when a blank line or some other sectioning command is encountered. See section \author for an example.

24.102 \warning { warning message }

Starts a paragraph where one or more warning messages may be entered. The paragraph will be indented. The text of the paragraph has no special internal structure. All visual enhancement commands may be used inside the paragraph. Multiple adjacent `\warning` commands will be joined into a single paragraph. Each warning description will start on a new line. Alternatively, one `\warning` command may mention several warnings. The `\warning` command ends when a blank line or some other sectioning command is encountered. See section \author for an example.

24.103 \xrefitem <key> "(heading)" "(list title)" { text }

This command is a generalization of commands such as \todo and \bug. It can be used to create user-defined text sections which are automatically cross-referenced between the place of occurrence and a related page, which will be generated. On the related page all sections of the same type will be collected.
The first argument <key> is an identifier uniquely representing the type of the section. The second argument is a quoted string representing the heading of the section under which text passed as the fourth argument is put. The third argument (list title) is used as the title for the related page containing all items with the same key. The keys `"todo"`, `"test"`, `"bug"` and `"deprecated"` are predefined.
To get an idea on how to use the `\xrefitem` command and what its effect is, consider the todo list, which (for English output) can be seen an alias for the command

```
\xrefitem todo "Todo" "Todo List"
```

Since it is very tedious and error-prone to repeat the first three parameters of the command for each section, the command is meant to be used in combination with the ALIASES option in the configuration file. To define a new command `\reminder`, for instance, one should add the following line to the configuration file:

```
ALIASES += "reminder=\xrefitem reminders \"Reminder\" \"Reminders\""
```

Note the use of escaped quotes for the second and third argument of the `\xrefitem` command.
In case parameter "(heading)" is the empty string no heading is generated. This can be useful when used in combination with the \page command e.g.

```
/** @page my_errors My Errors
 *  @brief Errors page
 *
 *  Errors page contents.
 */

/** \error ERROR 101: in case a file can not be opened.
    Check about file system read/write access. */
#define MY_ERR_CANNOT_OPEN_FILE                  101

/** \error ERROR 102: in case a file can not be closed.
    Check about file system read/write access. */
#define MY_ERR_CANNOT_CLOSE_FILE                 102
```

with `\error` defined as

```
ALIASES += "error=\xrefitem my_errors \"\" \"\""
```

Commands to create links

24.104 \addindex (text)

This command adds (text) to the LaTeX , DocBook and RTF index.

24.105 \anchor <word>

This command places an invisible, named anchor into the documentation to which you can refer with the \ref command.

See also

section \ref.

24.106 \cite <label>

Adds a bibliographic reference in the text and in the list of bibliographic references. The <label> must be a valid BibTeX label that can be found in one of the .bib files listed in CITE_BIB_FILES. For the LaTeX output the formatting of the reference in the text can be configured with LATEX_BIB_STYLE. For other output formats a fixed representation is used. Note that using this command requires the `bibtex` tool to be present in the search path.

24.107 \endlink

This command ends a link that is started with the \link command.

See also

section \link.

24.108 \link <link-object>

The links that are automatically generated by doxygen always have the name of the object they point to as link-text. The `\link` command can be used to create a link to an object (a file, class, or member) with a user specified link-text. The link command should end with an \endlink command. All text between the `\link` and \endlink commands serves as text for a link to the <link-object> specified as the first argument of `\link`.

See also

Section autolink for more information on automatically generated links and valid link-objects.

24.109 \ref <name> ["(text)"]

Creates a reference to a named section, subsection, page or anchor. For HTML documentation the reference command will generate a link to the section. For a section or subsection the title of the section will be used as the text of the link. For an anchor the optional text between quotes will be used or <name> if no text is specified. For LaTeX documentation the reference command will generate a section number for sections or the text followed by a page number if <name> refers to an anchor.

See also

Section \page for an example of the `\ref` command.

24.110 \refitem <name>

Just like the \ref command, this command creates a reference to a named section, but this reference appears in a list that is started by \secreflist and ends with \endsecreflist. An example of such a list can be seen at the top of the page.

24.111 \secreflist

Starts an index list of item, created with \refitem that each link to a named section.

24.112 \endsecreflist

End an index list started with \secreflist.

24.113 \subpage <name> ["(text)"]

This command can be used to create a hierarchy of pages. The same structure can be made using the \defgroup and \ingroup commands, but for pages the `\subpage` command is often more convenient. The main page (see \mainpage) is typically the root of hierarchy.

This command behaves similar as \ref in the sense that it creates a reference to a page labeled <name> with the optional link text as specified in the second argument.
It differs from the \ref command in that it only works for pages, and creates a parent-child relation between pages, where the child page (or sub page) is identified by label <name>.
See the \section and \subsection commands if you want to add structure without creating multiple pages.

Note

Each page can be the sub page of only one other page and no cyclic relations are allowed, i.e. the page hierarchy must have a tree structure.

Here is an example:

```
/*! \mainpage A simple manual

Some general info.

This manual is divided in the following sections:
- \subpage intro
- \subpage advanced "Advanced usage"
*/

//-----------------------------------------------------------

/*! \page intro Introduction
This page introduces the user to the topic.
Now you can proceed to the \ref advanced "advanced section".
*/

//-----------------------------------------------------------

/*! \page advanced Advanced Usage
This page is for advanced users.
Make sure you have first read \ref intro "the introduction".
*/
```

24.114 \tableofcontents['{'[option[:level]][,option[:level]]∗'}']

Creates a table of contents at the top of a page, listing all sections and subsections in the page. The `option` can be `HTML` or `LaTeX` or `XML` or `DocBook`. When a `level` is specified this means the maximum nesting level that is shown. The value of `level` should be in the range 1..5, values outside this range are considered to be 5. In case no `level` is specified `level` is set to 5 (show all) In case no `option`. is specified `\tableofcontents` acts as if just the `option` `HTML` and `XML` was specified. In case of multiple `\tableofcontents` commands in a page the `option`(s) will be used additional to the already specified `option`(s), but only the last `level` of an `option` is valid.

Warning

This command only works inside related page documentation and *not* in other documentation blocks and only has effect in the specified output!

24.115 \section <section-name> (section title)

Creates a section with name <section-name>. The title of the section should be specified as the second argument of the `\section` command.

Warning

This command only works inside related page documentation and *not* in other documentation blocks!

See also

Section \page for an example of the `\section` command.

24.116 \subsection <subsection-name> (subsection title)

Creates a subsection with name <subsection-name>. The title of the subsection should be specified as the second argument of the `\subsection` command.

Warning

This command only works inside a section of a related page documentation block and *not* in other documentation blocks!

See also

Section \page for an example of the `\subsection` command.

24.117 \subsubsection <subsubsection-name> (subsubsection title)

Creates a subsubsection with name <subsubsection-name>. The title of the subsubsection should be specified as the second argument of the `\subsubsection` command.

Warning

This command only works inside a subsection of a related page documentation block and *not* in other documentation blocks!

See also

Section \page for an example of the \section command and \subsection command.

24.118 \paragraph <paragraph-name> (paragraph title)

Creates a named paragraph with name <paragraph-name>. The title of the paragraph should be specified as the second argument of the `\paragraph` command.

Warning

This command only works inside a subsubsection of a related page documentation block and *not* in other documentation blocks!

Commands for displaying examples

24.119 \dontinclude['{lineno}'] <file-name>

This command can be used to parse a source file without actually verbatim including it in the documentation (as the \include command does). This is useful if you want to divide the source file into smaller pieces and add documentation between the pieces. Source files or directories can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.
You can add option `{lineno}` to enable line numbers for the included code if desired.
The class and member declarations and definitions inside the code fragment are 'remembered' during the parsing of the comment block that contained the `\dontinclude` command.
For line by line descriptions of source files, one or more lines of the example can be displayed using the \line, \skip, \skipline, and \until commands. An internal pointer is used for these commands. The `\dontinclude` command sets the pointer to the first line of the example.

Example:

```
/*! A test class. */
class Include_Test
{
  public:
    /// a member function
    void example();
};

/*! \page pag_example
 *  \dontinclude include_test.cpp
 *  Our main function starts like this:
 *  \skip main
 *  \until {
 *  First we create an object \c t of the Include_Test class.
 *  \skipline Include_Test
 *  Then we call the example member function
 *  \line example
 *  After that our little test routine ends.
 *  \line }
 */
```

Where the example file `include_test.cpp` looks as follows:

```
void main()
{
  Include_Test t;
  t.example();
}
```

See Include example for the corresponding LaTeX documentation that is generated by doxygen.

See also

sections \line, \skip, \skipline, \until, and \include.

24.120 \include['{'option'}'] <file-name>

This command can be used to include a source file as a block of code. The command takes the name of an include file as an argument. Source files or directories can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.
If <file-name> itself is not unique for the set of example files specified by the EXAMPLE_PATH tag, you can include part of the absolute path to disambiguate it.
Using the `\include` command is equivalent to inserting the file into the documentation block and surrounding it with \code and \endcode commands.
The main purpose of the `\include` command is to avoid code duplication in case of example blocks that consist of multiple source and header files.
For a line by line description of a source files use the \dontinclude command in combination with the \line, \skip, \skipline, and \until commands.
Alternatively, the \snippet command can be used to include only a fragment of a source file. For this to work the fragment has to be marked.

Note

Doxygen's special commands do not work inside blocks of code. It is allowed to nest C-style comments inside a code block though.

The `option` can either be `lineno` or `doc`. The `option lineno` can be used to enable line numbers for the included code if desired. The `option doc` can be used to treat the file as documentation rather than code.

Note

When using the `{doc}` option, some commands like \cond and \if don't work with this command due to the moment of parsing.

The included documentation should not have comment signs in it as they will appear in the documentation as well.

See also

sections \example, \dontinclude, \verbatim, \includedoc, and \snippet.

24.121 \includelineno <file-name>

This command is obsolete and is still supported for backward compatibility reasons, it works the same way as \include{lineno}

See also

sections \include{lineno}.

24.122 \includedoc <file-name>

This command is obsolete and is still supported for backward compatibility reasons, it works the same way as \include{doc}

See also

section \include{doc}.

24.123 \line (pattern)

This command searches line by line through the example that was last included using \include or \dontinclude until it finds a non-blank line. If that line contains the specified pattern, it is written to the output.
The internal pointer that is used to keep track of the current line in the example, is set to the start of the line following the non-blank line that was found (or to the end of the example if no such line could be found).
See section \dontinclude for an example.

24.124 \skip (pattern)

This command searches line by line through the example that was last included using \include or \dontinclude until it finds a line that contains the specified pattern.
The internal pointer that is used to keep track of the current line in the example, is set to the start of the line that contains the specified pattern (or to the end of the example if the pattern could not be found).
See section \dontinclude for an example.

24.125 \skipline (pattern)

This command searches line by line through the example that was last included using \include or \dontinclude until it finds a line that contains the specified pattern. It then writes the line to the output.
The internal pointer that is used to keep track of the current line in the example, is set to the start of the line following the line that is written (or to the end of the example if the pattern could not be found).

Note:

The command:

```
\skipline pattern
```

is equivalent to:

```
\skip pattern
\line pattern
```

See section \dontinclude for an example.

24.126 \snippet['{'option'}'] <file-name> (block_id)

Where the \include command can be used to include a complete file as source code, this command can be used to quote only a fragment of a source file. In case `this` is used as <file-name> the current file is taken as file to take the snippet from.
For example, the putting the following command in the documentation, references a snippet in file `example.cpp` residing in a subdirectory which should be pointed to by EXAMPLE_PATH.

```
\snippet snippets/example.cpp Adding a resource
```

The text following the file name is the unique identifier for the snippet. This is used to delimit the quoted code in the relevant snippet file as shown in the following example that corresponds to the above `\snippet` command:

```
    QImage image(64, 64, QImage::Format_RGB32);
    image.fill(qRgb(255, 160, 128));

//! [Adding a resource]
    document->addResource(QTextDocument::ImageResource,
        QUrl("mydata://image.png"), QVariant(image));
//! [Adding a resource]
    ...
```

Note that the lines containing the block markers will not be included, so the output will be:

```
document->addResource(QTextDocument::ImageResource,
    QUrl("mydata://image.png"), QVariant(image));
```

Note also that the [block_id] markers should appear exactly twice in the source file.
The `option` can either be `lineno` or `doc`. The `option lineno` can be used to enable line numbers for the included code if desired. The `option doc` can be used to treat the file as documentation rather than code.

Note

> When using the `{doc}` option, some commands like \cond and \if don't work with this command due to the moment of parsing.
>
> The included documentation should not have comment signs in it as they will appear in the documentation as well.

see section \dontinclude for an alternative way to include fragments of a source file that does not require markers.

24.127 \snippetlineno <file-name> (block_id)

This command is obsolete and is still supported for backward compatibility reasons, it works the same way as \snippet{lineno}

See also

> sections \snippet{lineno}

24.128 \snippetdoc <file-name> (block_id)

This command is obsolete and is still supported for backward compatibility reasons, it works the same way as \snippet{doc}

See also

> section \snippet{doc} and \include{doc}.

24.129 \until (pattern)

This command writes all lines of the example that was last included using \include or \dontinclude to the output, until it finds a line containing the specified pattern. The line containing the pattern will be written as well.
The internal pointer that is used to keep track of the current line in the example, is set to the start of the line following last written line (or to the end of the example if the pattern could not be found).
See section \dontinclude for an example.

24.130 \verbinclude <file-name>

This command includes the contents of the file <file-name> verbatim in the documentation. The command is equivalent to pasting the contents of the file in the documentation and placing \verbatim and \endverbatim commands around it.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

24.131 \htmlinclude ["[block]"] <file-name>

This command includes the contents of the file <file-name> as is in the HTML documentation and tagged with `<htmlonly>` in the generated XML output. The command is equivalent to pasting the contents of the file in the documentation and placing \htmlonly and \endhtmlonly commands around it.
Normally the contents of the file indicated by \htmlinclude is inserted as-is. When you want to insert a HTML fragment that has block scope like a table or list which should appear outside .. , this can lead to invalid HTML. You can use \htmlinclude[block] to make doxygen end the current paragraph and restart after the file is included.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

See also

section \htmlonly, \latexinclude, \rtfinclude, \maninclude, \docbookinclude and \xmlinclude.

24.132 \latexinclude <file-name>

This command includes the contents of the file <file-name> as is in the LaTeX documentation and tagged with `<latexonly>` in the generated XML output. The command is equivalent to pasting the contents of the file in the documentation and placing \latexonly and \endlatexonly commands around it.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

See also

section \latexonly, \htmlinclude, \rtfinclude, \maninclude, \docbookinclude and \xmlinclude.

24.133 \rtfinclude <file-name>

This command includes the contents of the file <file-name> as is in the RTF documentation and tagged with `<rtfonly>` in the generated XML output. The command is equivalent to pasting the contents of the file in the documentation and placing \rtfonly and \endrtfonly commands around it.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

See also

section \rtfonly, \htmlinclude, \latexinclude, \maninclude, \docbookinclude and \xmlinclude.

24.134 \maninclude <file-name>

This command includes the contents of the file <file-name> as is in the MAN documentation and tagged with `<manonly>` in the generated XML output. The command is equivalent to pasting the contents of the file in the documentation and placing \manonly and \endmanonly commands around it.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

See also

section \manonly, \htmlinclude, \latexinclude, \rtfinclude, \docbookinclude and \xmlinclude.

24.135 \docbookinclude <file-name>

This command includes the contents of the file <file-name> as is in the DocBook documentation and tagged with `<docbookonly>` in the generated XML output. The command is equivalent to pasting the contents of the file in the documentation and placing \docbookonly and \enddocbookonly commands around it.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

See also

section \docbookonly, \htmlinclude, \latexinclude, \rtfinclude, \maninclude and \xmlinclude.

24.136 \xmlinclude <file-name>

This command includes contents of the file <file-name> as is in the XML documentation. The command is equivalent to pasting the contents of the file in the documentation and placing \xmlonly and \endxmlonly commands around it.
Files or directories that doxygen should look for can be specified using the EXAMPLE_PATH tag of doxygen's configuration file.

See also

section \xmlonly, \htmlinclude, \latexinclude, \rtfinclude, \maninclude and \docbookinclude.

Commands for visual enhancements

24.137 \a <word>

Displays the argument <word> in italics. Use this command to emphasize words. Use this command to refer to member arguments in the running text.

Example:

```
... the \a x and \a y coordinates are used to ...
```

This will result in the following text:

... the *x* and *y* coordinates are used to ...

Equivalent to \e and \em. To emphasize multiple words use multiple words.

24.138 \arg { item-description }

This command has one argument that continues until the first blank line or until another `\arg` is encountered. The command can be used to generate a simple, not nested list of arguments. Each argument should start with a `\arg` command.

Example:

Typing:

```
\arg \c AlignLeft left alignment.
\arg \c AlignCenter center alignment.
\arg \c AlignRight right alignment

No other types of alignment are supported.
```

will result in the following text:

- `AlignLeft` left alignment.
- `AlignCenter` center alignment.
- `AlignRight` right alignment

No other types of alignment are supported.

Note:

For nested lists, HTML commands should be used.

Equivalent to \li

24.139 \b <word>

Displays the argument <word> using a bold font. Equivalent to word. To put multiple words in bold use multiple words.

24.140 \c <word>

Displays the argument <word> using a typewriter font. Use this to refer to a word of code. Equivalent to <tt>word</tt>.

Example:

Typing:

```
... This function returns \c void and not \c int ...
```

will result in the following text:

... This function returns `void` and not `int` ...

Equivalent to \p To have multiple words in typewriter font use <tt>multiple words</tt>.

24.141 \code['{'<word>'}']

Starts a block of code. A code block is treated differently from ordinary text. It is interpreted as source code. The names of classes and members and other documented entities are automatically replaced by links to the documentation.
By default the language that is assumed for syntax highlighting is based on the location where the `\code` block was found. If this part of a Python file for instance, the syntax highlight will be done according to the Python syntax. If it is unclear from the context which language is meant (for instance the comment is in a `.txt` or `.markdown` file) then you can also explicitly indicate the language, by putting the file extension typically that doxygen associated with the language in curly brackets after the code block. Here is an example:

```
\code{.py}
class Python:
   pass
\endcode

\code{.cpp}
class Cpp {};
\endcode
```

If the contents of the code block are in a language that doxygen cannot parse, doxygen will just show the output as-is. You can make this explicit using .unparsed, or by giving some other extension that doxygen doesn't support, e.g.

```
\code{.unparsed}
Show this as-is please
\endcode

\code{.sh}
echo "This is a shell script"
\endcode
```

See also

section \endcode and section \verbatim.

24.142 \copydoc <link-object>

Copies a documentation block from the object specified by <link-object> and pastes it at the location of the command. This command can be useful to avoid cases where a documentation block would otherwise have to be duplicated or it can be used to extend the documentation of an inherited member.

The link object can point to a member (of a class, file or group), a class, a namespace, a group, a page, or a file (checked in that order). Note that if the object pointed to is a member (function, variable, typedef, etc), the compound (class, file, or group) containing it should also be documented for the copying to work.
To copy the documentation for a member of a class one can, for instance, put the following in the documentation:

```
/*! @copydoc MyClass::myfunction()
 *  More documentation.
 */
```

if the member is overloaded, you should specify the argument types explicitly (without spaces!), like in the following:

```
//! @copydoc MyClass::myfunction(type1,type2)
```

Qualified names are only needed if the context in which the documentation block is found requires them.
The `\copydoc` command can be used recursively, but cycles in the `\copydoc` relation will be broken and flagged as an error.
Note that `\copydoc foo()` is roughly equivalent to doing:

```
\brief \copybrief foo()
\details \copydetails foo()
```

See \copybrief and \copydetails for copying only the brief or detailed part of the comment block.

24.143 \copybrief <link-object>

Works in a similar way as \copydoc but will only copy the brief description, not the detailed documentation.

24.144 \copydetails <link-object>

Works in a similar way as \copydoc but will only copy the detailed documentation, not the brief description.

24.145 \docbookonly

Starts a block of text that only will be verbatim included in the generated DocBook documentation and tagged with `<docbookonly>` in the generated XML output. The block ends with a \enddocbookonly command.

See also

section \manonly, \latexonly, \rtfonly, \xmlonly, \htmlonly and \docbookinclude.

24.146 \dot ["caption"] [<sizeindication>=<size>]

Starts a text fragment which should contain a valid description of a dot graph. The text fragment ends with \enddot. Doxygen will pass the text on to dot and include the resulting image (and image map) into the output.
The first argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The second argument is also optional and can be used to specify the width or height of the image. For a description of the possibilities see the paragraph Size indication with the \image command.
The nodes of a graph can be made clickable by using the URL attribute. By using the command \ref inside the URL value you can conveniently link to an item inside doxygen. Here is an example:

Note

usage of this command requires that HAVE_DOT is set to `YES`

doxygen creates a temporary file that is automatically removed unless the DOT_CLEANUP tag is set to `NO`.

```
/*! class B */
class B {};

/*! class C */
class C {};

/*! \mainpage
```

```
 *
 *  Class relations expressed via an inline dot graph:
 *  \dot
 *  digraph example {
 *      node [shape=record, fontname=Helvetica, fontsize=10];
 *      b [ label="class B" URL="\ref B"];
 *      c [ label="class C" URL="\ref C"];
 *      b -> c [ arrowhead="open", style="dashed" ];
 *  }
 *  \enddot
 *  Note that the classes in the above graph are clickable
 *  (in the HTML output).
 */
```

24.147 \emoji "name"

This command will produce an emoji character given its name.
The supported names are the ones also supported by GitHub and listed here https://gist.github.com/rxaviers/7360908
You can use the name with or without colons, i.e. `\emoji smile` is the same as writing `\emoji :smile:`. When an emoji is not supported the name with by places in the text with in between colons, i.e. `\emoji unsupported` will produce `:unsupported:` in the output. Doxygen will also give a warning message.
See also the emoji support page for details.

24.148 \msc ["caption"] [<sizeindication>=<size>]

Starts a text fragment which should contain a valid description of a message sequence chart. See http://www.mcternan.me.uk/mscgen/ for examples. The text fragment ends with \endmsc.
The first argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The second argument is also optional and can be used to specify the width or height of the image. For a description of the possibilities see the paragraph Size indication with the \image command.

Note

> The text fragment should only include the part of the message sequence chart that is within the `msc {...}` block (this is different from \mscfile).
>
> mscgen is now built in into doxygen
>
> doxygen creates a temporary file that is automatically removed unless the DOT_CLEANUP tag is set to `NO`.

Here is an example of the use of the `\msc` command.

```
/** Sender class. Can be used to send a command to the server.
 *  The receiver will acknowledge the command by calling Ack().
 *  \msc
 *    Sender,Receiver;
 *    Sender->Receiver [label="Command()", URL="\ref Receiver::Command()"];
 *    Sender<-Receiver [label="Ack()", URL="\ref Ack()", ID="1"];
 *  \endmsc
 */
class Sender
{
  public:
    /** Acknowledgment from server */
    void Ack(bool ok);
};

/** Receiver class. Can be used to receive and execute commands.
 *  After execution of a command, the receiver will send an acknowledgment
 *  \msc
 *    Receiver,Sender;
 *    Receiver<-Sender [label="Command()", URL="\ref Command()"];
 *    Receiver->Sender [label="Ack()", URL="\ref Sender::Ack()", ID="1"];
 *  \endmsc
 */
class Receiver
{
  public:
    /** Executable a command on the server */
    void Command(int commandId);
};
```

See also

section \mscfile.

24.149 \startuml ['{'option[,option]'}'] ["caption"] [<sizeindication>=<size>]

Starts a text fragment which should contain a valid description of a PlantUML diagram. See https://plantuml.com/ for examples. The text fragment ends with \enduml.

Note

You need to install Java and the PlantUML's jar file, if you want to use this command. When using PlantUML in LaTeX you have to download some more jar files, for details see the PlantUML documentation. This also is valid for the <engine>s latex and math. The location of the PlantUML file should be specified using PLANTUML_JAR_PATH. The other jar files should also reside in this directory.

The use of the <engine> ditaa is not possible in LaTeX as PlantUML only supports the png format and doxygen requires, temporary, eps output.

Not all diagrams can be created with the PlantUML @startuml command but need another PlantUML @start... command. This will look like @start<engine> where currently supported are the following <engine>s: uml, bpm, wire, dot, ditaa, salt, math, latex, gantt, mindmap, wbs, yaml, creole, json, flow, board and git. By default the <engine> is uml. The <engine> can be specified as an option. Also the file to write the resulting image to can be specified by means of an option, see the description of the first (optional) argument for details. Of course only one <engine> can be specified and also the filename can only be specified once.
The first argument is optional and is for compatibility with running PlantUML as a preprocessing step before running doxygen, you can also add the name of the image file after \startuml and inside curly brackets as option, i.e.

```
@startuml{myimage.png} "Image Caption" width=5cm
Alice -> Bob : Hello
@enduml
```

When the name of the image is specified, doxygen will generate an image with that name. Without the name doxygen will choose a name automatically.
The second argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The third argument is also optional and can be used to specify the width or height of the image. For a description of the possibilities see the paragraph Size indication with the \image command.

Note

doxygen creates a temporary file that is automatically removed unless the DOT_CLEANUP tag is set to NO.

Here is an example of the use of the \startuml command.

```
/** Sender class. Can be used to send a command to the server.
 *  The receiver will acknowledge the command by calling Ack().
 *  \startuml
 *    Sender->Receiver  : Command()
 *    Sender<--Receiver : Ack()
 *  \enduml
 */
class Sender
{
  public:
    /** Acknowledgment from server */
    void Ack(bool ok);
};

/** Receiver class. Can be used to receive and execute commands.
 *  After execution of a command, the receiver will send an acknowledgment
 *  \startuml
 *    Receiver<-Sender  : Command()
 *    Receiver-->Sender : Ack()
 *  \enduml
 */
class Receiver
{
  public:
    /** Executable a command on the server */
    void Command(int commandId);
};
```

24.150 \dotfile <file> ["caption"] [<sizeindication>=<size>]

Inserts an image generated by dot from <file> into the documentation.
The first argument specifies the file name of the image. doxygen will look for files in the paths (or files) that you specified after the DOTFILE_DIRS tag. If the dot file is found it will be used as an input file to the dot tool. The resulting image will be put into the correct output directory. If the dot file name contains spaces you'll have to put quotes ("...") around it.
The second argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The third argument is also optional and can be used to specify the width or height of the image. For a description of the possibilities see the paragraph Size indication with the \image command.

Note

usage of this command requires that HAVE_DOT is set to `YES`

See also

section \dot.

24.151 \mscfile <file> ["caption"] [<sizeindication>=<size>]

Inserts an image generated by mscgen from <file> into the documentation. See http://www.mcternan.↩me.uk/mscgen/ for examples.
The first argument specifies the file name of the image. doxygen will look for files in the paths (or files) that you specified after the MSCFILE_DIRS tag. If the msc file is found it will be used as an input file to the built in mscgen tool. The resulting image will be put into the correct output directory. If the msc file name contains spaces you'll have to put quotes ("...") around it.
The second argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The third argument is also optional and can be used to specify the width or height of the image. For a description of the possibilities see the paragraph Size indication with the \image command.

Note

The text fragment should include the part message of the sequence chart as well as the starting `msc {` and ending `}` (this is different from \msc).

See also

section \msc.

24.152 \diafile <file> ["caption"] [<sizeindication>=<size>]

Inserts an image made in dia from <file> into the documentation.
The first argument specifies the file name of the image. doxygen will look for files in the paths (or files) that you specified after the DIAFILE_DIRS tag. If the dia file is found it will be used as an input file dia. The resulting image will be put into the correct output directory. If the dia file name contains spaces you'll have to put quotes ("...") around it.
The second argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The third argument is also optional and can be used to specify the width or height of the image. For a description of the possibilities see the paragraph Size indication with the \image command.

24.153 \e <word>

Displays the argument <word> in italics. Use this command to emphasize words.

Example:

Typing:

```
... this is a \e really good example ...
```

will result in the following text:

... this is a *really* good example ...

Equivalent to \a and \em. To emphasize multiple words use multiple words.

24.154 \em <word>

Displays the argument <word> in italics. Use this command to emphasize words.

Example:

Typing:

```
... this is a \em really good example ...
```

will result in the following text:

... this is a *really* good example ...

Equivalent to \a and \e. To emphasize multiple words use multiple words.

24.155 \endcode

Ends a block of code.

See also

section \code

24.156 \enddocbookonly

Ends a block of text that was started with a \docbookonly command.

See also

section \docbookonly.

24.157 \enddot

Ends a block that was started with \dot.

24.158 \endmsc

Ends a block that was started with \msc.

24.159 \enduml

Ends a block that was started with \startuml.

24.160 \endhtmlonly

Ends a block of text that was started with a \htmlonly command.

See also

section \htmlonly.

24.161 \endlatexonly

Ends a block of text that was started with a \latexonly command.

See also

section \latexonly.

24.162 \endmanonly

Ends a block of text that was started with a \manonly command.

See also

section \manonly.

24.163 \endrtfonly

Ends a block of text that was started with a \rtfonly command.

See also

section \rtfonly.

24.164 \endverbatim

Ends a block of text that was started with a \verbatim command.

See also

section \verbatim.

24.165 \endxmlonly

Ends a block of text that was started with a \xmlonly command.

See also

section \xmlonly.

24.166 \f$

Marks the start and end of an in-text formula.

See also

section formulas for an example.

24.167 \f(

Marks the start of an in-text formula, but contrary to \f$ it will not explicitly open the math-mode in LaTeX.

See also

section \f) and section formulas.

24.168 \f)

Marks the end of an in-text formula started with \f(.

See also

section \f(and section formulas.

24.169 \f[

Marks the start of a long formula that is displayed centered on a separate line.

See also

section \f] and section formulas.

24.170 \f]

Marks the end of a long formula that is displayed centered on a separate line.

See also

section \f[and section formulas.

24.171 \f{environment}{

Marks the start of a formula that is in a specific environment.

Note

The second `{` is optional and is only to help editors (such as `Vim`) to do proper syntax highlighting by making the number of opening and closing braces the same.

See also

section \f} and section formulas.

24.172 \f}

Marks the end of a formula that is in a specific environment.

See also

section \f{ and section formulas.

24.173 \htmlonly ["[block]"]

Starts a block of text that only will be verbatim included in the generated HTML documentation and tagged with `<htmlonly>` in the generated XML output. The block ends with a \endhtmlonly command.
This command can be used to include HTML code that is too complex for doxygen (i.e. applets, java-scripts, and HTML tags that require specific attributes).
Normally the contents between \htmlonly and \endhtmlonly is inserted as-is. When you want to insert a HTML fragment that has block scope like a table or list which should appear outside .. , this can lead to invalid HTML. You can use \htmlonly[block] to make doxygen end the current paragraph and restart it after \endhtmlonly.

Note

environment variables (like $(HOME)) are resolved inside a HTML-only block.

See also

section \manonly, \latexonly, \rtfonly, \xmlonly, \docbookonly, and \htmlinclude.

24.174 \image['{'option[,option]'}'] <format> <file> ["caption"] [<sizeindication>=<size>]

Inserts an image into the documentation. This command is format specific, so if you want to insert an image for more than one format you'll have to repeat this command for each format.
The first argument specifies the output format in which the image should be embedded. Currently, the following values are supported: `html`, `latex`, `docbook`, `rtf` and `xml`.
The second argument specifies the file name of the image. doxygen will look for files in the paths (or files) that you specified after the IMAGE_PATH tag. If the image is found it will be copied to the correct output directory. If the image name contains spaces you'll have to put quotes ("...") around the name. You can also specify an absolute URL instead of a file name, but then doxygen does not copy the image nor check its existence.
The third argument is optional and can be used to specify the caption that is displayed below the image. This argument has to be specified on a single line and between quotes even if it does not contain any spaces. The quotes are stripped before the caption is displayed.
The fourth argument is also optional and can be used to specify the width or height of the image. This can be useful for LaTeX or DocBook output (i.e. format=`latex` or format=`docbook`).

Size indication

The `sizeindication` can specify the width or height to be used (or a combination). The size specifier in LaTeX (for example `10cm` or `4in` or a symbolic width like `\textwidth`).

Currently only the options `inline` and `anchor` are supported. In case the option `inline` is specified the image is placed "in the line", when a caption s present it is shown in HTML as tooltip (ignored for the other formats). For the `anchor` option the syntax is: `anchor:<anchorId>`.
Here is example of a comment block:

```
/*! Here is a snapshot of my new application:
 *  \image html application.jpg
 *  \image latex application.eps "My application" width=10cm
 */
```

And this is an example of how the relevant part of the configuration file may look:

```
IMAGE_PATH     = my_image_dir
```

Warning

The image format for HTML is limited to what your browser supports.
For LaTeX, the image format must be supported by the LaTeX `\includegraphics` command i.e. Encapsulated PostScript (eps), Portable network graphics (png), Joint photographic experts group (jpg / jpeg).

Doxygen does not check if the image is in the correct format. So *you* have to make sure this is the case!

24.175 \latexonly

Starts a block of text that only will be verbatim included in the generated LaTeX documentation and tagged with `<latexonly>` in the generated XML output. The block ends with a \endlatexonly command.
This command can be used to include LaTeX code that is too complex for doxygen (i.e. images, formulas, special characters). You can use the \htmlonly and \endhtmlonly pair to provide a proper HTML alternative.
Note: environment variables (like $(HOME)) are resolved inside a LaTeX-only block.

See also

sections \rtfonly, \xmlonly, \manonly, \htmlonly, \docbookonly, and \latexinclude.

24.176 \manonly

Starts a block of text that only will be verbatim included in the generated MAN documentation and tagged with `<manonly>` in the generated XML output. The block ends with a \endmanonly command.
This command can be used to include groff code directly into MAN pages. You can use the \htmlonly and \endhtmlonly and \latexonly and \endlatexonly pairs to provide proper HTML and LaTeX alternatives.

See also

sections \htmlonly, \xmlonly, \rtfonly, \latexonly, \docbookonly and \maninclude.

24.177 \li { item-description }

This command has one argument that continues until the first blank line or until another `\li` is encountered. The command can be used to generate a simple, not nested list of arguments. Each argument should start with a `\li` command.

Example:

Typing:

```
\li \c AlignLeft left alignment.
\li \c AlignCenter center alignment.
\li \c AlignRight right alignment

No other types of alignment are supported.
```

will result in the following text:

- `AlignLeft` left alignment.
- `AlignCenter` center alignment.
- `AlignRight` right alignment

No other types of alignment are supported.

Note:

For nested lists, HTML commands should be used.

Equivalent to \arg

24.178 \n

Forces a new line. Equivalent to `<br>` and inspired by the `printf` function.

24.179 \p <word>

Displays the parameter <word> using a typewriter font. You can use this command to refer to member function parameters in the running text.

Example:

```
... the \p x and \p y coordinates are used to ...
```

This will result in the following text:

... the `x` and `y` coordinates are used to ...

Equivalent to \c To have multiple words in typewriter font use <tt>multiple words</tt>.

24.180 \rtfonly

Starts a block of text that only will be verbatim included in the generated RTF documentation and tagged with `<rtfonly>` in the generated XML output. The block ends with a \endrtfonly command.
This command can be used to include RTF code that is too complex for doxygen.
Note: environment variables (like $(HOME)) are resolved inside a RTF-only block.

See also

sections \manonly, \xmlonly, \latexonly, \htmlonly, \docbookonly and \rtfinclude.

24.181 \verbatim

Starts a block of text that will be verbatim included in the documentation. The block should end with a \endverbatim command. All commands are disabled in a verbatim block.

Warning

Make sure you include a \endverbatim command for each `\verbatim` command or the parser will get confused!

See also

sections \code, \endverbatim and \verbinclude.

24.182 \xmlonly

Starts a block of text that only will be verbatim included in the generated XML output. The block ends with a \endxmlonly command.
This command can be used to include custom XML tags.

See also

sections \manonly, \rtfonly, \latexonly, \htmlonly, and \docbookonly.

24.183 \\

This command writes a backslash character (`\`) to the output. The backslash has to be escaped in some cases because doxygen uses it to detect commands.

24.184 \@

This command writes an at-sign (`@`) to the output. The at-sign has to be escaped in some cases because doxygen uses it to detect Javadoc commands.

24.185 \~[LanguageId]

This command enables/disables a language specific filter. This can be used to put documentation for different language into one comment block and use the OUTPUT_LANGUAGE tag to filter out only a specific language. Use `\~language_id` to enable output for a specific language only and \~ to enable output for all languages (this is also the default mode).
Example:

```
/*! \~english This is English \~dutch Dit is Nederlands \~german Dies ist
    Deutsch. \~ output for all languages.
 */
```

24.186 \&

This command writes the & character to the output. This character has to be escaped because it has a special meaning in HTML.

24.187 \$

This command writes the $ character to the output. This character has to be escaped in some cases, because it is used to expand environment variables.

24.188 \#

This command writes the # character to the output. This character has to be escaped in some cases, because it is used to refer to documented entities.

24.189 \<

This command writes the < character to the output. This character has to be escaped because it has a special meaning in HTML.

24.190 \>

This command writes the > character to the output. This character has to be escaped because it has a special meaning in HTML.

24.191 \%

This command writes the % character to the output. This character has to be escaped in some cases, because it is used to prevent auto-linking to a word that is also a documented class or struct.

24.192 \"

This command writes the " character to the output. This character has to be escaped in some cases, because it is used in pairs to indicate an unformatted text fragment.

24.193 \.

This command writes a dot (.) to the output. This can be useful to prevent ending a brief description when JAVADOC_AUTOBRIEF is enabled or to prevent starting a numbered list when the dot follows a number at the start of a line.

24.194 \=

This command writes an equal sign (=) to the output. This character sequence has to be escaped in some cases, because it is used in Markdown header processing.

24.195 \::

This command writes a double colon (`::`) to the output. This character sequence has to be escaped in some cases, because it is used to reference to documented entities.

24.196 \|

This command writes a pipe symbol (|) to the output. This character has to be escaped in some cases, because it is used for Markdown tables.

24.197 \--

This command writes two dashes (--) to the output. This allows writing two consecutive dashes to the output instead of one n-dash character (–).

24.198 \---

This command writes three dashes (---) to the output. This allows writing three consecutive dashes to the output instead of one m-dash character (—).

Commands included for Qt compatibility

The following commands are supported to remain compatible to the Qt class browser generator. Do *not* use these commands in your own documentation.

- \annotatedclasslist
- \classhierarchy
- \define
- \functionindex
- \header
- \headerfilelist
- \inherit
- \l
- \postheader

Chapter 25

HTML Commands

Here is a list of all HTML commands that may be used inside the documentation. Note that although these HTML tags are translated to the proper commands for output formats other than HTML, all attributes of a HTML tag are passed on to the HTML output only (the HREF and NAME attributes for the A tag are the only exception).

- <A HREF="...">> Starts a hyperlink (if supported by the output format).
- <A ID="...">> Starts a named anchor (if supported by the output format).
- <A NAME="...">> Starts a named anchor (if supported by the output format).
- </A> Ends a link or anchor
- <B> Starts a piece of text displayed in a bold font.
- </B> Ends a <B> section.
- <BLOCKQUOTE> Starts a quotation block.
- </BLOCKQUOTE> Ends the quotation block.
-
 Forces a line break.
- <CENTER> starts a section of centered text.
- </CENTER> ends a section of centered text.
- <CAPTION> Starts a caption. Use within a table only.
- </CAPTION> Ends a caption. Use within a table only.
- <CITE> Starts a section of text displayed in a font specific for citations.
- </CITE> Ends a <CITE> section.
- <CODE> Starts a piece of text displayed in a typewriter font. Note that only for C# code, this command is equivalent to \code (see <code>).
- </CODE> Ends a <CODE> section. Note that only for C# code, this command is equivalent to \endcode (see <code>).
- <DD> Starts an item description.
- </DD> Ends an item description.
- <DEL> Starts a section of deleted text, typically shown strike through text.
- </DEL> Ends a section of deleted text.
- <DETAILS> Starts a section of detailed text that the user can open and close (in HTML output))
- </DETAILS> Ends a section of detailed text.

- <DFN> Starts a piece of text displayed in a typewriter font.
- </DFN> Ends a <DFN> section.
- <DIV> Starts a section with a specific style (HTML only)
- </DIV> Ends a section with a specific style (HTML only)
- <DL> Starts a description list.
- </DL> Ends a description list.
- <DT> Starts an item title.
- </DT> Ends an item title.
- <EM> Starts a piece of text displayed in an italic font.
- </EM> Ends a <EM> section.
- <HR> Writes a horizontal ruler.
- <H1> Starts an unnumbered section.
- </H1> Ends an unnumbered section.
- <H2> Starts an unnumbered subsection.
- </H2> Ends an unnumbered subsection.
- <H3> Starts an unnumbered subsubsection.
- </H3> Ends an unnumbered subsubsection.
- <H4> Starts an unnumbered subsubsection.
- </H4> Ends an unnumbered subsubsection.
- <H5> Starts an unnumbered subsubsection.
- </H5> Ends an unnumbered subsubsection.
- <H6> Starts an unnumbered subsubsection.
- </H6> Ends an unnumbered subsubsection.
- <I> Starts a piece of text displayed in an italic font.
- </I> Ends a <I> section.
- <IMG SRC="..." ...> This command is written with its attributes to the HTML output only. The SRC attribute is mandatory.
- <INS> Starts a section of inserted text, typically shown as underlined text.
- </INS> Ends a section of inserted text.
- <LI> Starts a new list item.
- </LI> Ends a list item.
- <OL> Starts a numbered item list.
- </OL> Ends a numbered item list.
- <P> Starts a new paragraph.
- </P> Ends a paragraph.
- <PRE> Starts a preformatted fragment.

- <PRE> Ends a preformatted fragment.
- <SMALL> Starts a section of text displayed in a smaller font.
- <SMALL> Ends a <SMALL> section.
- <SPAN> Starts an inline text fragment with a specific style (HTML only)
- <SPAN> Ends an inline text fragment with a specific style (HTML only)
- <S> Starts a section of strike through text.
- <S> Ends a section of strike through text.
- <STRIKE> Starts a section of strike through text.
- <STRIKE> Ends a section of strike through text.
- <STRONG> Starts a section of bold text.
- <STRONG> Ends a section of bold text.
- <SUB> Starts a piece of text displayed in subscript.
- <SUB> Ends a <SUB> section.
- <SUP> Starts a piece of text displayed in superscript.
- <SUP> Ends a <SUP> section.
- <TABLE> starts a table.
- <TABLE> ends a table.
- <TD> Starts a new table data element.
- <TD> Ends a table data element.
- <TH> Starts a new table header.
- <TH> Ends a table header.
- <TR> Starts a new table row.
- <TR> Ends a table row.
- <TT> Starts a piece of text displayed in a typewriter font.
- <TT> Ends a <TT> section.
- <KBD> Starts a piece of text displayed in a typewriter font.
- <KBD> Ends a <KBD> section.
- <U> Starts a section of underlined text.
- <U> Ends a section of underlined text.
- <UL> Starts an unnumbered item list.
- <UL> Ends an unnumbered item list.
- <VAR> Starts a piece of text displayed in an italic font.
- <VAR> Ends a <VAR> section.

The special HTML4 character entities.
The list of entities with their descriptions has been taken from Character entity references in HTML 4. (Portions © International Organization for Standardization 1986 Permission to copy in any form is granted for use with conforming SGML systems and applications as defined in ISO 8879, provided this notice is included in all copies.)

- ` ` no-break space = non-breaking space:
- `¡` inverted exclamation mark: ¡
- `¢` cent sign: ¢
- `£` pound sign: £
- `¤` currency sign: ¤
- `¥` yen sign = yuan sign: ¥
- `¦` broken bar = broken vertical bar: ¦
- `§` section sign: §
- `¨` diaeresis = spacing diaeresis: ¨
- `©` copyright sign: ©
- `ª` feminine ordinal indicator: ª
- `«` left-pointing double angle quotation mark = left pointing guillemet: «
- `¬` not sign: ¬
- `` soft hyphen = discretionary hyphen:
- `®` registered sign = registered trade mark sign: ®
- `¯` macron = spacing macron = overline = APL overbar: ¯
- `°` degree sign: °
- `±` plus-minus sign = plus-or-minus sign: ±
- `²` superscript two = superscript digit two = squared: ²
- `³` superscript three = superscript digit three = cubed: ³
- `´` acute accent = spacing acute: ´
- `µ` micro sign: µ
- `¶` pilcrow sign = paragraph sign: ¶
- `·` middle dot = Georgian comma = Greek middle dot: ·
- `¸` cedilla = spacing cedilla: ¸
- `¹` superscript one = superscript digit one: ¹
- `º` masculine ordinal indicator: º
- `»` right-pointing double angle quotation mark = right pointing guillemet: »
- `¼` vulgar fraction one quarter = fraction one quarter: $\frac{1}{4}$
- `½` vulgar fraction one half = fraction one half: $\frac{1}{2}$
- `¾` vulgar fraction three quarters = fraction three quarters: $\frac{3}{4}$
- `¿` inverted question mark = turned question mark: ¿
- `À` latin capital letter A with grave = latin capital letter A grave: À
- `Á` latin capital letter A with acute: Á
- `Â` latin capital letter A with circumflex: Â
- `Ã` latin capital letter A with tilde: Ã

- `Ä` latin capital letter A with diaeresis: Ä
- `Å` latin capital letter A with ring above = latin capital letter A ring: Å
- `Æ` latin capital letter AE = latin capital ligature AE: Æ
- `Ç` latin capital letter C with cedilla: Ç
- `È` latin capital letter E with grave: È
- `É` latin capital letter E with acute: É
- `Ê` latin capital letter E with circumflex: Ê
- `Ë` latin capital letter E with diaeresis: Ë
- `Ì` latin capital letter I with grave: Ì
- `Í` latin capital letter I with acute: Í
- `Î` latin capital letter I with circumflex: Î
- `Ï` latin capital letter I with diaeresis: Ï
- `Ð` latin capital letter ETH: Ð
- `Ñ` latin capital letter N with tilde: Ñ
- `Ò` latin capital letter O with grave: Ò
- `Ó` latin capital letter O with acute: Ó
- `Ô` latin capital letter O with circumflex: Ô
- `Õ` latin capital letter O with tilde: Õ
- `Ö` latin capital letter O with diaeresis: Ö
- `×` multiplication sign: ×
- `Ø` latin capital letter O with stroke = latin capital letter O slash: Ø
- `Ù` latin capital letter U with grave: Ù
- `Ú` latin capital letter U with acute: Ú
- `Û` latin capital letter U with circumflex: Û
- `Ü` latin capital letter U with diaeresis: Ü
- `Ý` latin capital letter Y with acute: Ý
- `Þ` latin capital letter THORN: Þ
- `ß` latin small letter sharp s = ess-zed: ß
- `à` latin small letter a with grave = latin small letter a grave: à
- `á` latin small letter a with acute: á
- `â` latin small letter a with circumflex: â
- `ã` latin small letter a with tilde: ã
- `ä` latin small letter a with diaeresis: ä
- `å` latin small letter a with ring above = latin small letter a ring: å
- `æ` latin small letter ae = latin small ligature ae: æ
- `ç` latin small letter c with cedilla: ç

- `è` latin small letter e with grave: è
- `é` latin small letter e with acute: é
- `ê` latin small letter e with circumflex: ê
- `ë` latin small letter e with diaeresis: ë
- `ì` latin small letter i with grave: ì
- `í` latin small letter i with acute: í
- `î` latin small letter i with circumflex: î
- `ï` latin small letter i with diaeresis: ï
- `ð` latin small letter eth: ð
- `ñ` latin small letter n with tilde: ñ
- `ò` latin small letter o with grave: ò
- `ó` latin small letter o with acute: ó
- `ô` latin small letter o with circumflex: ô
- `õ` latin small letter o with tilde: õ
- `ö` latin small letter o with diaeresis: ö
- `÷` division sign: ÷
- `ø` latin small letter o with stroke, = latin small letter o slash: ø
- `ù` latin small letter u with grave: ù
- `ú` latin small letter u with acute: ú
- `û` latin small letter u with circumflex: û
- `ü` latin small letter u with diaeresis: ü
- `ý` latin small letter y with acute: ý
- `þ` latin small letter thorn: þ
- `ÿ` latin small letter y with diaeresis: ÿ
- `ƒ` latin small f with hook = function = florin: f
- `Α` greek capital letter alpha: A
- `Β` greek capital letter beta: B
- `Γ` greek capital letter gamma: Γ
- `Δ` greek capital letter delta: Δ
- `Ε` greek capital letter epsilon: E
- `Ζ` greek capital letter zeta: Z
- `Η` greek capital letter eta: H
- `Θ` greek capital letter theta: Θ
- `Ι` greek capital letter iota: I
- `Κ` greek capital letter kappa: K
- `Λ` greek capital letter lambda: Λ

- `Μ` greek capital letter mu: M
- `Ν` greek capital letter nu: N
- `Ξ` greek capital letter xi: Ξ
- `Ο` greek capital letter omicron: O
- `Π` greek capital letter pi: Π
- `Ρ` greek capital letter rho: P
- `Σ` greek capital letter sigma: Σ
- `Τ` greek capital letter tau: T
- `Υ` greek capital letter upsilon: ϒ
- `Φ` greek capital letter phi: Φ
- `Χ` greek capital letter chi: X
- `Ψ` greek capital letter psi: Ψ
- `Ω` greek capital letter omega: Ω
- `α` greek small letter alpha: α
- `β` greek small letter beta: β
- `γ` greek small letter gamma: γ
- `δ` greek small letter delta: δ
- `ε` greek small letter epsilon: ε
- `ζ` greek small letter zeta: ζ
- `η` greek small letter eta: η
- `θ` greek small letter theta: θ
- `ι` greek small letter iota: ι
- `κ` greek small letter kappa: κ
- `λ` greek small letter lambda: λ
- `μ` greek small letter mu: μ
- `ν` greek small letter nu: ν
- `ξ` greek small letter xi: ξ
- `ο` greek small letter omicron: o
- `π` greek small letter pi: π
- `ρ` greek small letter rho: ρ
- `ς` greek small letter final sigma: ς
- `σ` greek small letter sigma: σ
- `τ` greek small letter tau: τ
- `υ` greek small letter upsilon: υ
- `φ` greek small letter phi: φ
- `χ` greek small letter chi: χ

- `ψ` greek small letter psi: ψ
- `ω` greek small letter omega: ω
- `ϑ` greek small letter theta symbol: ϑ
- `ϒ` greek upsilon with hook symbol: Υ
- `ϖ` greek pi symbol: ϖ
- `•` bullet = black small circle: $\bullet$
- `…` horizontal ellipsis = three dot leader: $\ldots$
- `′` prime = minutes = feet: $'$
- `″` double prime = seconds = inches: $''$
- `‾` overline = spacing overscore: $\overline{}$
- `⁄` fraction slash: /
- `℘` script capital P = power set = Weierstrass p: $\wp$
- `ℑ` blackletter capital I = imaginary part: $\Im$
- `ℜ` blackletter capital R = real part symbol: $\Re$
- `™` trade mark sign: ™
- `ℵ` alef symbol = first transfinite cardinal: $\aleph$
- `←` leftwards arrow: $\leftarrow$
- `↑` upwards arrow: $\uparrow$
- `→` rightwards arrow: $\rightarrow$
- `↓` downwards arrow: $\downarrow$
- `↔` left right arrow: $\leftrightarrow$
- `↵` downwards arrow with corner leftwards = carriage return: $\hookleftarrow$
- `⇐` leftwards double arrow: $\Leftarrow$
- `⇑` upwards double arrow: $\Uparrow$
- `⇒` rightwards double arrow: $\Rightarrow$
- `⇓` downwards double arrow: $\Downarrow$
- `⇔` left right double arrow: $\Leftrightarrow$
- `∀` for all: $\forall$
- `∂` partial differential: ∂
- `∃` there exists: $\exists$
- `∅` empty set = null set = diameter: $\emptyset$
- `∇` nabla = backward difference: ∇
- `∈` element of: $\in$
- `∉` not an element of: $\notin$
- `∋` contains as member: $\ni$
- `∏` n-ary product = product sign: $\prod$

- `∑` n-ary summation: $\sum$
- `−` minus sign: -
- `∗` asterisk operator: $*$
- `√` square root = radical sign: $\surd$
- `∝` proportional to: $\propto$
- `∞` infinity: ∞
- `∠` angle: $\angle$
- `∧` logical and = wedge: $\wedge$
- `∨` logical or = vee: $\vee$
- `∩` intersection = cap: $\cap$
- `∪` union = cup: $\cup$
- `∫` integral: $\int$
- `∴` therefore: $\therefore$
- `∼` tilde operator = varies with = similar to: $\sim$
- `≅` approximately equal to: $\cong$
- `≈` almost equal to = asymptotic to: $\approx$
- `≠` not equal to: $\neq$
- `≡` identical to: $\equiv$
- `≤` less-than or equal to: $\leq$
- `≥` greater-than or equal to: $\geq$
- `⊂` subset of: $\subset$
- `⊃` superset of: $\supset$
- `⊄` not a subset of: $\not\subset$
- `⊆` subset of or equal to: $\subseteq$
- `⊇` superset of or equal to: $\supseteq$
- `⊕` circled plus = direct sum: $\oplus$
- `⊗` circled times = vector product: $\otimes$
- `⊥` up tack = orthogonal to = perpendicular: $\perp$
- `⋅` dot operator: $\cdot$
- `⌈` left ceiling = apl upstile: $\lceil$
- `⌉` right ceiling: $\rceil$
- `⌊` left floor = apl downstile: $\lfloor$
- `⌋` right floor: $\rfloor$
- `⟨` left-pointing angle bracket = bra: $\langle$
- `⟩` right-pointing angle bracket = ket: $\rangle$
- `◊` lozenge: $\lozenge$

- `♠` black spade suit: ♠
- `♣` black club suit = shamrock: ♣
- `♥` black heart suit = valentine: ♡
- `♦` black diamond suit: ♢
- `"` quotation mark = APL quote: "
- `&` ampersand: &
- `<` less-than sign: <
- `>` greater-than sign: >
- `Œ` latin capital ligature OE: Œ
- `œ` latin small ligature oe: œ
- `Š` latin capital letter S with caron: Š
- `š` latin small letter s with caron: š
- `Ÿ` latin capital letter Y with diaeresis: Ÿ
- `ˆ` modifier letter circumflex accent: ˆ
- `˜` small tilde: ˜
- ` ` en space:
- ` ` em space:
- ` ` thin space:
- `‌` zero width non-joiner:
- `‍` zero width joiner:
- `‎` left-to-right mark:
- `‏` right-to-left mark:
- `–` en dash: –
- `—` em dash: —
- `‘` left single quotation mark: ‘
- `’` right single quotation mark: ’
- `‚` single low-9 quotation mark: ‚
- `“` left double quotation mark: “
- `”` right double quotation mark: ”
- `„` double low-9 quotation mark: „
- `†` dagger: †
- `‡` double dagger: ‡
- `‰` per mille sign: ‰
- `‹` single left-pointing angle quotation mark: ‹
- `›` single right-pointing angle quotation mark: ›
- `€` euro sign: €

Doxygen extensions:

- `&tm;` trade mark sign: ™
- `'` apostrophe: '

Finally, to put invisible comments inside comment blocks, HTML style comments can be used:

```
/*! <!-- This is a comment with a comment block --> Visible text */
```

The part `<!-- ... -->` will not be shown in the main documentation.

Chapter 26

XML Commands

Doxygen supports most of the XML commands that are typically used in C# code comments. The XML tags are defined in Appendix D of the ECMA-334 standard, which defines the C# language. Unfortunately, the specification is not very precise and a number of the examples given are of poor quality.
Here is the list of tags supported by doxygen:

- <c> Identifies inline text that should be rendered as a piece of code. Similar to using <tt>text</tt>.
- <code> Set one or more lines of source code or program output. Note that this command behaves like \code ... \endcode for C# code, but it behaves like the HTML equivalent <CODE>...</CODE> for other languages.
- <description> Part of a <list> command, describes an item.
- <example> Marks a block of text as an example, ignored by doxygen.
- <exception cref="member"> Identifies the exception a method can throw.
- <include> Can be used to import a piece of XML from an external file. Ignored by doxygen at the moment.
- <inheritdoc> Can be used to insert the documentation of a member of a base class into the documentation of a member of a derived class that reimplements it.
- <item> List item. Can only be used inside a <list> context.
- <list type="type"> Starts a list, supported types are bullet or number and table. A list consists of a number of <item> tags. A list of type table, is a two column table which can have a header.
- <listheader> Starts the header of a list of type "table".
- <para> Identifies a paragraph of text.
- <param name="paramName"> Marks a piece of text as the documentation for parameter "paramName". Similar to using \param.
- <paramref name="paramName"> Refers to a parameter with name "paramName". Similar to using \a.
- <permission> Identifies the security accessibility of a member. Ignored by doxygen.
- <remarks> Identifies the detailed description.
- <returns> Marks a piece of text as the return value of a function or method. Similar to using \return.
- <see cref="member"> Refers to a member. Similar to \ref.
- <seealso cref="member"> Starts a "See also" section referring to "member". Similar to using \sa member.
- <summary> In case this tag is used outside a <DETAILS> tag this tag identifies the brief description. Similar to using \brief. In case this tag is used inside a <DETAILS> tag this tag identifies the heading of the <DETAILS> tag.

- <term> Part of a <list> command.
- <typeparam name="paramName"> Marks a piece of text as the documentation for type parameter "paramName". Similar to using \param.
- <typeparamref name="paramName"> Refers to a parameter with name "paramName". Similar to using \a.
- <value> Identifies a property. Ignored by doxygen.
- <![CDATA[...]]> The text inside this tag (on the ...) is handled as normal doxygen comment except for the XML special characters <, > and & that are used as if they were escaped.

Here is an example of a typical piece of code using some of the above commands:

```
/// <summary>
/// A search engine.
/// </summary>
class Engine
{
  /// <summary>
  /// The Search method takes a series of parameters to specify the search criterion
  /// and returns a dataset containing the result set.
  /// </summary>
  /// <param name="connectionString">the connection string to connect to the
  /// database holding the content to search</param>
  /// <param name="maxRows">The maximum number of rows to
  /// return in the result set</param>
  /// <param name="searchString">The text that we are searching for</param>
  /// <returns>A DataSet instance containing the matching rows. It contains a maximum
  /// number of rows specified by the maxRows parameter</returns>
  public DataSet Search(string connectionString, int maxRows, int searchString)
  {
    DataSet ds = new DataSet();
    return ds;
  }
}
```

Chapter 27

Emoji support

The Unicode consortium has defined a set of emoji with the corresponding unicode sequences. Doxygen supports the subset of emoji characters as used by GitHub (based on the list https://api.github.com/emojis). An emoji is created using the \emoji command. For example \emoji smile (or \emoji :smile:) both produce 😄.

27.1 Representation

For the different doxygen output types there is an output defined:

- Unicode code sequence, the actual representation is depending on the possibilities of the fonts loaded:
  - HTML
  - DocBook
  - RTF, converted to UTF-16 representation.
- Image
  - LaTeX, in case the image can be found (see Emoji image retrieval) otherwise the plain emoji text (i.e. :<text>:) is displayed
- plain emoji text (i.e. :<text>:)
  - man
  - perl
- For XML there is a dedicated <emoji> tag with name and unicode attributes.

27.2 Emoji image retrieval

In the list of images can be downloaded via the following Python script:

```
# script to download the emoticons from GitHub and to produce a table for
# inclusion in doxygen. Works with python 2.7+ and python 3.x
import json
import os
import argparse
import re
try:
    import urllib.request as urlrequest
except ImportError:
    import urllib as urlrequest
unicode_re = re.compile(r'.*?/unicode/(.*?).png\?.*')
def get_emojis():
    response  = urlrequest.urlopen('https://api.github.com/emojis')
    raw_data  = response.read()
    return json.loads(raw_data)
def download_images(dir_name):
    if not os.path.exists(dir_name):
        os.makedirs(dir_name)
    json_data = get_emojis()
    num_items = len(json_data)
    cur_item=0
```

```
    for image,url in sorted(json_data.items()):
        image_name = image+'.png'
        cur_item=cur_item+1
        if url.find('/unicode/')==-1 or not os.path.isfile(dir_name+'/'+image_name):
            with open(dir_name+'/'+image_name,'wb') as file:
                print('%s/%s: fetching %s' % (cur_item,num_items,image_name))
                file.write(urlrequest.urlopen(url).read())
        else:
            print('%s/%s: skipping %s' % (cur_item,num_items,image_name))
def produce_table():
    json_data = get_emojis()
    lines = []
    for image,url in sorted(json_data.items()):
        match = unicode_re.match(url)
        if match:
            unicodes = match.group(1).split('-')
            unicodes_html = ''.join(["&#x"+x+";" for x in unicodes])
            image_str = "\":"+image+":\","
            unicode_str = "\""+unicodes_html+"\""
            lines.append('  { %-42s %-38s }' % (image_str,unicode_str))
    out_str = ',\n'.join(lines)
    print("{")
    print(out_str)
    print("};")
if __name__=="__main__":
    parser = argparse.ArgumentParser()
    group = parser.add_mutually_exclusive_group()
    group.add_argument('-d','--dir',help='directory to place images in')
    group.add_argument('-t','--table',help='generate code fragment',action='store_true')
    args = parser.parse_args()
    if args.table:
        produce_table()
    else:
        download_images(args.dir)
```

When invoking it with the `-d image_dir` option the images will by downloaded in the `image_dir` directory. By means of the doxygen configuration parameter LATEX_EMOJI_DIRECTORY the requested directory can be selected.

For convenience a zip with the result of running the script can also be downloaded from https://www.doxygen.nl/dl/github_emojis.zip

For an overview of the supported emoji one can issue the command:

```
doxygen -f emoji <outputFileName>
```

Part III

Developers Manual

Chapter 28

Internationalization

Support for multiple languages

Doxygen has built-in support for multiple languages. This means that the text fragments, generated by doxygen, can be produced in languages other than English (the default). The output language is chosen through the configuration option OUTPUT_LANGUAGE in the configuration file (with default name and known as Doxyfile). To switch between languages inside a comment block the \~ command can be used.
Currently (version 1.9.3), 40 languages are supported (sorted alphabetically): Afrikaans, Arabic, Armenian, Brazilian Portuguese, Catalan, Chinese, Chinese Traditional, Croatian, Czech, Danish, Dutch, English, Esperanto, Finnish, French, German, Greek, Hungarian, Indonesian, Italian, Japanese (+En), Korean (+En), Latvian, Lithuanian, Macedonian, Norwegian, Persian, Polish, Portuguese, Romanian, Russian, Serbian, SerbianCyrillic, Slovak, Slovene, Spanish, Swedish, Turkish, Ukrainian, and Vietnamese..
The table of information related to the supported languages follows. It is sorted by language alphabetically. The **Status** column was generated from sources and shows approximately the last version when the translator was updated.

Language	Maintainer	Contact address	Status
Afrikaans	Johan Prinsloo	johan at zippysnoek dot com	1.6.0
Arabic	Moaz Reyad Muhammad Bashir Al-Noimi	[resigned] moazreyad at yahoo dot com mbnoimi at gmail dot com	1.4.6
Armenian	Armen Tangamyan	armen dot tangamyan at anu dot edu dot au	1.8.0
Brazilian Portuguese	Fabio "FJTC" Jun Takada Chino	jun-chino at uol dot com dot br	up-to-date
Catalan	Maximiliano Pin Albert Mora	max dot pin at bitroit dot com [unreachable] amora at iua dot upf dot es	1.8.0
Chinese	Lian Yang Li Daobing Wei Liu	lian dot yang dot cn at gmail dot com lidaobing at gmail dot com liuwei at asiainfo dot com	almost up-to-date
Chinese Traditional	Daniel YC Lin Gary Lee	dlin dot tw at gmail dot com garywlee at gmail dot com	1.8.15
Croatian	Boris Bralo	boris dot bralo at gmail dot com	1.8.2
Czech	Petr Přikryl	prikryl at atlas dot cz	up-to-date
Danish	Poul-Erik Hansen Erik Søe Sørensen	pouhan at gnotometrics dot dk eriksoe+doxygen at daimi dot au dot dk	1.8.0
Dutch	Dimitri van Heesch	doxygen at gmail dot com	up-to-date
English	Dimitri van Heesch	doxygen at gmail dot com	up-to-date
Esperanto	Ander Martínez	ander dot basaundi at gmail dot com	1.8.4
Finnish	Antti Laine	antti dot a dot laine at tut dot fi	1.6.0
French	David Martinet Xavier Outhier Benoît BROSSE	contact at e-concept-applications dot fr xouthier at yahoo dot fr Benoit dot BROSSE at ingenico dot com	1.8.19
German	Peter Grotrian Jens Seidel	Peter dot Grotrian at pdv-FS dot de jensseidel at users dot sf dot net	1.8.15
Greek	Paul Gessos	gessos dot paul at yahoo dot gr	almost up-to-date
Hungarian	Ákos Kiss Földvári György	akiss at users dot sourceforge dot net [unreachable] foldvari lost at cyberspace	1.8.15
Indonesian	Hendy Irawan	ceefour at gauldong dot net	1.8.0
Italian	Alessandro Falappa Ahmed Aldo Faisal	alex dot falappa at gmail dot com aaf23 at cam dot ac dot uk	1.8.15
Japanese	Suzumizaki-Kimikata Hiroki Iseri Ryunosuke Satoh Kenji Nagamatsu	szmml at hl2u.com goyoki at gmail dot com sun594 at hotmail dot com [unreachable] naga at joyful dot club dot ne dot jp	1.8.15

	Iwasa Kazmi	[unreachable] iwasa at cosmo-system dot jp	
JapaneseEn	see the Japanese language		English based
Korean	Kim Taedong SooYoung Jung Richard Kim	fly1004 at gmail dot com jung5000 at gmail dot com [unreachable] ryk at dspwiz dot com	1.8.15
KoreanEn	see the Korean language		English based
Latvian	Lauris	lauris at nix.lv	1.8.4
Lithuanian	Tomas Simonaitis Mindaugas Radzius Aidas Berukstis – searching for the maintainer –	[unreachable] haden at homelan dot lt [unreachable] mindaugasradzius at takas dot lt [unreachable] aidasber at takas dot lt [Please, try to help to find someone.]	1.4.6
Macedonian	Slave Jovanovski	slavejovanovski at yahoo dot com	1.6.0
Norwegian	Lars Erik Jordet	lejordet at gmail dot com	1.4.6
Persian	Ali Nadalizadeh	nadalizadeh at gmail dot com	1.7.5
Polish	Piotr Kaminski Grzegorz Kowal Krzysztof Kral	[unreachable] Piotr dot Kaminski at ctm dot gdynia dot pl [unreachable] g_kowal at poczta dot onet dot pl krzysztof dot kral at gmail dot com	1.8.2
Portuguese	Rui Godinho Lopes Fabio "FJTC" Jun Takada Chino	[resigned] rgl at ruilopes dot com jun-chino at uol dot com dot br	up-to-date
Romanian	Ionut Dumitrascu Alexandru Iosup	reddumy at yahoo dot com aiosup at yahoo dot com	1.8.15
Russian	Brilliantov Kirill Vladimirovich Alexandr Chelpanov	brilliantov at byterg dot ru cav at cryptopro dot ru	1.8.15
Serbian	Dejan Milosavljevic	[unreachable] dmilos at email dot com	1.6.0
SerbianCyrillic	Nedeljko Stefanovic	stenedjo at yahoo dot com	1.6.0
Slovak	Kali+Laco Švec Petr Přikryl	[the Slovak language advisors] prikryl at atlas dot cz	1.8.15
Slovene	Matjaž Ostroveršnik	matjaz dot ostroversnik at ostri dot org	1.4.6
Spanish	Bartomeu Francisco Oltra Thennet David Vaquero	bartomeu at loteria3cornella dot com [unreachable] foltra at puc dot cl david at grupoikusnet dot com	1.8.19
Swedish	Björn Palmqvist	bjorn.palmqvist at aidium.se	up-to-date
Turkish	Emin Ilker Cetinbas	niw3 at yahoo dot com	1.7.5
Ukrainian	Olexij Tkatchenko Petro Yermolenko	[resigned] olexij at tkatchenko dot com python at i dot ua	1.8.4
Vietnamese	Dang Minh Tuan	tuanvietkey at gmail dot com	1.6.0

Most people on the list have indicated that they were also busy doing other things, so if you want to help to speed things up please let them (or me) know.
If you want to add support for a language that is not yet listed please read the next section.

Adding a new language to doxygen

This short HOWTO explains how to add support for the new language to doxygen:
Just follow the following steps:

1. Tell me for which language you want to add support. If no one else is already working on support for that language, you will be assigned as the maintainer for the language.

2. Create a copy of `doxygen/src/translator_en.h` and name it `doxygen/src/translator_<your_2_letter_country_code>.h` I'll use `xx` in the rest of this document (and `XX` for the uppercase version).

3. Edit `doxygen/src/language.cpp`: Add the following code:

   ```
   #ifdef LANG_XX
   #include<translator_xx.h>
   #endif
   ```

   Remember to use the same symbol `LANG_XX` that was added to `doxygen/src/lang_cfg.h`.
   Now, in `setTranslator()` add

   ```
   #ifdef LANG_XX
       else if (L_EQUAL("your_language_name"))
       {
         theTranslator = new TranslatorYourLanguage;
       }
   #endif
   ```

after the `if { ... }`. I.e., it must be placed after the code for creating the English translator at the beginning, and before the `else { ... }` part that creates the translator for the default language (English again).

4. Edit `doxygen/src/translator_xx.h`:
   - Use the UTF-8 capable editor and open the file using the UTF-8 mode.
   - Rename `TRANSLATOR_EN_H` to `TRANSLATOR_XX_H` twice (i.e. in the `#ifndef` and `#define` preprocessor commands at the beginning of the file).
   - Rename `TranslatorEnglish` to `TranslatorYourLanguage`
   - In the member `idLanguage()` change "english" into the name of your language (use lower case characters only). Depending on the language you may also wish to change the member functions `latex↩LanguageSupportCommand()` and other (you will recognize them when you start the work).
   - Edit all the strings that are returned by the member functions that start with `tr`. Try to match punctuation and capitals! To enter special characters (with accents) you can:
     - Enter them directly if your keyboard supports that. Recall that the text is expected to be saved using the UTF-8 encoding. Doxygen will translate the characters to proper LaTeX and leaves the HTML and man output in UTF-8.
     - Use HTML codes like `ä` for an `a` with an `umlaut` (i.e. ä). See the HTML specification for the codes.
5. Edit `doxygen/doc/maintainers.txt` and add yourself to the list of maintainers like:
   ```
   TranslatorYourLanguage
   <your name>: <your dot email at your dot domain>
   ```
6. Build the documentation by giving the appropriate build command (like: `make docs`).
7. Now you can use `OUTPUT_LANGUAGE = your_language_name` in the config file to generate output in your language.
8. Send `translator_xx.h` to me so I can add it to doxygen. Send also your name and e-mail address to be included in the `maintainers.txt` list. You can also clone the doxygen repository at GitHub and make a Pull Request later.

Maintaining a language

New versions of doxygen may use new translated sentences. In such situation, the `Translator` class requires implementation of new methods – its interface changes. Of course, the English sentences need to be translated to the other languages. At least, new methods have to be implemented by the language-related translator class; otherwise, doxygen wouldn't even compile. Waiting until all language maintainers have translated the new sentences and sent the results would not be very practical. The following text describes the usage of translator adapters to solve the problem.

The role of Translator Adapters. Whenever the `Translator` class interface changes in the new release, the new class `TranslatorAdapter_x_y_z` is added to the `translator_adapter.h` file (here x, y, and z are numbers that correspond to the current official version of doxygen). All translators that previously derived from the `Translator` class now derive from this adapter class.

The `TranslatorAdapter_x_y_z` class implements the new, required methods. If the new method replaces some similar but obsolete method(s) (e.g. if the number of arguments changed and/or the functionality of the older method was changed or enriched), the `TranslatorAdapter_x_y_z` class may use the obsolete method to get the result which is as close as possible to the older result in the target language. If it is not possible, the result (the default translation) is obtained using the English translator, which is (by definition) always up-to-date.

For example, when the new `trFile()` method with parameters (to determine the capitalization of the first letter and the singular/plural form) was introduced to replace the older method `trFiles()` without arguments, the following code appeared in one of the translator adapter classes:

```
/*! This is the default implementation of the obsolete method
 * used in the documentation of a group before the list of
 * links to documented files.  This is possibly localized.
 */
virtual QCString trFiles()
{ return "Files"; }
```

```
/*! This is the localized implementation of newer equivalent
 * using the obsolete method trFiles().
 */
virtual QCString trFile(bool first_capital, bool singular)
{
  if (first_capital && !singular)
    return trFiles();  // possibly localized, obsolete method
  else
    return english.trFile(first_capital, singular);
}
```

The `trFiles()` is not present in the `TranslatorEnglish` class, because it was removed as obsolete. However, it was used until now and its call was replaced by

```
trFile(true, false)
```

in the doxygen source files. Probably, many language translators implemented the obsolete method, so it perfectly makes sense to use the same language dependent result in those cases. The `TranslatorEnglish` does not implement the old method. It derives from the abstract `Translator` class. On the other hand, the old translator for a different language does not implement the new `trFile()` method. Because of that it is derived from another base class – `TranslatorAdapter_x_y_z`. The `TranslatorAdapter_x_y_z` class has to implement the new, required `trFile()` method. However, the translator adapter would not be compiled if the `trFiles()` method was not implemented. This is the reason for implementing the old method in the translator adapter class (using the same code, that was removed from the TranslatorEnglish).
The simplest way would be to pass the arguments to the English translator and to return its result. Instead, the adapter uses the old `trFiles()` in one special case – when the new `trFile(true, false)` is called. This is the mostly used case at the time of introducing the new method – see above. While this may look too complicated, the technique allows the developers of the core sources to change the Translator interface, while the users may not even notice the change. Of course, when the new `trFile()` is used with different arguments, the English result is returned and it will be noticed by non English users. Here the maintainer of the language translator should implement at least that one particular method.
What says the base class of a language translator? If the language translator class inherits from any adapter class then maintenance is needed. In such case, the language translator is considered not up-to-date. On the other hand, if the language translator derives directly from the abstract class `Translator`, the language translator is up-to-date.
The translator adapter classes are chained so that the older translator adapter class uses the one-step-newer translator adapter as the base class. The newer adapter does less *adapting* work than the older one. The oldest adapter class derives (indirectly) from all of the adapter classes. The name of the adapter class is chosen so that its suffix is derived from the previous official version of doxygen that did not need the adapter. This way, one can say approximately, when the language translator class was last updated – see details below.
The newest translator adapter derives from the abstract `TranslatorAdapterBase` class that derives directly from the abstract `Translator` class. It adds only the private English-translator member for easy implementation of the default translation inside the adapter classes, and it also enforces implementation of one method for notifying the user that the language translation is not up-to-date (because of that some sentences in the generated files may appear in English).
Once the oldest adapter class is not used by any of the language translators, it can be removed from the doxygen project. The maintainers should try to reach the state with the minimal number of translator adapter classes.
To simplify the maintenance of the language translator classes for the supported languages, the `translator.py` Python script was developed (located in `doxygen/doc` directory). It extracts the important information about obsolete and new methods from the source files for each of the languages. The information is stored in the translator report ASCII file (`translator_report.txt`).
Looking at the base class of the language translator, the script guesses also the status of the translator – see the last column of the table with languages above. The `translator.py` is called automatically when the doxygen documentation is generated. You can also run the script manually whenever you feel that it can help you. Of course, you are not forced to use the results of the script. You can find the same information by looking at the adapter class and its base classes.
How should I update my language translator? First, you should be the language maintainer, or you should let him/her know about the changes. The following text was written for the language maintainers as the primary audience.
There are several approaches to be taken when updating your language. If you are not extremely busy, you should always chose the most radical one. When the update takes much more time than you expected, you can always

decide use some suitable translator adapter to finish the changes later and still make your translator working.
The most radical way of updating the language translator is to make your translator class derive directly from the abstract class `Translator` and provide translations for the methods that are required to be implemented – the compiler will tell you if you forgot to implement some of them. If you are in doubt, have a look at the `Translator↩English` class to recognize the purpose of the implemented method. Looking at the previously used adapter class may help you sometimes, but it can also be misleading because the adapter classes do implement also the obsolete methods (see the previous `trFiles()` example).
In other words, the up-to-date language translators do not need the `TranslatorAdapter_x_y_z` classes at all, and you do not need to implement anything else than the methods required by the Translator class (i.e. the pure virtual methods of the `Translator` – they end with `=0;`).
If everything compiles fine, try to run `translator.py`, and have a look at the translator report (ASCII file) at the `doxygen/doc` directory. Your translator is marked as up-to-date only if the script does not detect anything special. If the translator uses the `Translator` base class, there still may be some remarks related to your source code. In the case, the translator is marked as *almost up-to-date*. Namely, the obsolete methods–that are not used at all–may be listed in the section for your language. Simply, remove their code (and run the `translator.py` again). Also, you will be informed when you forgot to change the base class of your translator class to some newer adapter class or directly to the Translator class.
If you do not have time to finish all the updates you should still start with *the most radical approach* as described above. You can always change the base class to the translator adapter class that implements all of the not-yet-implemented methods.
If you prefer to update your translator gradually, have a look at `TranslatorEnglish` (the `translator↩_en.h` file). Inside, you will find the comments like `new since 1.2.4` that separate always a number of methods that were implemented in the stated version. Do implement the group of methods that are placed below the comment that uses the same version numbers as your translator adapter class. (For example, your translator class have to use the `TranslatorAdapter_1_2_4`, if it does not implement the methods below the comment `new since 1.2.4`. When you implement them, your class should use a newer translator adapter.
Run the `translator.py` script occasionally and give it your `xx` identification (from `translator_xx.h`) to create the translator report shorter (also produced faster) – it will contain only the information related to your translator. Once you reach the state when the base class should be changed to some newer adapter, you will see the note in the translator report.
Warning: Don't forget to compile doxygen to discover, whether it is compilable. The `translator.py` does not check if everything is correct with respect to the compiler. Because of that, it may lie sometimes about the necessary base class.
The most obsolete language translators would lead to implementation of too complicated adapters. Because of that, doxygen developers may decide to derive such translators from the `TranslatorEnglish` class, which is by definition always up-to-date.
When doing so, all the missing methods will be replaced by the English translation. This means that not-implemented methods will always return the English result. Such translators are marked using the word `obsolete`. You should read it **really obsolete**. No guess about the last update can be done.
Often, it is possible to construct better result from the obsolete methods. Because of that, the translator adapter classes should be used if possible. On the other hand, implementation of adapters for really obsolete translators brings too much maintenance and run-time overhead.

Chapter 29

Perl Module Output

Since version 1.2.18, doxygen can generate a new output format we have called the "Perl Module output format". It has been designed as an intermediate format that can be used to generate new and customized output without having to modify the doxygen source. Therefore, its purpose is similar to the XML output format that can be also generated by doxygen. The XML output format is more standard, but the Perl Module output format is possibly simpler and easier to use.
The Perl Module output format is still experimental at the moment and could be changed in incompatible ways in future versions, although this should not be very probable. It is also lacking some features of other doxygen backends. However, it can be already used to generate useful output, as shown by the Perl Module-based LaTeX generator.
Please report any bugs or problems you find in the Perl Module backend or the Perl Module-based LaTeX generator to the doxygen-develop mailing list. Suggestions are welcome as well.

29.1 Usage

When the GENERATE_PERLMOD tag is enabled in the Doxyfile, running doxygen generates a number of files in the `perlmod/` subdirectory of your output directory. These files are the following:

- `DoxyDocs.pm`: This is the Perl module that actually contains the documentation, in the Perl Module format described below.
- `DoxyModel.pm`: This Perl module describes the structure of `DoxyDocs.pm`, independently of the actual documentation. See below for details.
- `doxyrules.make`: This file contains the make rules to build and clean the files that are generated from the Doxyfile. Also contains the paths to those files and other relevant information. This file is intended to be included by your own Makefile.
- `Makefile`: This is a simple Makefile including `doxyrules.make`.

To make use of the documentation stored in DoxyDocs.pm you can use one of the default Perl Module-based generators provided by doxygen (at the moment this includes the Perl Module-based LaTeX generator, see below) or write your own customized generator. This should not be too hard if you have some knowledge of Perl and it's the main purpose of including the Perl Module backend in doxygen. See below for details on how to do this.

29.2 Using the LaTeX generator.

The Perl Module-based LaTeX generator is pretty experimental and incomplete at the moment, but you could find it useful nevertheless. It can generate documentation for functions, typedefs and variables within files and classes and can be customized quite a lot by redefining TeX macros. However, there is still no documentation on how to do this.
Setting the PERLMOD_LATEX tag to `YES` in the `Doxyfile` enables the creation of some additional files in the `perlmod/` subdirectory of your output directory. These files contain the Perl scripts and LaTeX code necessary to generate PDF and DVI output from the Perl Module output, using `pdflatex` and `latex` respectively. Rules to automate the use of these files are also added to `doxyrules.make` and the `Makefile`.

The additional generated files are the following:

- doxylatex.pl: This Perl script uses DoxyDocs.pm and DoxyModel.pm to generate doxydocs.tex, a TEX file containing the documentation in a format that can be accessed by LATEX code. This file is not directly LaTeXable.
- doxyformat.tex: This file contains the LATEX code that transforms the documentation from doxydocs.tex into LATEX text suitable to be LATEX'ed and presented to the user.
- doxylatex-template.pl: This Perl script uses DoxyModel.pm to generate doxytemplate.tex, a TEX file defining default values for some macros. doxytemplate.tex is included by doxyformat.tex to avoid the need of explicitly defining some macros.
- doxylatex.tex: This is a very simple LATEX document that loads some packages and includes doxyformat.tex and doxydocs.tex. This document is LATEX'ed to produce the PDF and DVI documentation by the rules added to doxyrules.make.

29.2.1 Creation of PDF and DVI output

To try this you need to have installed latex, pdflatex and the packages used by doxylatex.tex.

1. Update your Doxyfile to the latest version using:

   ```
   doxygen -u Doxyfile
   ```

2. Set both GENERATE_PERLMOD and PERLMOD_LATEX tags to YES in your Doxyfile.
3. Run doxygen on your Doxyfile:

   ```
   doxygen Doxyfile
   ```

4. A perlmod/ subdirectory should have appeared in your output directory. Enter the perlmod/ subdirectory and run:

   ```
   make pdf
   ```

   This should generate a doxylatex.pdf with the documentation in PDF format.

5. Run:

   ```
   make dvi
   ```

   This should generate a doxylatex.dvi with the documentation in DVI format.

29.3 Documentation format.

The Perl Module documentation generated by doxygen is stored in DoxyDocs.pm. This is a very simple Perl module that contains only two statements: an assignment to the variable $doxydocs and the customary 1; statement which usually ends Perl modules.
The documentation is stored in the variable $doxydocs, which can then be accessed by a Perl script using DoxyDocs.pm.
$doxydocs contains a tree-like structure composed of three types of nodes: strings, hashes and lists.

- Strings: These are normal Perl strings. They can be of any length can contain any character. Their semantics depends on their location within the tree. This type of node has no children.
- Hashes: These are references to anonymous Perl hashes. A hash can have multiple fields, each with a different key. The value of a hash field can be a string, a hash or a list, and its semantics depends on the key of the hash field and the location of the hash within the tree. The values of the hash fields are the children of the node.
- Lists: These are references to anonymous Perl lists. A list has an undefined number of elements, which are the children of the node. Each element has the same type (string, hash or list) and the same semantics, depending on the location of the list within the tree.

As you can see, the documentation contained in $doxydocs does not present any special impediment to be processed by a simple Perl script.

29.4 Data structure

You might be interested in processing the documentation contained in `DoxyDocs.pm` without needing to take into account the semantics of each node of the documentation tree. For this purpose, doxygen generates a `Doxy↩Model.pm` file which contains a data structure describing the type and children of each node in the documentation tree.
The rest of this section is to be written yet, but in the meantime you can look at the Perl scripts generated by doxygen (such as `doxylatex.pl` or `doxytemplate-latex.pl`) to get an idea on how to use `DoxyModel.pm`.

29.5 Perl Module Tree Nodes

Nodes in the documentation tree of the Perl Module output format.

This is a description of the structure of the documentation tree in **DoxyDocs.pm**. Each item in the list below describes a node in the tree, and the format of the description is as follows:

- [key =>] **Name** *(type)*. Explanation of the content.

Where

- The "key =>" part only appears if the parent node is a hash. "key" is the key for this node.
- **"Name"** is a unique name for the node, defined in DoxyModel.pm.
- *"(type)"* is the type of the node: "string" for string nodes, "hash" for hash nodes, "list" for list nodes, and "doc" for documentation subtrees. The structure of documentation subtrees is not described anywhere yet, but you can look for example at **doxylatex.pl** to see how to process it.

The meaning of each node in the documentation tree is as follows:

- **Root** *(hash)*. Root node.
  - classes => **Classes** *(list)*. Documented classes.
    - **Class** *(hash)*. A documented class.
      - protected_members => **ClassProtectedMembers** *(hash)*. Information about the protected members in the class.
        - members => **ClassProtectedMemberList** *(list)*. protected member list.
          - **ClassProtectedMember** *(hash)*. A protected member.
            - protection => **ClassProtectedMemberProtection** *(string)*. Protection of the protected member.
            - detailed => **ClassProtectedMemberDetailed** *(hash)*. Detailed information about the protected member.
              - doc => **ClassProtectedMemberDetailedDoc** *(doc)*. Detailed documentation for the protected member.
              - see => **ClassProtectedMemberSee** *(doc)*. "See also" documentation for the protected member.
            - kind => **ClassProtectedMemberKind** *(string)*. Kind of protected member (usually "variable").
            - name => **ClassProtectedMemberName** *(string)*. Name of the protected member.
            - type => **ClassProtectedMemberType** *(string)*. Data type of the protected member.
      - detailed => **ClassDetailed** *(hash)*. Detailed information about the class.
        - doc => **ClassDetailedDoc** *(doc)*. Detailed documentation block for the class.
      - protected_typedefs => **ClassProtectedTypedefs** *(hash)*. Information about the protected typedefs in the class.
        - members => **ClassProtectedTypedefList** *(list)*. protected typedef list.
          - **ClassProtectedTypedef** *(hash)*. A protected typedef.
            - protection => **ClassProtectedTypedefProtection** *(string)*. Protection of the protected typedef.

- detailed => **ClassProtectedTypedefDetailed** *(hash)*. Detailed information about the protected typedef.
  - doc => **ClassProtectedTypedefDetailedDoc** *(doc)*. Detailed documentation for the protected typedef.
  - see => **ClassProtectedTypedefSee** *(doc)*. "See also" documentation for the protected typedef.
- kind => **ClassProtectedTypedefKind** *(string)*. Kind of protected typedef (usually "typedef").
- name => **ClassProtectedTypedefName** *(string)*. Name of the protected typedef.
- type => **ClassProtectedTypedefType** *(string)*. Data type of the protected typedef.

- name => **ClassName** *(string)*. Name of the class.
- private_members => **ClassPrivateMembers** *(hash)*. Information about the private members in the class.
  - members => **ClassPrivateMemberList** *(list)*. private member list.
    - **ClassPrivateMember** *(hash)*. A private member.
      - protection => **ClassPrivateMemberProtection** *(string)*. Protection of the private member.
      - detailed => **ClassPrivateMemberDetailed** *(hash)*. Detailed information about the private member.
        - doc => **ClassPrivateMemberDetailedDoc** *(doc)*. Detailed documentation for the private member.
        - see => **ClassPrivateMemberSee** *(doc)*. "See also" documentation for the private member.
      - kind => **ClassPrivateMemberKind** *(string)*. Kind of private member (usually "variable").
      - name => **ClassPrivateMemberName** *(string)*. Name of the private member.
      - type => **ClassPrivateMemberType** *(string)*. Data type of the private member.
- private_typedefs => **ClassPrivateTypedefs** *(hash)*. Information about the private typedefs in the class.
  - members => **ClassPrivateTypedefList** *(list)*. private typedef list.
    - **ClassPrivateTypedef** *(hash)*. A private typedef.
      - protection => **ClassPrivateTypedefProtection** *(string)*. Protection of the private typedef.
      - detailed => **ClassPrivateTypedefDetailed** *(hash)*. Detailed information about the private typedef.
        - doc => **ClassPrivateTypedefDetailedDoc** *(doc)*. Detailed documentation for the private typedef.
        - see => **ClassPrivateTypedefSee** *(doc)*. "See also" documentation for the private typedef.
      - kind => **ClassPrivateTypedefKind** *(string)*. Kind of private typedef (usually "typedef").
      - name => **ClassPrivateTypedefName** *(string)*. Name of the private typedef.
      - type => **ClassPrivateTypedefType** *(string)*. Data type of the private typedef.
- protected_methods => **ClassProtectedMethods** *(hash)*. Information about the protected methods in the class.
  - members => **ClassProtectedMethodList** *(list)*. protected method list.
    - **ClassProtectedMethod** *(hash)*. A protected method.
      - parameters => **ClassProtectedMethodParams** *(list)*. List of the parameters of the protected method.
        - **ClassProtectedMethodParam** *(hash)*. A parameter of the protected method.
          - declaration_name => **ClassProtectedMethodParamName** *(string)*. The name of the parameter.
          - type => **ClassProtectedMethodParamType** *(string)*. The data type of the parameter.

- protection => **ClassProtectedMethodProtection** *(string)*. Protection of the protected method.
- virtualness => **ClassProtectedMethodVirtualness** *(string)*. Virtualness of the protected method.
- detailed => **ClassProtectedMethodDetailed** *(hash)*. Detailed information about the protected method.
  - params => **ClassProtectedMethodPDBlocks** *(list)*. List of parameter documentation blocks for the protected method.
    - **ClassProtectedMethodPDBlock** *(hash)*. A parameter documentation block for the protected method.
      - parameters => **ClassProtectedMethodPDParams** *(list)*. Parameter list for this parameter documentation block.
        - **ClassProtectedMethodPDParam** *(hash)*. A parameter documented by this documentation block.
          - name => **ClassProtectedMethodPDParamName** *(string)*. Name of the parameter.
      - doc => **ClassProtectedMethodPDDoc** *(doc)*. Documentation for this parameter documentation block.
  - doc => **ClassProtectedMethodDetailedDoc** *(doc)*. Detailed documentation for the protected method.
  - see => **ClassProtectedMethodSee** *(doc)*. "See also" documentation for the protected method.
  - return => **ClassProtectedMethodReturn** *(doc)*. Documentation about the return value of the protected method.
- kind => **ClassProtectedMethodKind** *(string)*. Kind of protected method (usually "function").
- name => **ClassProtectedMethodName** *(string)*. Name of the protected method.
- type => **ClassProtectedMethodType** *(string)*. Data type returned by the protected method.
- static => **ClassProtectedMethodStatic** *(string)*. Whether the protected method is static.

- public_typedefs => **ClassPublicTypedefs** *(hash)*. Information about the public typedefs in the class.
  - members => **ClassPublicTypedefList** *(list)*. public typedef list.
    - **ClassPublicTypedef** *(hash)*. A public typedef.
      - protection => **ClassPublicTypedefProtection** *(string)*. Protection of the public typedef.
      - detailed => **ClassPublicTypedefDetailed** *(hash)*. Detailed information about the public typedef.
        - doc => **ClassPublicTypedefDetailedDoc** *(doc)*. Detailed documentation for the public typedef.
        - see => **ClassPublicTypedefSee** *(doc)*. "See also" documentation for the public typedef.
      - kind => **ClassPublicTypedefKind** *(string)*. Kind of public typedef (usually "typedef").
      - name => **ClassPublicTypedefName** *(string)*. Name of the public typedef.
      - type => **ClassPublicTypedefType** *(string)*. Data type of the public typedef.
- public_members => **ClassPublicMembers** *(hash)*. Information about the public members in the class.
  - members => **ClassPublicMemberList** *(list)*. public member list.
    - **ClassPublicMember** *(hash)*. A public member.
      - protection => **ClassPublicMemberProtection** *(string)*. Protection of the public member.
      - detailed => **ClassPublicMemberDetailed** *(hash)*. Detailed information about the public member.

- doc => **ClassPublicMemberDetailedDoc** *(doc)*. Detailed documentation for the public member.
- see => **ClassPublicMemberSee** *(doc)*. "See also" documentation for the public member.
- kind => **ClassPublicMemberKind** *(string)*. Kind of public member (usually "variable").
- name => **ClassPublicMemberName** *(string)*. Name of the public member.
- type => **ClassPublicMemberType** *(string)*. Data type of the public member.

- private_methods => **ClassPrivateMethods** *(hash)*. Information about the private methods in the class.
  - members => **ClassPrivateMethodList** *(list)*. private method list.
    - **ClassPrivateMethod** *(hash)*. A private method.
      - parameters => **ClassPrivateMethodParams** *(list)*. List of the parameters of the private method.
        - **ClassPrivateMethodParam** *(hash)*. A parameter of the private method.
          - declaration_name => **ClassPrivateMethodParamName** *(string)*. The name of the parameter.
          - type => **ClassPrivateMethodParamType** *(string)*. The data type of the parameter.
      - protection => **ClassPrivateMethodProtection** *(string)*. Protection of the private method.
      - virtualness => **ClassPrivateMethodVirtualness** *(string)*. Virtualness of the private method.
      - detailed => **ClassPrivateMethodDetailed** *(hash)*. Detailed information about the private method.
        - params => **ClassPrivateMethodPDBlocks** *(list)*. List of parameter documentation blocks for the private method.
          - **ClassPrivateMethodPDBlock** *(hash)*. A parameter documentation block for the private method.
            - parameters => **ClassPrivateMethodPDParams** *(list)*. Parameter list for this parameter documentation block.
              - **ClassPrivateMethodPDParam** *(hash)*. A parameter documented by this documentation block.
                - name => **ClassPrivateMethodPDParamName** *(string)*. Name of the parameter.
            - doc => **ClassPrivateMethodPDDoc** *(doc)*. Documentation for this parameter documentation block.
        - doc => **ClassPrivateMethodDetailedDoc** *(doc)*. Detailed documentation for the private method.
        - see => **ClassPrivateMethodSee** *(doc)*. "See also" documentation for the private method.
        - return => **ClassPrivateMethodReturn** *(doc)*. Documentation about the return value of the private method.
      - kind => **ClassPrivateMethodKind** *(string)*. Kind of private method (usually "function").
      - name => **ClassPrivateMethodName** *(string)*. Name of the private method.
      - type => **ClassPrivateMethodType** *(string)*. Data type returned by the private method.
      - static => **ClassPrivateMethodStatic** *(string)*. Whether the private method is static.

- public_methods => **ClassPublicMethods** *(hash)*. Information about the public methods in the class.
  - members => **ClassPublicMethodList** *(list)*. public method list.
    - **ClassPublicMethod** *(hash)*. A public method.
      - parameters => **ClassPublicMethodParams** *(list)*. List of the parameters of the public method.
        - **ClassPublicMethodParam** *(hash)*. A parameter of the public method.

            - declaration_name => **ClassPublicMethodParamName** *(string)*. The name of the parameter.
            - type => **ClassPublicMethodParamType** *(string)*. The data type of the parameter.
        - protection => **ClassPublicMethodProtection** *(string)*. Protection of the public method.
        - virtualness => **ClassPublicMethodVirtualness** *(string)*. Virtualness of the public method.
        - detailed => **ClassPublicMethodDetailed** *(hash)*. Detailed information about the public method.
            - params => **ClassPublicMethodPDBlocks** *(list)*. List of parameter documentation blocks for the public method.
                - **ClassPublicMethodPDBlock** *(hash)*. A parameter documentation block for the public method.
                - parameters => **ClassPublicMethodPDParams** *(list)*. Parameter list for this parameter documentation block.
                - **ClassPublicMethodPDParam** *(hash)*. A parameter documented by this documentation block.
                - name => **ClassPublicMethodPDParamName** *(string)*. Name of the parameter.
                - doc => **ClassPublicMethodPDDoc** *(doc)*. Documentation for this parameter documentation block.
            - doc => **ClassPublicMethodDetailedDoc** *(doc)*. Detailed documentation for the public method.
            - see => **ClassPublicMethodSee** *(doc)*. "See also" documentation for the public method.
            - return => **ClassPublicMethodReturn** *(doc)*. Documentation about the return value of the public method.
        - kind => **ClassPublicMethodKind** *(string)*. Kind of public method (usually "function").
        - name => **ClassPublicMethodName** *(string)*. Name of the public method.
        - type => **ClassPublicMethodType** *(string)*. Data type returned by the public method.
        - static => **ClassPublicMethodStatic** *(string)*. Whether the public method is static.
- files => **Files** *(list)*. Documented files.
    - **File** *(hash)*. A documented file.
        - detailed => **FileDetailed** *(hash)*. Detailed information about the file.
            - doc => **FileDetailedDoc** *(doc)*. Detailed documentation block for the file.
        - functions => **FileFunctions** *(hash)*. Information about the functions in the file.
            - members => **FileFunctionList** *(list)*. function list.
                - **FileFunction** *(hash)*. A function.
                - parameters => **FileFunctionParams** *(list)*. List of the parameters of the function.
                - **FileFunctionParam** *(hash)*. A parameter of the function.
                - declaration_name => **FileFunctionParamName** *(string)*. The name of the parameter.
                - type => **FileFunctionParamType** *(string)*. The data type of the parameter.
                - protection => **FileFunctionProtection** *(string)*. Protection of the function.
                - virtualness => **FileFunctionVirtualness** *(string)*. Virtualness of the function.
                - detailed => **FileFunctionDetailed** *(hash)*. Detailed information about the function.
                - params => **FileFunctionPDBlocks** *(list)*. List of parameter documentation blocks for the function.
                - **FileFunctionPDBlock** *(hash)*. A parameter documentation block for the function.
                - parameters => **FileFunctionPDParams** *(list)*. Parameter list for this parameter documentation block.
                - **FileFunctionPDParam** *(hash)*. A parameter documented by this documentation block.

- name => **FileFunctionPDParamName** *(string)*. Name of the parameter.
- doc => **FileFunctionPDDoc** *(doc)*. Documentation for this parameter documentation block.
- doc => **FileFunctionDetailedDoc** *(doc)*. Detailed documentation for the function.
- see => **FileFunctionSee** *(doc)*. "See also" documentation for the function.
- return => **FileFunctionReturn** *(doc)*. Documentation about the return value of the function.
- kind => **FileFunctionKind** *(string)*. Kind of function (usually "function").
- name => **FileFunctionName** *(string)*. Name of the function.
- type => **FileFunctionType** *(string)*. Data type returned by the function.
- static => **FileFunctionStatic** *(string)*. Whether the function is static.
- name => **FileName** *(string)*. Name of the file.
- variables => **FileVariables** *(hash)*. Information about the variables in the file.
  - members => **FileVariableList** *(list)*. variable list.
    - **FileVariable** *(hash)*. A variable.
      - protection => **FileVariableProtection** *(string)*. Protection of the variable.
      - detailed => **FileVariableDetailed** *(hash)*. Detailed information about the variable.
        - doc => **FileVariableDetailedDoc** *(doc)*. Detailed documentation for the variable.
        - see => **FileVariableSee** *(doc)*. "See also" documentation for the variable.
      - kind => **FileVariableKind** *(string)*. Kind of variable (usually "variable").
      - name => **FileVariableName** *(string)*. Name of the variable.
      - type => **FileVariableType** *(string)*. Data type of the variable.
- typedefs => **FileTypedefs** *(hash)*. Information about the typedefs in the file.
  - members => **FileTypedefList** *(list)*. typedef list.
    - **FileTypedef** *(hash)*. A typedef.
      - protection => **FileTypedefProtection** *(string)*. Protection of the typedef.
      - detailed => **FileTypedefDetailed** *(hash)*. Detailed information about the typedef.
        - doc => **FileTypedefDetailedDoc** *(doc)*. Detailed documentation for the typedef.
        - see => **FileTypedefSee** *(doc)*. "See also" documentation for the typedef.
      - kind => **FileTypedefKind** *(string)*. Kind of typedef (usually "typedef").
      - name => **FileTypedefName** *(string)*. Name of the typedef.
      - type => **FileTypedefType** *(string)*. Data type of the typedef.

Chapter 30

Doxygen's internals

Doxygen's internals

Note that this section is still under construction!
The following picture shows how source files are processed by doxygen.

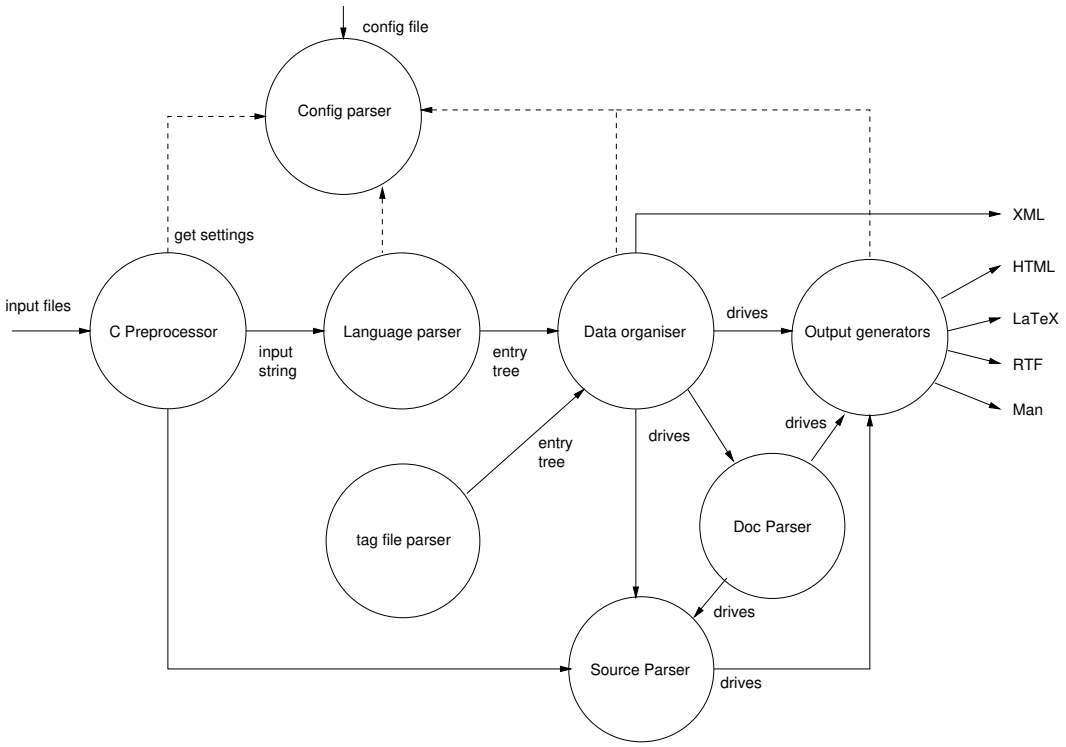


Figure 30.1: Data flow overview

The following sections explain the steps above in more detail.

Config parser

The configuration file that controls the settings of a project is parsed and the settings are stored in the singleton class `Config` in `src/config.h`. The parser itself is written using `flex` and can be found in `src/config.l`. This parser is also used directly by `doxywizard`, so it is put in a separate library.
Each configuration option has one of 5 possible types: `String`, `List`, `Enum`, `Int`, or `Bool`. The values of these options are available through the global functions `Config_getXXX()`, where `XXX` is the type of the option. The argument of these function is a string naming the option as it appears in the configuration file. For instance: `Config_getBool`("GENERATE_TESTLIST") returns a reference to a boolean value that is `TRUE` if the test list was enabled in the configuration file.

The function `readConfiguration()` in `src/doxygen.cpp` reads the command line options and then calls the configuration parser.

C Preprocessor

The input files mentioned in the configuration file are (by default) fed to the C Preprocessor (after being piped through a user defined filter if available).
The way the preprocessor works differs somewhat from a standard C Preprocessor. By default it does not do macro expansion, although it can be configured to expand all macros. Typical usage is to only expand a user specified set of macros. This is to allow macro names to appear in the type of function parameters for instance.
Another difference is that the preprocessor parses, but not actually includes code when it encounters a `#include` (with the exception of `#include` found inside { ... } blocks). The reasons behind this deviation from the standard is to prevent feeding multiple definitions of the same functions/classes to doxygen's parser. If all source files would include a common header file for instance, the class and type definitions (and their documentation) would be present in each translation unit.
The preprocessor is written using `flex` and can be found in `src/pre.l`. For condition blocks (`#if`) evaluation of constant expressions is needed. For this a `yacc` based parser is used, which can be found in `src/constexp.y` and `src/constexp.l`.
The preprocessor is invoked for each file using the `preprocessFile()` function declared in `src/pre.h`, and will append the preprocessed result to a character buffer. The format of the character buffer is

```
0x06 file name 1
0x06 preprocessed contents of file 1
...
0x06 file name n
0x06 preprocessed contents of file n
```

Language parser

The preprocessed input buffer is fed to the language parser, which is implemented as a big state machine using `flex`. It can be found in the file `src/scanner.l`. There is one parser for all languages (C/C++/Java/IDL). The state variables `insideIDL` and `insideJava` are uses at some places for language specific choices.
The task of the parser is to convert the input buffer into a tree of entries (basically an abstract syntax tree). An entry is defined in `src/entry.h` and is a blob of loosely structured information. The most important field is `section` which specifies the kind of information contained in the entry.
Possible improvements for future versions:

- Use one scanner/parser per language instead of one big scanner.
- Move the first pass parsing of documentation blocks to a separate module.
- Parse defines (these are currently gathered by the preprocessor, and ignored by the language parser).

Data organizer

This step consists of many smaller steps, that build dictionaries of the extracted classes, files, namespaces, variables, functions, packages, pages, and groups. Besides building dictionaries, during this step relations (such as inheritance relations), between the extracted entities are computed.
Each step has a function defined in `src/doxygen.cpp`, which operates on the tree of entries, built during language parsing. Look at the "Gathering information" part of `parseInput()` for details.
The result of this step is a number of dictionaries, which can be found in the doxygen "namespace" defined in `src/doxygen.h`. Most elements of these dictionaries are derived from the class `Definition`; The class `MemberDef`, for instance, holds all information for a member. An instance of such a class can be part of a file (class `FileDef`), a class (class `ClassDef`), a namespace (class `NamespaceDef`), a group (class `GroupDef`), or a Java package (class `PackageDef`).

Tag file parser

If tag files are specified in the configuration file, these are parsed by a SAX based XML parser, which can be found in `src/tagreader.cpp`. The result of parsing a tag file is the insertion of `Entry` objects in the entry tree. The field `Entry::tagInfo` is used to mark the entry as external, and holds information about the tag file.

Documentation parser

Special comment blocks are stored as strings in the entities that they document. There is a string for the brief description and a string for the detailed description. The documentation parser reads these strings and executes the commands it finds in it (this is the second pass in parsing the documentation). It writes the result directly to the output generators.
The parser is written in C++ and can be found in `src/docparser.cpp`. The tokens that are eaten by the parser come from `src/doctokenizer.l`. Code fragments found in the comment blocks are passed on to the source parser.
The main entry point for the documentation parser is `validatingParseDoc()` declared in `src/docparser.h`. For simple texts with special commands `validatingParseText()` is used.

Source parser

If source browsing is enabled or if code fragments are encountered in the documentation, the source parser is invoked.
The code parser tries to cross-reference to source code it parses with documented entities. It also does syntax highlighting of the sources. The output is directly written to the output generators.
The main entry point for the code parser is `parseCode()` declared in `src/code.h`.

Output generators

After data is gathered and cross-referenced, doxygen generates output in various formats. For this it uses the methods provided by the abstract class `OutputGenerator`. In order to generate output for multiple formats at once, the methods of `OutputList` are called instead. This class maintains a list of concrete output generators, where each method called is delegated to all generators in the list.
To allow small deviations in what is written to the output for each concrete output generator, it is possible to temporarily disable certain generators. The OutputList class contains various `disable()` and `enable()` methods for this. The methods `OutputList::pushGeneratorState()` and `OutputList::popGeneratorState()` are used to temporarily save the set of enabled/disabled output generators on a stack.
The XML is generated directly from the gathered data structures. In the future XML will be used as an intermediate language (IL). The output generators will then use this IL as a starting point to generate the specific output formats. The advantage of having an IL is that various independently developed tools written in various languages, could extract information from the XML output. Possible tools could be:

- an interactive source browser
- a class diagram generator
- computing code metrics.

Debugging

Since doxygen uses a lot of `flex` code it is important to understand how `flex` works (for this one should read the `man` page) and to understand what it is doing when `flex` is parsing some input. Fortunately, when `flex` is used with the `-d` option it outputs what rules matched. This makes it quite easy to follow what is going on for a particular input fragment.
To make it easier to toggle debug information for a given `flex` file I wrote the following `perl` script, which automatically adds or removes `-d` from the correct line in the `Makefile`:

```
#!/usr/bin/perl

$file = shift @ARGV;
print "Toggle debugging mode for $file\n";
if (!-e "../src/${file}.l")
{
  print STDERR "Error: file ../src/${file}.l does not exist!\n";
  exit 1;
}
system("touch ../src/${file}.l");
unless (rename "src/CMakeFiles/doxymain.dir/build.make","src/CMakeFiles/doxymain.dir/build.make.old") {
  print STDERR "Error: cannot rename src/CMakeFiles/doxymain.dir/build.make!\n";
  exit 1;
```

```
}
if (open(F,"<src/CMakeFiles/doxymain.dir/build.make.old")) {
  unless (open(G,">src/CMakeFiles/doxymain.dir/build.make")) {
    print STDERR "Error: opening file build.make for writing\n";
    exit 1;
  }
  print "Processing build.make...\n";
  while (<F>) {
    if ( s/flex \$\(LEX_FLAGS\) -d(.*) ${file}.l/flex \$(LEX_FLAGS)$1 ${file}.l/ ) {
      print "Disabling debug info for $file\n";
    }
    elsif ( s/flex \$\(LEX_FLAGS\)(.*) ${file}.l$/flex \$(LEX_FLAGS) -d$1 ${file}.l/ ) {
      print "Enabling debug info for $file.l\n";
    }
    print G "$_";
  }
  close F;
  unlink "src/CMakeFiles/doxymain.dir/build.make.old";
}
else {
  print STDERR "Warning file src/CMakeFiles/doxymain.dir/build.make does not exist!\n";
}

# touch the file
$now = time;
utime $now, $now, $file;
```

Another way to get rules matching / debugging information from the `flex` code is setting `LEX_FLAGS` with `make` (`make LEX_FLAGS=-d`).
Note that by running doxygen with `-d lex` you get information about which `flex codefile` is used.

Testing

Doxygen has a small set of tests available to test, some, code integrity. The tests can be run by means of the command `make tests`. When only one or a few tests are required one can set the variable `TEST_FLAGS` when running the test e.g. `make TEST_FLAGS="--id 5" tests` or for multiple tests `make TEST_FLAGS="--id 5 --id 7" tests`. For a full set of possibilities give the command `make TEST_FLAGS="--help" tests`. It is also possible to specify the `TEST_FLAGS` as an environment variable (works also for testing through Visual Studio projects), e.g. `setenv TEST_FLAGS "--id 5 --id 7"` and `make tests`.

Doxyfile differences

In case one has to communicate through e.g. a forum the configuration settings that are different from the standard doxygen configuration file settings one can run the doxygen command: with the `-x` option and the name of the configuration file (default is `Doxyfile`). The output will be a list of the not default settings (in `Doxyfile` format).

Appendices

Appendix A

Autolink Example

A.1 Class Documentation

A.1.1 Autolink_Test Class Reference

Public Types

- enum EType { Val1 , Val2 }

  An enum type.

Public Member Functions

- Autolink_Test ()

  constructor
- ~Autolink_Test ()

  destructor
- void member (int)

  A member function.
- void member (int, int)

  An overloaded member function.

Protected Attributes

- int **var**

  A member variable.

Detailed Description

Since this documentation block belongs to the class Autolink_Test no link to Autolink_Test is generated.
Two ways to link to a constructor are: Autolink_Test and Autolink_Test().
Links to the destructor are: ~Autolink_Test and ~Autolink_Test().
A link to a member in this class: member().
More specific links to the each of the overloaded members: member(int) and member(int,int).
A link to the variable var.
A link to the global typedef B.
A link to the global enumeration type GlobEnum.
A link to the define ABS(x).
A link to a variable using another text as a link.
A link to the enumeration type EType.
A link to some enumeration values: Val1 and GVal1.
And last but not least a link to a file: autolink.cpp.

See also

Inside a see also section any word is checked, so EType, Val1, GVal1, ~Autolink_Test and member will be replaced by links in HTML.

Member Enumeration Documentation

EType `enum Autolink_Test::EType`
An enum type.
More details

Enumerator

Val1	enum value 1
Val2	enum value 2

Constructor & Destructor Documentation

Autolink_Test() `Autolink_Test::Autolink_Test ( )`
constructor
details.

~Autolink_Test() `Autolink_Test::~Autolink_Test ( )`
destructor
details.

Member Function Documentation

member() [1/2]
```
void Autolink_Test::member (
    int )
```
A member function.
Details.

member() [2/2]
```
void Autolink_Test::member (
    int ,
    int )
```
An overloaded member function.
Details
The documentation for this class was generated from the following file:

- autolink.cpp

A.2 File Documentation

A.2.1 autolink.cpp File Reference

Classes

- class Autolink_Test

Macros

- #define ABS(x) (((x)>0)?(x):-(x))

Typedefs

- typedef Autolink_Test B

Enumerations

- enum GlobEnum { GVal1 , GVal2 }

Variables

- int globVar

Detailed Description

Testing automatic link generation.
A link to a member of the Autolink_Test class: Autolink_Test::member,
More specific links to the each of the overloaded members: Autolink_Test::member(int) and Autolink_Test::member(int,int)
A link to a protected member variable of Autolink_Test: Autolink_Test::var,
A link to the global enumeration type GlobEnum.
A link to the define ABS(x).
A link to the destructor of the Autolink_Test class: Autolink_Test::~Autolink_Test,
A link to the typedef B.
A link to the enumeration type Autolink_Test::EType
A link to some enumeration values Autolink_Test::Val1 and GVal2

Macro Definition Documentation

ABS `#define ABS( x ) (((x)>0)?(x):-(x))`

A macro definition.

Typedef Documentation

B `typedef Autolink_Test B`

A type definition.

Enumeration Type Documentation

GlobEnum `enum GlobEnum`

A global enum.

Enumerator

GVal1	global enum value 1
GVal2	global enum value 2

Variable Documentation

globVar `int globVar`
A global variable.

Appendix B

Resolving Typedef Example

B.1 Class Documentation

B.1.1 CoordStruct Struct Reference

Public Attributes

- float x
- float y

Detailed Description

A coordinate pair.

Member Data Documentation

x `float CoordStruct::x`
The x coordinate

y `float CoordStruct::y`
The y coordinate
The documentation for this struct was generated from the following file:

- restypedef.cpp

B.2 File Documentation

B.2.1 restypedef.cpp File Reference

Classes

- struct CoordStruct

Typedefs

- typedef CoordStruct Coord

Functions

- Coord add (Coord c1, Coord c2)

Detailed Description

An example of resolving typedefs.

Typedef Documentation

Coord `typedef CoordStruct Coord`
Creates a type name for CoordStruct

Function Documentation

add()
```
Coord add (
            Coord c1,
            Coord c2 )
```
This function returns the addition of *c1* and *c2*, i.e: (c1.x+c2.x,c1.y+c2.y)

Appendix C

Modules Example

C.1 Module Documentation

C.1.1 The First Group

This is the first group.

Namespaces

- namespace N1

  namespace N1 is in four groups

Classes

- class C1

  class C1 in group 1
- class C2

  class C2 in group 1

Functions

- void **func** ()

  function in group 1
- void **func2** ()

  another function in group 1
- void **func3** ()

  yet another function in group 1

Detailed Description

This is the first group.
More documentation for the first group.

C.1.2 The Second Group

This is the second group.

Namespaces

- namespace N1

  namespace N1 is in four groups

Classes

- class C3

  class C3 in group 2
- class C4

  class C4 in group 2

Detailed Description

This is the second group.

C.1.3 The Third Group

This is the third group.

Modules

- The Fourth Group

  Group 4 is a subgroup of group 3.

Files

- file group.cpp

  this file in group 3

Namespaces

- namespace N1

  namespace N1 is in four groups

Classes

- class C5

  class C5 in the third group.

Detailed Description

This is the third group.

C.1.4 The Fourth Group

Group 4 is a subgroup of group 3.

Namespaces

- namespace N1

  namespace N1 is in four groups

Detailed Description

Group 4 is a subgroup of group 3.

C.1.5 The Fifth Group

This is the fifth group.
This is the fifth group.

This is a section in group 5

This is another section in group 5

C.2 Namespace Documentation

C.2.1 N1 Namespace Reference

namespace N1 is in four groups

Detailed Description

namespace N1 is in four groups

See also

The first group, The Second Group, The Third Group, The Fourth Group

Also see This is another section in group 5

C.3 Class Documentation

C.3.1 C1 Class Reference

class C1 in group 1

Detailed Description

class C1 in group 1
The documentation for this class was generated from the following file:

- group.cpp

C.3.2 C2 Class Reference

class C2 in group 1

Detailed Description

class C2 in group 1
The documentation for this class was generated from the following file:

- group.cpp

C.3.3 C3 Class Reference

class C3 in group 2

Detailed Description

class C3 in group 2
The documentation for this class was generated from the following file:

- group.cpp

C.3.4 C4 Class Reference

class C4 in group 2

Detailed Description

class C4 in group 2
The documentation for this class was generated from the following file:

- group.cpp

C.3.5 C5 Class Reference

class C5 in the third group.

Detailed Description

class C5 in the third group.
The documentation for this class was generated from the following file:

- group.cpp

C.4 File Documentation

C.4.1 group.cpp File Reference

this file in group 3

Classes

- class C1

  class C1 in group 1
- class C2

  class C2 in group 1
- class C3

  class C3 in group 2
- class C4

  class C4 in group 2
- class C5

  class C5 in the third group.

Namespaces

- namespace N1

  namespace N1 is in four groups

Functions

- void **func** ()

  function in group 1
- void **func2** ()

  another function in group 1
- void **func3** ()

  yet another function in group 1

Detailed Description

this file in group 3

Appendix D

Member Groups Example

D.1 Class Documentation

D.1.1 Memgrp_Test Class Reference

A class.

Public Member Functions

- void ungroupedFunction ()

  Function without group.

- void func1InGroup1 ()

  Same documentation for both members.
- void func2InGroup1 ()

  Same documentation for both members.

Group2

Description of group 2.

- void func1InGroup2 ()

  Function 1 in group 2.
- void func2InGroup2 ()

  Function 2 in group 2.

Detailed Description

A class.
Details

Member Function Documentation

func1InGroup1() `void Memgrp_Test::func1InGroup1 ( )`
Same documentation for both members.
Details

func1InGroup2() `void Memgrp_Test::func1InGroup2 ( )`
Function 1 in group 2.
Details.

func2InGroup1() `void Memgrp_Test::func2InGroup1 ( )`
Same documentation for both members.
Details

func2InGroup2() `void Memgrp_Test::func2InGroup2 ( ) [protected]`
Function 2 in group 2.
Details.

ungroupedFunction() `void Memgrp_Test::ungroupedFunction ( )`
Function without group.
Details.
The documentation for this class was generated from the following file:

- memgrp.cpp

D.2 File Documentation

D.2.1 memgrp.cpp File Reference

Classes

- class Memgrp_Test

  A class.

- #define A 1
- #define B 2
- void glob_func ()

Detailed Description

docs for this file

Macro Definition Documentation

A `#define A 1`
one description for all members of this group (because DISTRIBUTE_GROUP_DOC is YES in the config file)

B `#define B 2`
one description for all members of this group (because DISTRIBUTE_GROUP_DOC is YES in the config file)

Function Documentation

glob_func() `void glob_func ( )`
one description for all members of this group (because DISTRIBUTE_GROUP_DOC is YES in the config file)

Appendix E

Style Examples

E.1 After Block Example

E.1.1 Class Documentation

Afterdoc_Test Class Reference

`#include <afterdoc.h>`

Public Types

- enum EnumType { EVal1 , EVal2 }

  An enum type.

Public Member Functions

- void **member** ()

  a member function.

Protected Attributes

- int value

Detailed Description A test class

Member Enumeration Documentation

EnumType `enum Afterdoc_Test::EnumType`
An enum type.
The documentation block cannot be put after the enum!

Enumerator

EVal1	enum value 1
EVal2	enum value 2

Member Data Documentation

value `int Afterdoc_Test::value [protected]`
an integer value
The documentation for this class was generated from the following file:

- afterdoc.h

E.1.2 File Documentation

afterdoc.h

```
/*! A test class */

class Afterdoc_Test
{
  public:
    /** An enum type.
     *  The documentation block cannot be put after the enum!
     */
    enum EnumType
    {
      int EVal1,      /**< enum value 1 */
      int EVal2       /**< enum value 2 */
    };
    void member();    //!< a member function.

  protected:
    int value;        /*!< an integer value */
};
```

E.2 QT Style Example

E.2.1 Class Documentation

QTstyle_Test Class Reference

A test class.

Public Types

- enum TEnum { TVal1 , TVal2 , TVal3 }

  An enum.

Public Member Functions

- QTstyle_Test ()

  A constructor.
- ~QTstyle_Test ()

  A destructor.
- int testMe (int a, const char *s)

  A normal member taking two arguments and returning an integer value.
- virtual void testMeToo (char c1, char c2)=0

  A pure virtual member.

Public Attributes

- enum QTstyle_Test::TEnum * enumPtr

  Enum pointer.
- enum QTstyle_Test::TEnum enumVar

  Enum variable.
- int publicVar

  A public variable.
- int(* handler)(int a, int b)

  A function variable.

Detailed Description A test class.
A more elaborate class description.

Member Enumeration Documentation

TEnum `enum QTstyle_Test::TEnum`
An enum.
More detailed enum description.

Enumerator

TVal1	Enum value TVal1.
TVal2	Enum value TVal2.
TVal3	Enum value TVal3.

Constructor & Destructor Documentation

QTstyle_Test() `QTstyle_Test::QTstyle_Test ( )`
A constructor.
A more elaborate description of the constructor.

~QTstyle_Test() `QTstyle_Test::~QTstyle_Test ( )`
A destructor.
A more elaborate description of the destructor.

Member Function Documentation

testMe()
```
int QTstyle_Test::testMe (
    int a,
    const char * s )
```
A normal member taking two arguments and returning an integer value.

Parameters

a	an integer argument.
s	a constant character pointer.

Returns

The test results

See also

QTstyle_Test(), ~QTstyle_Test(), testMeToo() and publicVar()

testMeToo()
```
virtual void QTstyle_Test::testMeToo (
    char c1,
    char c2 ) [pure virtual]
```
A pure virtual member.

See also

testMe()

Parameters

c1	the first argument.
c2	the second argument.

Member Data Documentation

enumPtr `enum QTstyle_Test::TEnum * QTstyle_Test::enumPtr`
Enum pointer.
Details.

enumVar `enum QTstyle_Test::TEnum QTstyle_Test::enumVar`
Enum variable.
Details.

handler `int(* QTstyle_Test::handler) (int a, int b)`
A function variable.
Details.

publicVar `int QTstyle_Test::publicVar`
A public variable.
Details.
The documentation for this class was generated from the following file:

- qtstyle.cpp

E.3 Javadoc Style Example

E.3.1 Class Documentation

Javadoc_Test Class Reference

A test class.

Public Types

- enum TEnum { TVal1 , TVal2 , TVal3 }

  An enum.

Public Member Functions

- Javadoc_Test ()

  A constructor.
- ~Javadoc_Test ()

  A destructor.
- int testMe (int a, const char *s)

  a normal member taking two arguments and returning an integer value.
- virtual void testMeToo (char c1, char c2)=0

  A pure virtual member.

Public Attributes

- enum Javadoc_Test::TEnum * enumPtr

  enum pointer.
- enum Javadoc_Test::TEnum enumVar

  enum variable.
- int publicVar

  a public variable.
- int(* handler)(int a, int b)

  a function variable.

Detailed Description A test class.
A more elaborate class description.

Member Enumeration Documentation

TEnum `enum Javadoc_Test::TEnum`
An enum.
More detailed enum description.

Enumerator

TVal1	enum value TVal1.
TVal2	enum value TVal2.
TVal3	enum value TVal3.

Constructor & Destructor Documentation

Javadoc_Test() `Javadoc_Test::Javadoc_Test ( )`
A constructor.
A more elaborate description of the constructor.

~Javadoc_Test() `Javadoc_Test::~Javadoc_Test ( )`
A destructor.
A more elaborate description of the destructor.

Member Function Documentation

testMe()
```
int Javadoc_Test::testMe (
    int a,
    const char * s )
```
a normal member taking two arguments and returning an integer value.

Parameters

a	an integer argument.
s	a constant character pointer.

See also

Javadoc_Test()
~Javadoc_Test()
testMeToo()
publicVar()

Returns

The test results

testMeToo()
```
virtual void Javadoc_Test::testMeToo (
    char c1,
    char c2 )  [pure virtual]
```
A pure virtual member.

See also

testMe()

Parameters

c1	the first argument.
c2	the second argument.

Member Data Documentation

enumPtr `enum Javadoc_Test::TEnum * Javadoc_Test::enumPtr`
enum pointer.
Details.

enumVar `enum Javadoc_Test::TEnum Javadoc_Test::enumVar`
enum variable.
Details.

handler `int(* Javadoc_Test::handler) (int a, int b)`
a function variable.
Details.

publicVar `int Javadoc_Test::publicVar`
a public variable.
Details.
The documentation for this class was generated from the following file:

- jdstyle.cpp

E.4 Javadoc Banner Example

E.4.1 File Documentation

javadoc-banner.h File Reference

Functions

- void cstyle (int theory)

  A brief history of JavaDoc-style (C-style) comments.
- void javadocBanner (int theory)

  A brief history of JavaDoc-style (C-style) banner comments.
- void doxygenBanner (int theory)

  A brief history of Doxygen-style banner comments.

Function Documentation

cstyle()
```
void cstyle (
    int theory )
```
A brief history of JavaDoc-style (C-style) comments.
This is the typical JavaDoc-style C-style comment. It starts with two asterisks.

Parameters

theory	Even if there is only one possible unified theory. it is just a set of rules and equations.

doxygenBanner() `void doxygenBanner ( int theory )`

A brief history of Doxygen-style banner comments.

This is a Doxygen-style C-style "banner" comment. It starts with a "normal" comment and is then converted to a "special" comment block near the end of the first line. It is written this way to be more "visible" to developers who are reading the source code. This style of commenting behaves poorly with clang-format.

Parameters

theory	Even if there is only one possible unified theory. it is just a set of rules and equations.

javadocBanner() `void javadocBanner ( int theory )`

A brief history of JavaDoc-style (C-style) banner comments.

This is the typical JavaDoc-style C-style "banner" comment. It starts with a forward slash followed by some number, n, of asterisks, where n $>$ 2. It's written this way to be more "visible" to developers who are reading the source code.

Often, developers are unaware that this is not (by default) a valid Doxygen comment block!

However, as long as JAVADOC_BLOCK = YES is added to the Doxyfile, it will work as expected.

This style of commenting behaves well with clang-format.

Parameters

theory	Even if there is only one possible unified theory. it is just a set of rules and equations.

javadoc-banner.h

Go to the documentation of this file.

```
/**
 * A brief history of JavaDoc-style (C-style) comments.
 *
 * This is the typical JavaDoc-style C-style comment. It starts with two
 * asterisks.
 *
 * @param theory Even if there is only one possible unified theory. it is just a
 *               set of rules and equations.
 */
void cstyle( int theory );

/*****************************************************************************
 * A brief history of JavaDoc-style (C-style) banner comments.
 *
 * This is the typical JavaDoc-style C-style "banner" comment. It starts with
 * a forward slash followed by some number, n, of asterisks, where n > 2. It's
 * written this way to be more "visible" to developers who are reading the
 * source code.
 *
 * Often, developers are unaware that this is not (by default) a valid Doxygen
 * comment block!
 *
 * However, as long as JAVADOC_BLOCK = YES is added to the Doxyfile, it will
 * work as expected.
 *
 * This style of commenting behaves well with clang-format.
 *
 * @param theory Even if there is only one possible unified theory. it is just a
 *               set of rules and equations.
 *****************************************************************************/
void javadocBanner( int theory );

/*****************************************************************************//**
 * A brief history of Doxygen-style banner comments.
 *
 * This is a Doxygen-style C-style "banner" comment. It starts with a "normal"
 * comment and is then converted to a "special" comment block near the end of
```

```
 * the first line. It is written this way to be more "visible" to developers
 * who are reading the source code.
 * This style of commenting behaves poorly with clang-format.
 *
 * @param theory Even if there is only one possible unified theory. it is just a
 *               set of rules and equations.
 ***************************************************************************/
void doxygenBanner( int theory );
```

Appendix F

Structural Commands Example

F.1 File Documentation

F.1.1 structcmd.h File Reference

A Documented file.

Macros

- #define MAX(a, b) (((a)>(b))?(a):(b))

  A macro that returns the maximum of a and b.

Typedefs

- typedef unsigned int UINT32

  A type definition for a .

Functions

- int open (const char ∗, int)

  Opens a file descriptor.
- int close (int)

  Closes the file descriptor fd.
- size_t write (int, const char ∗, size_t)

  Writes count bytes from buf to the filedescriptor fd.
- int read (int, char ∗, size_t)

  Read bytes from a file descriptor.

Variables

- int errno

  Contains the last error code.

Detailed Description

A Documented file.
Details.

Macro Definition Documentation

MAX `#define MAX( a, b ) (((a)>(b))?(a):(b))`

A macro that returns the maximum of *a* and *b*.
Details.

Typedef Documentation

UINT32 `typedef unsigned int UINT32`

A type definition for a .
Details.

Function Documentation

close() `int close ( int fd )`

Closes the file descriptor *fd*.

Parameters

fd	The descriptor to close.

open() `int open ( const char * pathname, int flags )`

Opens a file descriptor.

Parameters

pathname	The name of the descriptor.
flags	Opening flags.

read() `int read ( int fd, char * buf, size_t count )`

Read bytes from a file descriptor.

Parameters

fd	The descriptor to read from.
buf	The buffer to read into.
count	The number of bytes to read.

write() `size_t write ( int fd,`

```
const char * buf,
size_t count )
```

Writes *count* bytes from *buf* to the filedescriptor *fd*.

Parameters

fd	The descriptor to write to.
buf	The data buffer to write.
count	The number of bytes to write.

Variable Documentation

errno `int errno`

Contains the last error code.

Warning

Not thread safe!

F.1.2 structcmd.h

Go to the documentation of this file.

```
/*! \file structcmd.h
    \brief A Documented file.

    Details.
*/

/*! \def MAX(a,b)
    \brief A macro that returns the maximum of \a a and \a b.

    Details.
*/

/*! \var typedef unsigned int UINT32
    \brief A type definition for a .

    Details.
*/

/*! \var int errno
    \brief Contains the last error code.

    \warning Not thread safe!
*/

/*! \fn int open(const char *pathname,int flags)
    \brief Opens a file descriptor.

    \param pathname The name of the descriptor.
    \param flags Opening flags.
*/

/*! \fn int close(int fd)
    \brief Closes the file descriptor \a fd.
    \param fd The descriptor to close.
*/

/*! \fn size_t write(int fd,const char *buf, size_t count)
    \brief Writes \a count bytes from \a buf to the filedescriptor \a fd.
    \param fd The descriptor to write to.
    \param buf The data buffer to write.
    \param count The number of bytes to write.
*/

/*! \fn int read(int fd,char *buf,size_t count)
    \brief Read bytes from a file descriptor.
    \param fd The descriptor to read from.
    \param buf The buffer to read into.
    \param count The number of bytes to read.
*/

```

```
#define MAX(a,b) (((a)>(b))?(a):(b))
typedef unsigned int UINT32;
int errno;
int open(const char *,int);
int close(int);
size_t write(int,const char *, size_t);
int read(int,char *,size_t);
```

Appendix G

Language Examples

G.1 Python Docstring Example

G.1.1 Namespace Documentation

docstring Namespace Reference

Classes

- class PyClass

Functions

- def func ()

Detailed Description

```
@package docstring
Documentation for this module.

More details.
```

Function Documentation

func() `def docstring.func ( )`

```
Documentation for a function.

More details.
```

G.1.2 Class Documentation

docstring.PyClass Class Reference

Public Member Functions

- def __init__ (self)
- def PyMethod (self)

Detailed Description

```
Documentation for a class.

More details.
```

Constructor & Destructor Documentation

__init__() `def docstring.PyClass.__init__ ( self )`

`The constructor.`

Member Function Documentation

PyMethod() `def docstring.PyClass.PyMethod ( self )`

`Documentation for a method.`

The documentation for this class was generated from the following file:

- docstring.py

G.1.3 File Documentation

docstring.py File Reference

Classes

- class docstring.PyClass

Namespaces

- namespace docstring

Functions

- def docstring.func ()

G.2 Python Example

G.2.1 Namespace Documentation

pyexample Namespace Reference

Documentation for this module.

Classes

- class PyClass

  Documentation for a class.

Functions

- def func ()

  Documentation for a function.

Detailed Description Documentation for this module.
More details.

Function Documentation

func() `def pyexample.func ( )`
Documentation for a function.
More details.

G.2.2 Class Documentation

pyexample.PyClass Class Reference

Documentation for a class.

Public Member Functions

- def **__init__** (self)

  The constructor.
- def PyMethod (self)

  Documentation for a method.

Static Public Attributes

- int **classVar** = 0;

  A class variable.

Detailed Description Documentation for a class.
More details.

Member Function Documentation

PyMethod() `def pyexample.PyClass.PyMethod (self )`
Documentation for a method.

Parameters

self	The object pointer.

The documentation for this class was generated from the following file:

- pyexample.py

G.3 VHDL Example

G.3.1 Design Unit Documentation

behavior Architecture Reference

Architecture definition of the MUX.
Entity >> behavior

Detailed Description Architecture definition of the MUX.
More details about this mux element.
The documentation for this design unit was generated from the following file:

- mux.vhdl

mux_using_with Entity Reference

Mux entity brief description Detailed description of this mux design element.

Entities

- behavior architecture

  Architecture definition of the MUX.

Libraries

- ieee

  Use standard library.

Use Clauses

- std_logic_1164

  Use logic elements.

Ports

- din_0 **in** **std_logic**

  Mux first input.
- din_1 **in** **std_logic**

  Mux Second input.
- sel **in** **std_logic**

  Select input.
- mux_out **out** **std_logic**

  Mux output.

Detailed Description Mux entity brief description Detailed description of this mux design element.
The documentation for this design unit was generated from the following file:

- mux.vhdl

G.3.2 File Documentation

mux.vhdl File Reference

2:1 Mux using with-select

Entities

- mux_using_with entity

  Mux entity brief description Detailed description of this mux design element.
- behavior architecture

  Architecture definition of the MUX.

Detailed Description 2:1 Mux using with-select

Appendix H

Class Example

H.1 Class Documentation

H.1.1 Test Class Reference

This is a test class.
`#include "inc/class.h"`

Detailed Description

This is a test class.
Some details about the Test class.
The documentation for this class was generated from the following file:

- class.h

H.2 File Documentation

H.2.1 class.h

```
/* A dummy class */

class Test
{
};

/*! \class Test class.h "inc/class.h"
 *  \brief This is a test class.
 *
 * Some details about the Test class.
 */
```

Appendix I

Define Example

I.1 File Documentation

I.1.1 define.h File Reference

testing defines

Macros

- #define ABS(x) (((x)>0)?(x):-(x))

  Computes the absolute value of its argument x.
- #define MAX(x, y) ((x)>(y)?(x):(y))
- #define MIN(x, y) ((x)>(y)?(y):(x))

Detailed Description

testing defines
This is to test the documentation of defines.

Macro Definition Documentation

ABS `#define ABS(`
`x ) (((x)>0)?(x):-(x))`

Computes the absolute value of its argument *x*.

Parameters

x	input value.

Returns

absolute value of *x*.

MAX `#define MAX(`
`x,`
`y ) ((x)>(y)?(x):(y))`

Computes the maximum of *x* and *y*.

MIN `#define MIN(`
`x,`
`y ) ((x)>(y)?(y):(x))`

Computes the minimum of *x* and *y*.

I.1.2 define.h

Go to the documentation of this file.

```
/*! \file define.h
    \brief testing defines

    This is to test the documentation of defines.
*/

/*!
  \def MAX(x,y)
  Computes the maximum of \a x and \a y.
*/

/*!
   \brief Computes the absolute value of its argument \a x.
   \param x input value.
   \returns absolute value of \a x.
*/
#define ABS(x) (((x)>0)?(x):-(x))
#define MAX(x,y) ((x)>(y)?(x):(y))
#define MIN(x,y) ((x)>(y)?(y):(x))
        /*!< Computes the minimum of \a x and \a y. */
```

Appendix J

Enum Example

J.1 Class Documentation

J.1.1 Enum_Test Class Reference

`#include <enum.h>`

Public Types

- enum TEnum { Val1 , **Val2** }
- enum AnotherEnum { V1 , V2 }

Detailed Description

The class description.

Member Enumeration Documentation

AnotherEnum `enum Enum_Test::AnotherEnum`
Another enum, with inline docs

Enumerator

V1	value 1
V2	value 2

TEnum `enum Enum_Test::TEnum`
A description of the enum type.

Enumerator

Val1	The description of the first enum value.

The documentation for this class was generated from the following file:

- enum.h

J.2 File Documentation

J.2.1 enum.h

```
class Enum_Test
{
  public:
    enum TEnum { Val1, Val2 };

    /*! Another enum, with inline docs */
    enum AnotherEnum
    {
      V1, /*!< value 1 */
       V2  /*!< value 2 */
     };
};

/*! \class Enum_Test
 * The class description.
 */

/*! \enum Enum_Test::TEnum
 * A description of the enum type.
 */

/*! \var Enum_Test::TEnum Enum_Test::Val1
 * The description of the first enum value.
 */
```

Appendix K

Example Example

K.1 Class Documentation

K.1.1 Example_Test Class Reference

A Example_Test class.

Public Member Functions

- void example ()

  An example member function.

Detailed Description

A Example_Test class.
More details about this class.

Examples

example_test.cpp.

Member Function Documentation

example() `void Example_Test::example ( )`
An example member function.
More details about this function.

Examples

example_test.cpp.

The documentation for this class was generated from the following file:

- example.cpp

K.2 Example Documentation

K.2.1 example_test.cpp

This is an example of how to use the Example_Test class.
This is an example of how to use the Example_Test class.More details about this example.

```
void main()
{
  Example_Test t;
  t.example();
}
```

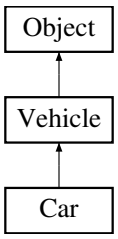
Appendix L

Extends/Implements Example

L.1 Class Documentation

L.1.1 Car Struct Reference

Car type.
Inheritance diagram for Car:



Protected Attributes

- Vehicle **base**

  Base class.

Additional Inherited Members

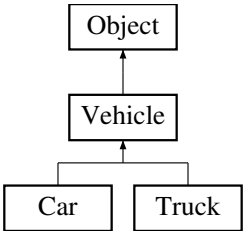
Detailed Description

Car type.
Car class.
The documentation for this struct was generated from the following file:

- manual.c

L.1.2 Object Struct Reference

Object type.
Inheritance diagram for Object:



Static Public Member Functions

- static Object * objRef (Object *obj)
- static Object * objUnref (Object *obj)

Private Attributes

- int **ref**

  Reference count.

Detailed Description

Object type.
Base object class.

Member Function Documentation

objRef() `static Object * objRef ( Object * obj ) [static]`

Increments object reference count by one.

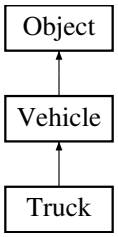
objUnref() `static Object * objUnref ( Object * obj ) [static]`

Decrements object reference count by one.
The documentation for this struct was generated from the following file:

- manual.c

L.1.3 Truck Struct Reference

Truck type.
Inheritance diagram for Truck:



Protected Attributes

- Vehicle **base**

  Base class.

Additional Inherited Members

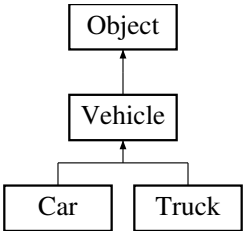
Detailed Description

Truck type.
Truck class.
The documentation for this struct was generated from the following file:

- manual.c

L.1.4 Vehicle Struct Reference

Vehicle type.
Inheritance diagram for Vehicle:



Public Member Functions

- void vehicleStart (Vehicle *obj)
- void vehicleStop (Vehicle *obj)

Protected Attributes

- Object **base**

  Base class.

Additional Inherited Members

Detailed Description

Vehicle type.
Vehicle class.

Member Function Documentation

vehicleStart() `void vehicleStart (Vehicle * obj )`

Starts the vehicle.
Referenced by main().

vehicleStop() `void vehicleStop (Vehicle * obj )`

Stops the vehicle.
The documentation for this struct was generated from the following file:

- manual.c

L.2 File Documentation

L.2.1 manual.c File Reference

Classes

- struct Object

  Object type.
- struct Vehicle

  Vehicle type.

- struct Car

  Car type.
- struct Truck

  Truck type.

Functions

- int main (void)

Function Documentation

main() `int main ( void )`

Main function.

Ref vehicleStart(), objRef(), objUnref().

```
{
  Car c;
  vehicleStart((Vehicle*) &c);
}
```

References Vehicle::vehicleStart().

Appendix M

File Example

M.1 File Documentation

M.1.1 file.h File Reference

A brief file description.

Variables

- int globalValue

  A global integer value.

Detailed Description

A brief file description.
A more elaborated file description.

Variable Documentation

globalValue `int globalValue [extern]`
A global integer value.
More details about this value.

M.1.2 file.h

Go to the documentation of this file.

```
/** \file file.h
 * A brief file description.
 * A more elaborated file description.
 */

/**
 * A global integer value.
 * More details about this value.
 */
extern int globalValue;
```

Appendix N

Fn Example

N.1 Class Documentation

N.1.1 Fn_Test Class Reference

Fn_Test class.
`#include <func.h>`

Public Member Functions

- const char * member (char, int) throw (std::out_of_range)

  A member function.

Detailed Description

Fn_Test class.
Details about Fn_Test.

Member Function Documentation

member()
```
const char * Fn_Test::member (
    char c,
    int n ) throw ( std::out_of_range)
```
A member function.

Parameters

c	a character.
n	an integer.

Exceptions

std::out_of_range	parameter is out of range.

Returns

a character pointer.

The documentation for this class was generated from the following file:

- func.h

N.2 File Documentation

N.2.1 func.h

```
class Fn_Test
{
  public:
    const char *member(char,int) throw(std::out_of_range);
};

const char *Fn_Test::member(char c,int n) throw(std::out_of_range) {}

/*! \class Fn_Test
 * \brief Fn_Test class.
 *
 * Details about Fn_Test.
 */

/*! \fn const char *Fn_Test::member(char c,int n)
 *  \brief A member function.
 *  \param c a character.
 *  \param n an integer.
 *  \exception std::out_of_range parameter is out of range.
 *  \return a character pointer.
 */
```

Appendix O

Overload Example

O.1 Class Documentation

O.1.1 Overload_Test Class Reference

A short description.

Public Member Functions

- void drawRect (int, int, int, int)
- void drawRect (const Rect &r)

Detailed Description

A short description.
More text.

Member Function Documentation

drawRect() [1/2]

```
void Overload_Test::drawRect (
    int x,
    int y,
    int w,
    int h )
```

This command draws a rectangle with a left upper corner at (*x* , *y*), width *w* and height *h*.

drawRect() [2/2]

```
void Overload_Test::drawRect (
    const Rect & r )
```

This is an overloaded member function, provided for convenience. It differs from the above function only in what argument(s) it accepts.
The documentation for this class was generated from the following file:

- overload.cpp

Appendix P

Page Example

P.1 A documentation page

Leading text.

P.1.1 An example section

This page contains the subsections The first subsection and The second subsection. For more info see page Another page.

The first subsection

Text.

The second subsection

More text.

P.2 Another page

Even more info.

Appendix Q

Relates Example

Q.1 Class Documentation

Q.1.1 String Class Reference

Friends

- int strcmp (const String &, const String &)

Related Functions

(Note that these are not member functions.)

- void stringDebug ()

Detailed Description

A String class.

Friends And Related Function Documentation

strcmp `int strcmp ( const String & s1, const String & s2 ) [friend]`

Compares two strings.

stringDebug() `void stringDebug ( ) [related]`

A string debug function.

The documentation for this class was generated from the following file:

- relates.cpp

Appendix R

Author Example

R.1 Bug List

Class SomeNiceClass

Not all memory is freed when deleting an object of this class.

R.2 Class Documentation

R.2.1 SomeNiceClass Class Reference

Pretty nice class.

Detailed Description

Pretty nice class.
This class is used to demonstrate a number of section commands.

Author

John Doe

Jan Doe

Version

4.1a

Date

1990-2011

Precondition

First initialize the system.

Bug Not all memory is freed when deleting an object of this class.

Warning

Improper use can crash your application

Copyright

GNU Public License.

The documentation for this class was generated from the following file:

- author.cpp

Appendix S

Par Example

S.1 Class Documentation

S.1.1 Par_Test Class Reference

Detailed Description

Normal text.

User defined paragraph:

> Contents of the paragraph.
>
> New paragraph under the same heading.

Note

> This note consists of two paragraphs. This is the first paragraph.
>
> And this is the second paragraph.

More normal text.
The documentation for this class was generated from the following file:

- par.cpp

Appendix T

Include Example

T.1 pag_example

Our main function starts like this:

```
void main()
{
```

First we create an object `t` of the Include_Test class.

```
  Include_Test t;
```

Then we call the example member function

```
  t.example();
```

After that our little test routine ends.

```
}
```

T.2 Class Documentation

T.2.1 Include_Test Class Reference

Public Member Functions

- void **example** ()

  a member function

Detailed Description

A test class.
The documentation for this class was generated from the following file:

- include.cpp

Index

<![CDATA[...]]>, 214
</A>, 201
</B>, 201
</BLOCKQUOTE>, 201
</CAPTION>, 201
</CENTER>, 201
</CITE>, 201
</CODE>, 201
</DD>, 201
</DEL>, 201
</DETAILS>, 201
</DFN>, 202
</DIV>, 202
</DL>, 202
</DT>, 202
</EM>, 202
</H1>, 202
</H2>, 202
</H3>, 202
</H4>, 202
</H5>, 202
</H6>, 202
</I>, 202
</INS>, 202
</KBD>, 203
</LI>, 202
</OL>, 202
</P>, 202
</PRE>, 203
</S>, 203
</SMALL>, 203
</SPAN>, 203
</STRIKE>, 203
</STRONG>, 203
</SUB>, 203
</SUP>, 203
</TABLE>, 203
</TD>, 203
</TH>, 203
</TR>, 203
</TT>, 203
</U>, 203
</UL>, 203
</VAR>, 203
<A HREF="...">, 201
<A ID="...">, 201
<A NAME="...">, 201
<B>, 201
<BLOCKQUOTE>, 201

, 201
<CAPTION>, 201
<CENTER>, 201
<CITE>, 201
<CODE>, 201
<DD>, 201
<DEL>, 201
<DETAILS>, 201
<DFN>, 202
<DIV>, 202
<DL>, 202
<DT>, 202
<EM>, 202
<H1>, 202
<H2>, 202
<H3>, 202
<H4>, 202
<H5>, 202
<H6>, 202
<HR>, 202
<I>, 202
<IMG SRC="...">, 202
<INS>, 202
<KBD>, 203
<LI>, 202
<OL>, 202
<P>, 202
<PRE>, 202
<S>, 203
<SMALL>, 203
<SPAN>, 203
<STRIKE>, 203
<STRONG>, 203
<SUB>, 203
<SUP>, 203
<TABLE>, 203
<TD>, 203
<TH>, 203
<TR>, 203
<TT>, 203
<U>, 203
<UL>, 203
<VAR>, 203
<c>, 213
<code>, 213
<description>, 213
<example>, 213
<exception>, 213
<include>, 213

<inheritdoc>, 213
<item>, 213
<list>, 213
<listheader>, 213
<para>, 213
<param>, 213
<paramref>, 213
<permission>, 213
<remarks>, 213
<returns>, 213
<see>, 213
<seealso>, 213
<summary>, 213
<term>, 214
<typeparam>, 214
<typeparamref>, 214
<value>, 214
__init__
    docstring.PyClass, 263
\<, 199
\>, 199
\~, 199
\--, 200
\---, 200
\., 199
\::, 200
\=, 199
\@, 198
\#, 199
\$, 199
\%, 199
\&, 199
\", 199
\\, 198
\|, 200
\a, 187
\addindex, 179
\addtogroup, 157
\anchor, 179
\arg, 187
\attention, 170
\author, 170
\authors, 171
\b, 188
\brief, 171
\bug, 171
\c, 188
\callergraph, 158
\callgraph, 157
\category, 159
\cite, 180
\class, 159
\code, 188
\concept, 160
\cond, 171
\copybrief, 189
\copydetails, 189
\copydoc, 188
\copyright, 172
\date, 172
\def, 160
\defgroup, 160
\deprecated, 172
\details, 172
\diafile, 192
\dir, 160
\docbookinclude, 186
\docbookonly, 189
\dontinclude, 182
\dot, 189
\dotfile, 192
\e, 193
\else, 173
\elseif, 173
\em, 193
\endcode, 193
\endcond, 173
\enddocbookonly, 193
\enddot, 193
\endhtmlonly, 194
\endif, 174
\endinternal, 162
\endlatexonly, 194
\endlink, 180
\endmanonly, 194
\endmsc, 193
\endparblock, 176
\endrtfonly, 194
\endsecreflist, 180
\enduml, 193
\endverbatim, 194
\endxmlonly, 194
\enum, 160
\example, 161
\exception, 174
\extends, 162
\f(, 195
\f), 195
\f$, 194
\f{, 195
\f[, 195
\f], 195
\f}, 195
\file, 162
\fn, 162
\headerfile, 163
\hidecallergraph, 158
\hidecallgraph, 157
\hideinitializer, 163
\hiderefby, 158
\hiderefs, 159
\htmlinclude, 186
\htmlonly, 196
\idlexcept, 164
\if, 174
\ifnot, 175

\image, 196
\implements, 164
\include, 183
\includedoc, 184
\includelineno, 184
\ingroup, 164
\interface, 164
\internal, 164
\invariant, 175
\latexinclude, 186
\latexonly, 197
\li, 197
\line, 184
\link, 180
\mainpage, 164
\maninclude, 186
\manonly, 197
\memberof, 165
\msc, 190
\mscfile, 192
\n, 197
\name, 165
\namespace, 165
\noop, 173
\nosubgrouping, 165
\note, 175
\overload, 165
\p, 198
\package, 166
\page, 166
\par, 175
\paragraph, 182
\param, 176
\parblock, 176
\post, 176
\pre, 177
\private, 167
\privatesection, 167
\property, 167
\protected, 167
\protectedsection, 167
\protocol, 168
\public, 168
\publicsection, 168
\pure, 168
\raisewarning, 173
\ref, 180
\refitem, 180
\related, 169
\relatedalso, 169
\relates, 168
\relatesalso, 169
\remark, 177
\remarks, 177
\result, 177
\return, 177
\returns, 177
\retval, 177
\rtfinclude, 186
\rtfonly, 198
\sa, 177
\secreflist, 180
\section, 181
\see, 178
\short, 178
\showinitializer, 169
\showrefby, 158
\showrefs, 159
\since, 178
\skip, 184
\skipline, 184
\snippet, 184
\snippetdoc, 185
\snippetlineno, 185
\startuml, 191
\static, 169
\struct, 169
\subpage, 180
\subsection, 182
\subsubsection, 182
\tableofcontents, 181
\test, 178
\throw, 178
\throws, 178
\todo, 178
\tparam, 176
\typedef, 169
\union, 170
\until, 185
\var, 170
\verbatim, 198
\verbinclude, 185
\version, 178
\vhdlflow, 170
\warning, 179
\weakgroup, 170
\xmlinclude, 187
\xmlonly, 198
\xrefitem, 179
~Autolink_Test
    Autolink_Test, 240
~Javadoc_Test
    Javadoc_Test, 255
~QTstyle_Test
    QTstyle_Test, 253

A
    memgrp.cpp, 250
ABBREVIATE_BRIEF, 116
ABS
    autolink.cpp, 241
    define.h, 269
acknowledgments, 5
add
    restypedef.cpp, 244
Afterdoc_Test, 251
    EnumType, 251

EVal1, 251
EVal2, 251
value, 251
ALIASES, 118
ALLEXTERNALS, 147
ALLOW_UNICODE_NAMES, 116
ALPHABETICAL_INDEX, 129
ALWAYS_DETAILED_SEC, 117
AnotherEnum
Enum_Test, 271
autolink.cpp, 240
ABS, 241
B, 241
GlobEnum, 241
globVar, 242
GVal1, 241
GVal2, 241
AUTOLINK_SUPPORT, 119
Autolink_Test, 239
~Autolink_Test, 240
Autolink_Test, 240
EType, 240
member, 240
Val1, 240
Val2, 240

B
autolink.cpp, 241
memgrp.cpp, 250
behavior, 265
BINARY_TOC, 134
bison, 7, 9
BRIEF_MEMBER_DESC, 116
browser, 13
BUILTIN_STL_SUPPORT, 119

C1, 247
C2, 247
C3, 247
C4, 247
C5, 248
CALL_GRAPH, 149
CALLER_GRAPH, 149
Car, 275
CASE_SENSE_NAMES, 122
CHM_FILE, 133
CHM_INDEX_ENCODING, 134
CITE_BIB_FILES, 124
CLANG_ADD_INC_PATHS, 128
CLANG_ASSISTED_PARSING, 128
CLANG_DATABASE_PATH, 128
CLANG_OPTIONS, 128
CLASS_GRAPH, 148
close
structcmd.h, 260
cmake, 7, 9
COLLABORATION_GRAPH, 148
COMPACT_LATEX, 139
COMPACT_RTF, 143
Coord
restypedef.cpp, 244
CoordStruct, 243
x, 243
y, 243
CPP_CLI_SUPPORT, 119
CREATE_SUBDIRS, 116
cstyle
javadoc-banner.h, 256

define.h, 269
ABS, 269
MAX, 269
MIN, 269
DIA_PATH, 147
DIAFILE_DIRS, 150
DIR_GRAPH_MAX_DEPTH, 149
DIRECTORY_GRAPH, 149
DISABLE_INDEX, 135
DISTRIBUTE_GROUP_DOC, 119
Doc++, 5
docbook, 14
DOCBOOK_OUTPUT, 144
DOCSET_BUNDLE_ID, 133
DOCSET_FEEDNAME, 133
DOCSET_FEEDURL, 133
DOCSET_PUBLISHER_ID, 133
DOCSET_PUBLISHER_NAME, 133
docstring, 263
func, 263
docstring.py, 264
docstring.PyClass, 263
__init__, 263
PyMethod, 264
DOT_CLEANUP, 151
DOT_FONTNAME, 148
DOT_FONTPATH, 148
DOT_FONTSIZE, 148
DOT_GRAPH_MAX_NODES, 150
DOT_IMAGE_FORMAT, 150
DOT_MULTI_TARGETS, 151
DOT_NUM_THREADS, 147
DOT_PATH, 150
DOT_TRANSPARENT, 151
DOT_UML_DETAILS, 148
DOT_WRAP_THRESHOLD, 149
DOTFILE_DIRS, 150
DOXYFILE_ENCODING, 115
doxygenBanner
javadoc-banner.h, 257
drawRect
Overload_Test, 283

ECLIPSE_DOC_ID, 135
ENABLE_PREPROCESSING, 146
ENABLED_SECTIONS, 123
Enum_Test, 271
AnotherEnum, 271
TEnum, 271

V1, 271
V2, 271
Val1, 271
ENUM_VALUES_PER_LINE, 135
enumPtr
Javadoc_Test, 256
QTstyle_Test, 254
EnumType
Afterdoc_Test, 251
enumVar
Javadoc_Test, 256
QTstyle_Test, 254
errno
structcmd.h, 261
EType
Autolink_Test, 240
EVal1
Afterdoc_Test, 251
EVal2
Afterdoc_Test, 251
example
Example_Test, 273
EXAMPLE_PATH, 126
EXAMPLE_PATTERNS, 126
EXAMPLE_RECURSIVE, 126
Example_Test, 273
example, 273
EXCLUDE, 126
EXCLUDE_PATTERNS, 126
EXCLUDE_SYMBOLS, 126
EXCLUDE_SYMLINKS, 126
EXPAND_AS_DEFINED, 146
EXPAND_ONLY_PREDEF, 146
EXT_LINKS_IN_WINDOW, 135
EXTENSION_MAPPING, 118
EXTERNAL_GROUPS, 147
EXTERNAL_PAGES, 147
EXTERNAL_SEARCH, 138
EXTERNAL_SEARCH_ID, 138
EXTRA_PACKAGES, 139
EXTRA_SEARCH_MAPPINGS, 138
EXTRACT_ALL, 120
EXTRACT_ANON_NSPACES, 121
EXTRACT_LOCAL_CLASSES, 121
EXTRACT_LOCAL_METHODS, 121
EXTRACT_PACKAGE, 121
EXTRACT_PRIV_VIRTUAL, 121
EXTRACT_PRIVATE, 121
EXTRACT_STATIC, 121

features, 97
file.h, 279
globalValue, 279
FILE_PATTERNS, 126
FILE_VERSION_FILTER, 124
FILTER_PATTERNS, 127
FILTER_SOURCE_FILES, 127
FILTER_SOURCE_PATTERNS, 127
flex, 7, 9
Fn_Test, 281
member, 281
FORCE_LOCAL_INCLUDES, 122
FORMULA_FONTSIZE, 136
FORMULA_MACROFILE, 136
FORMULA_TRANSPARENT, 136
FULL_PATH_NAMES, 117
FULL_SIDEBAR, 135
func
docstring, 263
pyexample, 264
func1InGroup1
Memgrp_Test, 249
func1InGroup2
Memgrp_Test, 249
func2InGroup1
Memgrp_Test, 249
func2InGroup2
Memgrp_Test, 250

GENERATE_AUTOGEN_DEF, 144
GENERATE_BUGLIST, 123
GENERATE_CHI, 133
GENERATE_DEPRECATEDLIST, 123
GENERATE_DOCBOOK, 144
GENERATE_DOCSET, 132
GENERATE_ECLIPSEHELP, 134
GENERATE_HTML, 129
GENERATE_HTMLHELP, 133
GENERATE_LATEX, 138
GENERATE_LEGEND, 151
GENERATE_MAN, 143
GENERATE_PERLMOD, 145
GENERATE_QHP, 134
GENERATE_RTF, 143
GENERATE_SQLITE3, 145
GENERATE_TAGFILE, 147
GENERATE_TESTLIST, 123
GENERATE_TODOLIST, 123
GENERATE_TREEVIEW, 135
GENERATE_XML, 144
glob_func
memgrp.cpp, 250
globalValue
file.h, 279
GlobEnum
autolink.cpp, 241
globVar
autolink.cpp, 242
GPL, 4
GRAPHICAL_HIERARCHY, 149
group.cpp, 248
GROUP_GRAPHS, 148
GROUP_NESTED_COMPOUNDS, 119
GVal1
autolink.cpp, 241
GVal2
autolink.cpp, 241

handler
Javadoc_Test, 256
QTstyle_Test, 254
HAVE_DOT, 147
HHC_LOCATION, 133
HIDE_COMPOUND_REFERENCE, 122
HIDE_FRIEND_COMPOUNDS, 121
HIDE_IN_BODY_DOCS, 121
HIDE_SCOPE_NAMES, 122
HIDE_UNDOC_CLASSES, 121
HIDE_UNDOC_MEMBERS, 121
HIDE_UNDOC_RELATIONS, 147
HTML_COLORSTYLE_GAMMA, 132
HTML_COLORSTYLE_HUE, 131
HTML_COLORSTYLE_SAT, 132
HTML_DYNAMIC_MENUS, 132
HTML_DYNAMIC_SECTIONS, 132
HTML_EXTRA_FILES, 131
HTML_EXTRA_STYLESHEET, 131
HTML_FILE_EXTENSION, 129
HTML_FOOTER, 130
HTML_FORMULA_FORMAT, 136
HTML_HEADER, 129
HTML_INDEX_NUM_ENTRIES, 132
HTML_OUTPUT, 129
HTML_STYLESHEET, 131
HTML_TIMESTAMP, 132

IDL_PROPERTY_SUPPORT, 119
IGNORE_PREFIX, 129
IMAGE_PATH, 126
INCLUDE_FILE_PATTERNS, 146
INCLUDE_GRAPH, 149
INCLUDE_PATH, 146
Include_Test, 293
INCLUDED_BY_GRAPH, 149
INHERIT_DOCS, 118
INLINE_GROUPED_CLASSES, 120
INLINE_INFO, 122
INLINE_INHERITED_MEMB, 117
INLINE_SIMPLE_STRUCTS, 120
INLINE_SOURCES, 127
INPUT, 125
INPUT_ENCODING, 125
INPUT_FILTER, 126
installation, 7
INTERACTIVE_SVG, 150
INTERNAL_DOCS, 121

javadoc-banner.h, 256
cstyle, 256
doxygenBanner, 257
javadocBanner, 257
JAVADOC_AUTOBRIEF, 117
JAVADOC_BANNER, 117
Javadoc_Test, 254
~Javadoc_Test, 255
enumPtr, 256
enumVar, 256
handler, 256
Javadoc_Test, 255
publicVar, 256
TEnum, 255
testMe, 255
testMeToo, 255
TVal1, 255
TVal2, 255
TVal3, 255
javadocBanner
javadoc-banner.h, 257

LaTeX, 14
LATEX_BATCHMODE, 142
LATEX_BIB_STYLE, 142
LATEX_CMD_NAME, 138
LATEX_EMOJI_DIRECTORY, 142
LATEX_EXTRA_FILES, 142
LATEX_EXTRA_STYLESHEET, 141
LATEX_FOOTER, 141
LATEX_HEADER, 139
LATEX_HIDE_INDICES, 142
LATEX_MAKEINDEX_CMD, 139
LATEX_OUTPUT, 138
LATEX_TIMESTAMP, 142
LAYOUT_FILE, 124
libiconv, 7
license, 4
LOOKUP_CACHE_SIZE, 120

MACRO_EXPANSION, 146
main
manual.c, 278
make, 7
MAKEINDEX_CMD_NAME, 139
man, 14
MAN_EXTENSION, 143
MAN_LINKS, 144
MAN_OUTPUT, 143
MAN_SUBDIR, 144
manual.c, 277
main, 278
MARKDOWN_SUPPORT, 119
MATHJAX_CODEFILE, 137
MATHJAX_EXTENSIONS, 137
MATHJAX_FORMAT, 136
MATHJAX_RELPATH, 137
MATHJAX_VERSION, 136
MAX
define.h, 269
structcmd.h, 259
MAX_DOT_GRAPH_DEPTH, 151
MAX_INITIALIZER_LINES, 123
member
Autolink_Test, 240
Fn_Test, 281
memgrp.cpp, 250
A, 250
B, 250

glob_func, 250
Memgrp_Test, 249
func1InGroup1, 249
func1InGroup2, 249
func2InGroup1, 249
func2InGroup2, 250
ungroupedFunction, 250
MIN
define.h, 269
MSCFILE_DIRS, 150
MULTILINE_CPP_IS_BRIEF, 117
mux.vhdl, 266
mux_using_with, 265

N1, 247
NUM_PROC_THREADS, 120

OBFUSCATE_EMAILS, 136
Object, 275
objRef, 276
objUnref, 276
objRef
Object, 276
objUnref
Object, 276
open
structcmd.h, 260
OPTIMIZE_FOR_FORTRAN, 118
OPTIMIZE_OUTPUT_FOR_C, 118
OPTIMIZE_OUTPUT_JAVA, 118
OPTIMIZE_OUTPUT_SLICE, 118
OPTIMIZE_OUTPUT_VHDL, 118
output formats, 65
OUTPUT_DIRECTORY, 116
OUTPUT_LANGUAGE, 116
Overload_Test, 283
drawRect, 283

PAPER_TYPE, 139
Par_Test, 291
parsing, 15
PDF_HYPERLINKS, 142
perlmod, 225
PERLMOD_LATEX, 145
PERLMOD_MAKEVAR_PREFIX, 145
PERLMOD_PRETTY, 145
PLANTUML_CFG_FILE, 150
PLANTUML_INCLUDE_PATH, 150
PLANTUML_JAR_PATH, 150
PREDEFINED, 146
PROJECT_BRIEF, 116
PROJECT_LOGO, 116
PROJECT_NAME, 115
PROJECT_NUMBER, 116
publicVar
Javadoc_Test, 256
QTstyle_Test, 254
pyexample, 264
func, 264
pyexample.PyClass, 265
PyMethod, 265
PyMethod
docstring.PyClass, 264
pyexample.PyClass, 265
python, 7, 9
PYTHON_DOCSTRING, 117

QCH_FILE, 134
QHG_LOCATION, 134
QHP_CUST_FILTER_ATTRS, 134
QHP_CUST_FILTER_NAME, 134
QHP_NAMESPACE, 134
QHP_SECT_FILTER_ATTRS, 134
QHP_VIRTUAL_FOLDER, 134
Qt, 7
QT_AUTOBRIEF, 117
QTstyle_Test, 252
~QTstyle_Test, 253
enumPtr, 254
enumVar, 254
handler, 254
publicVar, 254
QTstyle_Test, 253
TEnum, 252
testMe, 253
testMeToo, 253
TVal1, 253
TVal2, 253
TVal3, 253
QUIET, 124

read
structcmd.h, 260
RECURSIVE, 126
REFERENCED_BY_RELATION, 127
REFERENCES_LINK_SOURCE, 127
REFERENCES_RELATION, 127
REPEAT_BRIEF, 116
RESOLVE_UNNAMED_PARAMS, 121
restypedef.cpp, 243
add, 244
Coord, 244
RTF, 14
RTF_EXTENSIONS_FILE, 143
RTF_HYPERLINKS, 143
RTF_OUTPUT, 143
RTF_STYLESHEET_FILE, 143

SEARCH_INCLUDES, 146
SEARCHDATA_FILE, 138
SEARCHENGINE, 137
SEARCHENGINE_URL, 138
SEPARATE_MEMBER_PAGES, 118
SERVER_BASED_SEARCH, 137
SHORT_NAMES, 117
SHOW_FILES, 124
SHOW_GROUPED_MEMB_INC, 122
SHOW_HEADERFILE, 122

SHOW_INCLUDE_FILES, 122
SHOW_NAMESPACES, 124
SHOW_USED_FILES, 123
SIP_SUPPORT, 119
SKIP_FUNCTION_MACROS, 146
SomeNiceClass, 289
SORT_BRIEF_DOCS, 122
SORT_BY_SCOPE_NAME, 123
SORT_GROUP_NAMES, 123
SORT_MEMBER_DOCS, 122
SORT_MEMBERS_CTORS_1ST, 122
SOURCE_BROWSER, 127
SOURCE_TOOLTIPS, 127
SQLITE3_OUTPUT, 145
SQLITE3_RECREATE_DB, 145
strcmp
    String, 287
STRICT_PROTO_MATCHING, 123
String, 287
    strcmp, 287
    stringDebug, 287
stringDebug
    String, 287
STRIP_CODE_COMMENTS, 127
STRIP_FROM_INC_PATH, 117
STRIP_FROM_PATH, 117
structcmd.h, 259
    close, 260
    errno, 261
    MAX, 259
    open, 260
    read, 260
    UINT32, 260
    write, 260
SUBGROUPING, 120

TAB_SIZE, 118
TAGFILES, 147
TEMPLATE_RELATIONS, 149
TEnum
    Enum_Test, 271
    Javadoc_Test, 255
    QTstyle_Test, 252
Test, 267
testMe
    Javadoc_Test, 255
    QTstyle_Test, 253
testMeToo
    Javadoc_Test, 255
    QTstyle_Test, 253
The Fifth Group, 246
The First Group, 245
The Fourth Group, 246
The Second Group, 245
The Third Group, 246
TOC_EXPAND, 134
TOC_INCLUDE_HEADINGS, 119
TREEVIEW_WIDTH, 135
Truck, 276
TVal1
    Javadoc_Test, 255
    QTstyle_Test, 253
TVal2
    Javadoc_Test, 255
    QTstyle_Test, 253
TVal3
    Javadoc_Test, 255
    QTstyle_Test, 253
TYPEDEF_HIDES_STRUCT, 120

UINT32
    structcmd.h, 260
UML_LIMIT_NUM_FIELDS, 148
UML_LOOK, 148
ungroupedFunction
    Memgrp_Test, 250
USE_HTAGS, 128
USE_MATHJAX, 136
USE_MDFILE_AS_MAINPAGE, 127
USE_PDFLATEX, 142

V1
    Enum_Test, 271
V2
    Enum_Test, 271
Val1
    Autolink_Test, 240
    Enum_Test, 271
Val2
    Autolink_Test, 240
value
    Afterdoc_Test, 251
Vehicle, 277
    vehicleStart, 277
    vehicleStop, 277
vehicleStart
    Vehicle, 277
vehicleStop
    Vehicle, 277
VERBATIM_HEADERS, 128

WARN_AS_ERROR, 125
WARN_FORMAT, 125
WARN_IF_DOC_ERROR, 125
WARN_IF_INCOMPLETE_DOC, 125
WARN_IF_UNDOCUMENTED, 125
WARN_LOGFILE, 125
WARN_NO_PARAMDOC, 125
WARNINGS, 124
write
    structcmd.h, 260

x
    CoordStruct, 243
XML, 14
XML_NS_MEMB_FILE_SCOPE, 144
XML_OUTPUT, 144
XML_PROGRAMLISTING, 144

y
CoordStruct, 243