

CHAPTER 1	WHY CMAKE?	1
1.1	The History of CMake	3
1.2	Why Not Use Autoconf?	3
1.3	Why Not Use JAM, qmake, SCons, or ANT?	4
1.4	Why Not Script It Yourself?	4
1.5	On What Platforms Does CMake Run?	5
CHAPTER 2	GETTING STARTED	7
2.1	Getting and Installing CMake on Your Computer	7
	<i>UNIX and Mac Binary Installations</i>	7
	<i>Windows Binary Installation</i>	7
2.2	Building CMake Yourself	8
2.3	Basic CMake Usage and Syntax	8
2.4	Hello World for CMake	9
2.5	How to Run CMake?	10
	<i>Running CMake's Qt Interface</i>	11
	<i>Running the ccmake Curses Interface</i>	13
	<i>Running CMake from the Command Line</i>	15
	<i>Specifying the Compiler to CMake</i>	15
	<i>Dependency Analysis</i>	16
2.6	Editing CMakeLists Files	17
2.7	Setting Initial Values for CMake	17
2.8	Building Your Project	19
CHAPTER 3	KEY CONCEPTS	21
3.1	Main Structures	21
3.2	Targets	24
3.3	Source Files	25
3.4	Directories, Generators, Tests, and Properties	26
3.5	Variables and Cache Entries	27
3.6	Build Configurations	32
CHAPTER 4	WRITING CMAKELISTS FILES	33
4.1	CMake Syntax	33
4.2	Basic Commands	34
4.3	Flow Control	35
4.4	Regular Expressions	42

4.5	Checking Versions of CMake	44
4.6	Using Modules	45
	<i>Using CMake with SWIG</i>	48
	<i>Using CMake with Qt</i>	49
	<i>Using CMake with FLTK</i>	50
4.7	Policies	50
	<i>Updating a Project For a New Version of CMake</i>	53
4.8	Linking Libraries	57
	<i>Specifying Optimized or Debug Libraries with a Target</i>	59
4.9	Shared Libraries and Loadable Modules	59
4.10	Shared Library Versioning	64
4.11	Installing Files	66
	<i>Installing Prerequisite Shared Libraries</i>	76
4.12	Advanced Commands	82
CHAPTER 5 SYSTEM INSPECTION		85
5.1	Using Header Files and Libraries	85
5.2	System Properties	87
5.3	Finding Packages	92
5.4	Built-in Find Modules	93
5.5	How to Pass Parameters to a Compilation?	95
5.6	How to Configure a Header File	97
5.7	Creating CMake Package Configuration Files	99
CHAPTER 6 CUSTOM COMMANDS AND TARGETS		103
6.1	Portable Custom Commands	103
6.2	Using <code>add_custom_command</code> on a Target	105
	<i>How to Copy an Executable Once it is Built?</i>	106
6.3	Using <code>add_custom_command</code> to Generate a File	107
	<i>Using an Executable to Build a Source File</i>	107
6.4	Adding a Custom Target	108
6.5	Specifying Dependencies and Outputs	111
6.6	When There Isn't One Rule For One Output	112
	<i>A Single Command Producing Multiple Outputs</i>	112
	<i>Having One Output That Can Be Generated By Different Commands</i>	112
CHAPTER 7 CONVERTING EXISTING SYSTEMS TO CMAKE		115
7.1	Source Code Directory Structures	115
7.2	Build Directories	117
7.3	Useful CMake Commands When Converting Projects	119
7.4	Converting UNIX Makefiles	120

7.5	Converting Autoconf Based Projects	121
7.6	Converting Windows Based Workspaces	123

CHAPTER 8 CROSS COMPILING WITH CMAKE 125

8.1	Toolchain Files	126
	<i>Finding External Libraries, Programs and Other Files</i>	128
8.2	System Inspection	130
	<i>Using Compile Checks</i>	131
8.3	Running Executables Built in the Project	133
8.4	Cross Compiling Hello World	136
8.5	Cross Compiling for a Microcontroller	140
8.6	Cross Compiling an Existing Project	143
8.7	Cross Compiling a Complex Project - VTK	145
8.8	Some Tips and Tricks	147

CHAPTER 9 PACKAGING WITH CPACK 149

9.1	CPack Basics	149
	<i>Simple Example</i>	150
	<i>What Happens When CPack.cmake Is Included?</i>	151
	<i>Adding Custom CPack Options</i>	152
	<i>Options Added by CPack</i>	153
9.2	CPack Source Packages	154
9.3	CPack Installer Commands	154
9.4	CPack for Windows Installer NSIS	156
	<i>CPack Variables Used by CMake for NSIS</i>	156
	<i>Creating Windows Short Cuts in the Start Menu</i>	161
	<i>Advanced NSIS CPack Options</i>	161
	<i>Setting File Extension Associations With NSIS</i>	162
	<i>Installing Microsoft Run Time Libraries</i>	163
	<i>CPack Component Install Support</i>	163
9.5	CPack for Cygwin Setup	173
9.6	CPack for Mac OS X PackageMaker	176
9.7	CPack for Mac OS X Drag and Drop	178
9.8	CPack for Mac OS X X11 Applications	180
9.9	CPack for Debian Packages	182
9.10	CPack for RPM	183
9.11	CPack Files	183

CHAPTER 10 AUTOMATION & TESTING WITH CMAKE 185

10.1	Testing with CMake, CTest, and CDash	185
10.2	How Does CMake Facilitate Testing?	186

10.3	Additional Test Properties	187
10.4	Testing Using CTest	189
10.5	Using CTest to Drive Complex Tests	191
10.6	Handling a Large Number of Tests	192
10.7	Producing Test Dashboards	194
	<i>Adding CDash Dashboard Support to a Project</i>	196
	<i>Client Setup</i>	199
10.8	Customizing Dashboards for a Project	202
	<i>Dashboard Submissions Settings</i>	202
	<i>Filtering Errors and Warnings</i>	203
	<i>Adding Notes to a Dashboard</i>	205
10.9	Setting up Automated Dashboard Clients	206
	<i>Settings for Continuous Dashboards</i>	210
	<i>Variables Available in CTest Scripts</i>	212
10.10	Advanced CTest Scripting	212
	<i>Limitations of Traditional CTest Scripting</i>	213
	<i>Extended CTest Scripting</i>	213
10.11	Setting up a Dashboard Server	218
	<i>CDash Server</i>	218
	<i>Advanced Server Management</i>	220
	<i>Build Groups</i>	223
	<i>Email</i>	225
	<i>Sites</i>	226
	<i>Graphs</i>	227
	<i>Adding Notes to a Build</i>	228
	<i>Logging</i>	229
	<i>Test Timing</i>	229
	<i>Mobile Support</i>	230
	<i>Backing up CDash</i>	230
	<i>Upgrading CDash</i>	231
	<i>CDash Maintenance</i>	232
10.12	Subprojects	233
	<i>Using ctest_submit with PARTS and FILES</i>	236
	<i>Splitting Your Project into Multiple Subprojects</i>	237

CHAPTER 11 PORTING CMAKE TO NEW PLATFORMS AND LANGUAGES241

11.1	The Determine System Process	241
11.2	The Enable Language Process	242
11.3	Porting to a New Platform	244
11.4	Adding a New Language	246
11.5	Rule Variable Listing	247
	<i>General Tag Variables</i>	247
	<i>Language Specific Information</i>	248

11.6	Compiler and Platform Examples	248
	<i>Como Compiler</i>	248
	<i>Borland Compiler</i>	249
11.7	Extending CMake	250
	<i>Creating a Loaded Command</i>	250
	<i>Using a Loaded Command</i>	251

CHAPTER 12 TUTORIALS **255**

12.1	A Basic Starting Point (Step 1)	255
	<i>Adding a Version Number and Configured Header File</i>	256
12.2	Adding a Library (Step 2)	258
12.3	Installing and Testing (Step 3)	260
12.4	Adding System Introspection (Step 4)	262
12.5	Adding a Generated File and Generator (Step 5)	263
12.6	Building an Installer (Step 6)	267
12.7	Adding Support for a Dashboard (Step 7)	268

APPENDIX A - VARIABLES **269**

Variables That Change Behavior	269
Variables That Describe the System	272
Variables for Languages	274
Variables That Control the Build	278
Variables That Provide Information	280

APPENDIX B – COMMAND LINE REFERENCE **287**

CMake Command Line Options	287
CMake Generators	292
CTest Command Line Options	294
CPack Command Line Options	298
CPack Generators	299

APPENDIX C – LISTFILE COMMANDS **301**

Current Commands	301
Compatibility Commands	366

APPENDIX D – SELECTED MODULES **373**

CMake Modules	373
---------------	-----

APPENDIX E - PROPERTIES	411
Properties of Global Scope	411
Properties on Directories	414
Properties on Targets	417
Properties on Tests	431
Properties on Source Files	431
Properties on Cache Entries	434
APPENDIX F – CMAKE POLICIES	437
INDEX	447

Index

A

ALL_BUILD target, 13, 109
ANT, 4
assert, 41
autoconf, 3
 converting to CMake, 121

B

batch commands, 103
binary packages, 150
Borland compiler, 5, 21, 23, 249
build
 configurations, 32, 67
 in-source. *See* in-source build
 out-of-source. *See* out-of-source build
build platform, 125
building your project, 19

C

cache
 advanced entries, 18, 30
 documentation, 30
 entries, 27, 29, 434
 find_* commands, 86
 FORCE option, 18, 32
 initializing, 17
 predefined options, 30
 purpose, 30
 set command, 29
 variable behavior, 31
case sensitivity, 9, 38
ccmake. *See* running CMake
CDash, 195
 adding notes, 205
 automatic submissions, 206
 backup, 230
 client setup, 199
 creating a new project, 196
 email, 225

- expected builds, 224
- filtering errors/warnings, 203
- logging, 229
- mobile support, 230
- server setup, 218
- sites, 226
- specifying the server, 202
- submitting results, 196
- subprojects, 233
- timing, 229
- tutorial, 268
- upgrading, 231
- CMake
 - benefits, 1
 - command line, 287
 - compiler selection, 15
 - extending, 250
 - history, 3
 - plugin, 250
 - porting, 241
 - Structure, 21
 - syntax, 8, 33
 - tutorial, 255
 - versions, 43
- CMake Commands, 8, 9, 34, 301
 - add_custom_command, 62, 105–8, 109, 110, 111, 112, 123, 301
 - add_custom_target, 24, 108, 109, 110, 111, 123, 303
 - add_definitions, 88, 95, 96, 304
 - add_dependencies, 81, 304
 - add_executable, 9, 10, 24, 25, 34, 121, 193, 305
 - add_library, 24, 25, 34, 121, 306
 - add_subdirectory, 28, 34, 115, 116, 122, 307
 - add_test, 38, 39, 186, 187, 188, 192, 193, 307
 - aux_source_directory, 308
 - break, 42, 309
 - build_command, 309
 - cmake_minimum_required, 44, 51, 214, 309
 - cmake_policy, 51, 310
 - configure_file, 97, 98, 122, 311
 - create_test_sourcelist, 192, 193, 311
 - define_property, 312
 - else, 10, 35
 - elseif, 36
 - enable_language, 313
 - enable_testing, 313
 - endif, 10, 35
 - exec_program, 120, 217
 - execute_process, 313
 - export, 81, 314
 - file, 89, 116, 119, 120, 315
 - find_file, 29, 85, 318
 - find_library, 10, 41, 46, 47, 85, 86, 320
 - find_package, 48, 85, 92, 95, 323
 - find_path, 46, 47, 85, 86, 329
 - find_program, 85, 105, 332
 - fltk_wrap_ui, 50, 335
 - foreach, 29, 35, 38, 39, 335
 - function, 38, 39, 336
 - get_cmake_property, 336
 - get_directory_property, 337
 - get_filename_component, 193, 337
 - get_property, 25, 26, 337
 - get_source_file_property, 25, 338
 - get_target_property, 24, 105, 106, 108, 339
 - get_test_property, 339
 - if, 10, 27, 35, 36, 37, 38, 40, 42, 339
 - include, 28, 45, 46, 95, 343
 - include_directories, 86, 99, 252, 344
 - include_external_msproject, 344
 - include_regular_expression, 82, 344
 - install, 66, 68, 345
 - link_directories, 350
 - link_libraries, 25, 62
 - list, 351
 - load_cache, 352
 - load_command, 252, 352
 - macro, 35, 38, 39, 40, 41, 217, 352
 - make_directory, 120
 - mark_as_advanced, 18, 30, 119, 353
 - math, 353
 - message, 29, 122, 353
 - obsolete/deprecated, 366
 - option, 29, 95, 121, 354
 - output_required_files, 82, 354
 - project, 9, 10, 34, 82, 105, 119, 123, 242, 354
 - qt_wrap_cpp, 355
 - qt_wrap_ui, 355
 - remove, 34, 193

- remove_definitions, 355
- return, 42, 355
- separate_arguments, 34, 356
- set, 9, 10, 18, 24, 27, 28, 29, 31, 32, 34, 35, 46, 356
- set_directory_properties, 357
- set_property, 25, 26, 357
- set_source_file_properties, 358
- set_source_files_properties, 25, 48, 62
- set_target_properties, 24, 65, 359
- set_tests_properties, 187, 188, 359
- site_name, 359
- source_group, 123, 359
- string, 42, 62, 360
- subdirs, 189
- target_link_libraries, 25, 59, 60, 362
- try_compile, 85, 88, 89, 92, 122, 131, 363
- try_run, 85, 88, 89, 92, 364
- unset, 365
- variable_watch, 365
- while, 35, 38, 39, 365
- CMake Modules. *See* modules
- CMake Policies. *See* policies
- CMake Properties, 26, 411
 - ABSTRACT, 26
 - ADDITIONAL_MAKE_CLEAN_FILES, 26
 - COMPILE_DEFINITIONS, 96
 - COMPILE_DEFINITIONS_<CONFIG>, 97
 - COMPILE_FLAGS, 25
 - EXCLUDE_FROM_ALL, 26
 - GENERATED, 25
 - LABELS, 240
 - LINK_FLAGS, 25
 - list of, 27
 - LISTFILE_STACK, 26
 - OBJECT_DEPENDS, 26
 - WRAP_EXCLUDE, 26
- CMake Variables
 - BUILD_SHARED_LIBS, 24
 - CMAKE_BUILD_TYPE, 32
 - CMAKE_BUILD_TYPE, 67
 - CMAKE_C_COMPILER, 16, 249
 - CMAKE_C_COMPILER_WORKS, 89
 - CMAKE_C_CREATE_SHARED_LIBRARY, 249
 - CMAKE_C_FLAGS, 16, 252
 - CMAKE_C_LINK_EXECUTABLE, 82
 - CMAKE_CFG_INTDIR, 32, 62, 104
 - CMAKE_COMMAND, 104, 106, 107, 206
 - CMAKE_CONFIGURATION_TYPES, 32
 - CMAKE_CROSSCOMPILING, 127
 - CMAKE_CTEST_COMMAND, 192
 - CMAKE_CURRENT_BINARY_DIR**, 105, 267
 - CMAKE_CURRENT_SOURCE_DIR**, 105
 - CMAKE_CXX_COMPILE_OBJECT, 250
 - CMAKE_CXX_COMPILER, 16, 244, 245, 248, 249, 250
 - CMAKE_CXX_CREATE_SHARED_LIBRAR Y, 244, 248, 249
 - CMAKE_CXX_CREATE_SHARED_MODULE, 249
 - CMAKE_CXX_CREATE_STATIC_LIBRARY, 245, 249, 250
 - CMAKE_CXX_FLAGS, 16, 32, 251
 - CMAKE_CXX_FLAGS_DEBUG, 245
 - CMAKE_CXX_FLAGS_DEBUG_INIT, 245
 - CMAKE_CXX_FLAGS_INIT, 245
 - CMAKE_CXX_FLAGS_MINSIZEREL, 245
 - CMAKE_CXX_FLAGS_MINSIZEREL_INIT, 245
 - CMAKE_CXX_FLAGS_RELEASE, 245
 - CMAKE_CXX_FLAGS_RELEASE_INIT, 245
 - CMAKE_CXX_FLAGS_RELWITHDEBINFO, 246
 - CMAKE_CXX_FLAGS_RELWITHDEBINFO_INIT, 246
 - CMAKE_CXX_LINK_EXECUTABLE, 82, 249
 - CMAKE_DL_LIBS, 245
 - CMAKE_END_TEMP_FILE, 249, 250
 - CMAKE_FIND_ROOT_PATH**, 129
 - CMAKE_GENERATOR, 192, 207
 - CMAKE_HOST_*, 130
 - CMAKE_INSTALL_COMPONENT, 75
 - CMAKE_INSTALL_PREFIX, 15, 67, 75
 - CMAKE_INSTALL_RPATH, 148
 - CMAKE_LIBRARY_PREFIX, 105

- CMAKE_MAJOR_VERSION, 44
- CMAKE_MAKE_PROGRAM, 192
- CMAKE_MODULE_PATH, 45
- CMAKE_RANLIB**, 248, 249
- CMAKE_ROOT, 95, 252, 265
- CMAKE_SHARED_LIBRARY_C_FLAGS, 249
- CMAKE_SHARED_LIBRARY_CREATE_C_FLAGS, 245
- CMAKE_SHARED_LIBRARY_CREATE_CXX_FLAGS, 244, 245, 248
- CMAKE_SHARED_LIBRARY_RUNTIME_C_FLAG, 245
- CMAKE_SHARED_LIBRARY_RUNTIME_C_FLAG_SEP, 245
- CMAKE_SHARED_MODULE_PREFIX, 105
- CMAKE_SKIP_RPATH, 64
- CMAKE_START_TEMP_FILE, 249, 250
- CMAKE_SYSTEM_NAME**, 127, 241, 242, 245
- CMAKE_SYSTEM_PROCESSOR**, 127, 142
- CMAKE_SYSTEM_VERSION**, 127, 241
- CMAKE_TOOLCHAIN_FILE, 126
- CMAKE_VERSION, 44
- EXECUTABLE_OUTPUT_PATH**, 105, 118, 119
- LIBRARY_EXPORT, 61
- LIBRARY_OUTPUT_PATH**, 105, 118, 119
- PROJECT_BINARY_DIR, 105, 119, 252
- PROJECT_SOURCE_DIR, 37, 105, 109, 252, 253, 258
- WIN32, 10, 24, 61, 123
- cmake-gui, 11, 13, 15, 30
 - pull-down option, 30
- CMakeSetup. *See* cmake-gui
- cmMakefile, 23, 24, 31
- code coverage, 196, 200
- comments, 10, 33
- comparison, 37
- compile flags, 25
- compiler specification, 15
- compilers, 5, 243
- compiling CMake, 8
- conditional statements, 35
- configured header, 256, 260
- converting autoconf projects to CMake, 121
- converting Makefiles to CMake, 120
- converting Visual Studio projects, 123
- copying files. *See* file
- CPack, 149
 - command line, 298
 - components, 163
 - DESTDIR, 155
 - escape characters, 152
 - generators, 153
 - tutorial, 267
 - variables, 151
- cross compiling, 125
 - hello world, 136
 - system introspection, 130
- CTest, 189
 - advanced, 212
 - building tests, 191
 - command line, 294
 - options, 190
 - properties, 187
 - regular expressions, 188
 - running the tests, 189
 - tutorial, 260
 - variables, 212
- CTest Commands
 - ctest_build, 214
 - ctest_build_command, 213
 - ctest_configure, 214
 - ctest_empty_binary_directory, 213
 - ctest_start, 214
 - ctest_submit, 214
 - ctest_test, 214
 - ctest_update, 214
- custom commands, 103, 105
- custom targets, 108
- CVS, 209
- cygwin, 149, 173

D

- DART. *See* CDash
- dashboards, 17, 185, 194, 195
- Debian, 150, 182

declspec, 61
 dependencies, 82
 dependency analysis, 16, 26
 DESTDIR, 75, 149, 155
 directory installation, 72
 directory structures, 10, 115
 creating, 120
 properties, 26

E

editing CMakeLists files, 17
 Emacs modes, 17
 embedded devices, 125
 environment variables, 2, 9, 16, 64, 217
 escape character, 33
 executing programs, 120

F

false, 38
 file
 COMPONENT, 67
 copying, 104
 exclude, 74
 existence, 36
 globbing, 119
 installing, 66
 OPTIONAL, 68
 permissions, 67
 properties, 25
 regular expressions, 74
 remove, 104
 rename, 71
 filtering errors and warnings, 203
 final pass, 24
 find modules. *See* modules
 flags, 16, 25, 64
 flow control, 34
 FLTK, 50, 143
 fortran, 242, 278
 function, 35

functions, 39

G

generator, 15, 21, 23, 32, 207, 263
 graphviz, 289

H

header files, configured, 97
 hello world, 9, 136
 history of CMake, 3

I

initial pass, 23
 in-source build, 10, 117
 installation scripts, 75
 installer, 267
 installing CMake
 Mac OS X, 7
 UNIX, 7
 Windows, 7
 installing files. *See* files

J

JAM, 4

K

KDE, 3

L

languages, 34, 242, 247
 LaTeX custom target, 109

libraries, 59

- API changes, 64
- exporting, 80
- importing, 78
- installing prerequisites, 76
- modules, 24
- pitfalls, 63
- rpath, 64
- shared, 24
- shared vs static, 59
- soname, 64
- static, 24, 25
- versions, 64

library configurations, 59

linking

- libraries, 56
- system libraries, 57
- Windows, 59

list. *See* variables

loaded commands, 26, 250, 254

looping constructs, 35

M

Mac OS X

- drag and drop installer, 178
- frameworks, 319, 322, 327
- Package Maker, 149, 176
- relocatable applications, 76
- Xcode. *See* Xcode

macros, 39, 40

Makefiles, 21, 23, 32

- build configurations, 32

microcontroller, 140

MinGW, 13, 143

modules, 44, 373

- documentation, 47
- find, 45, 93
- find <Package>Config.cmake, 93
- find conventions, 93
- path, 45
- system introspection, 47, 87
- utility, 47

modules, loadable. *See* libraries

N

NMake, 23

not found, 86

NSIS, 149, 153, 156

Nullsoft Installer, 149

numeric comparison, 37

O

operator precedence, 38

operators, 36

out-of-source build, 10, 117

P

package configuration file, 99

platforms, 4, 242

PLEASE_FILL_OUT, 131

plugins, 59, 250, 251

policies, 50, 437

- scope, 52

- setting, 51

- support multiple versions, 56

portability issues, 103

portability of code, 87

porting CMake, 241

POSIX systems, 241

project

- languages, 34

- name, 34

properties. *See* CMake Properties

proxies, 203

purify, 82, 200, 203

Q

qmake, 4

Qt, 2, 49
 Qt CMake user interface. *See* cmake-gui
 quoting, 9

R

regression testing, 185
 regular expressions, 37, 42–43, 82, 190
 relocatable packages, 76, 150
 removing files. *See* file
 required package, 101
 RPATH, 64, 148
 RPM, 150, 183
 rule variables, 247
 running CMake, 10
 ccmake, 13
 cmake-gui, 11
 command line, 15

S

SCons, 4
 shared library. *See* libraries
 shell commands, 103
 source files, 25, 431
 generated, 107
 source packages, 150, 154
 subprojects, 237
 SWIG, 2, 47–49
 syntax of CMake, 8, 33
 system introspection, 262, *See* modules

T

target platform, 126
 targets, 24
 custom, 108
 custom commands, 105
 exporting, 79
 importing, 78
 properties, 25, 417

testing, 185
 toolchain file, 126
 true, 38
 tutorial, 255

U

unit testing, 186
 UNIX
 libraries, 63
 Makefiles. *See* Makefiles
 symbols, 61
 utility modules. *See* modules

V

valgrind, 200, 203
 variable argument lists, 41
 variable scope, 28
 variables, 9, 27, 269
 cache, 29
 interaction with cache, 31
 list, 9, 29, 34
 PARENT_SCOPE, 28
 quoting, 9
 remove from list, 34
 rule, 247
 scope, 40
 types, 30
 versions, 43
 Vim mode, 17
 Visual Studio, 3, 5, 13, 15, 17, 21, 23, 32, 34, 66,
 104, 105, 107, 109, 112, 117
 converting to CMake, 123
 file groups, 123
 header files, 123

W

white space, 33
 Windows

- build directory, 119
- CDash, 208
- dllexport, 61
- executable, 24
- executables, 123
- installers. *See* NSIS
- linking, 59
- manifest files, 163
- registry entries, 2, 86
- registry values, 9
- relocatable applications, 76

- run time libraries, 163
- symbols, 61
- WinMain, 24, 123
- wrapping C/C++. *See* SWIG

X

- Xcode, 3, 66, 274