CMake Internals

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Overview

Available build systems

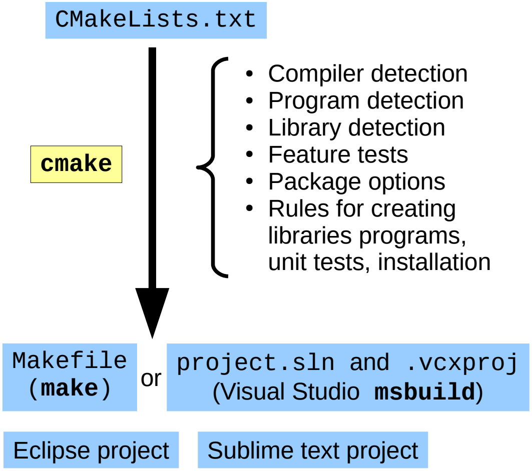
There are many available build systems, which include:

- Make and GNU Make
- GNU Autotools
- CMake
- Qt `qmake`
- SCons
- Jam / BJam
- Ant / Maven / Gradle

`cmake` features

- `cmake` is a generic cross-platform build system
- `cmake` generates build files for a large number of common build systems
- On FreeBSD, Linux and MacOS X, `make Makefile`s will be used
- On Windows with Visual Studio, `msbuild .sln` solution files will be used
- Eclipse, Sublime Text, Kate, Code::Blocks or several other IDEs or build systems may be used instead, if desired

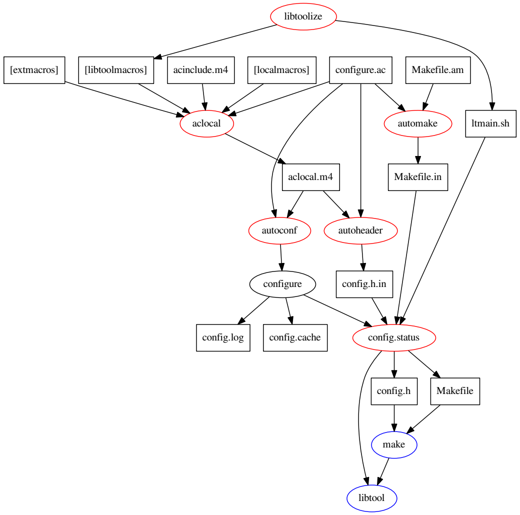
`cmake` overview



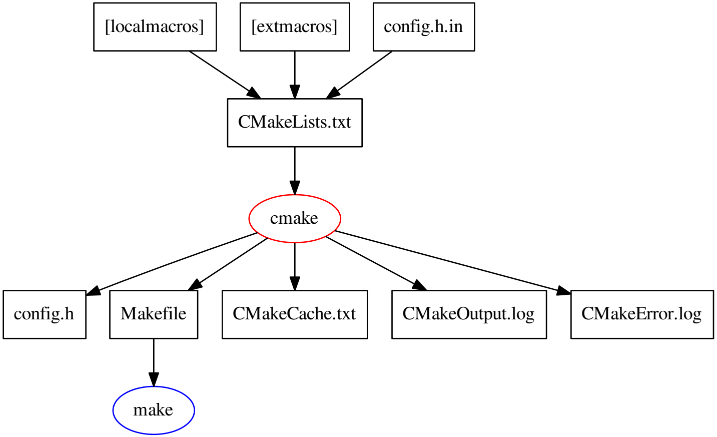
- Compiler detection
- Program detection
- Library detection
- Feature tests
- Package options
- Rules for creating libraries programs, unit tests, installation

…and many more build systems and IDES are supported

Autotools overview



cmake overview



A simple program

```
cmake_minimum_required(VERSION 2.8)
cmake_policy(VERSION 2.8.0)

project("test-program")

enable_language(CXX)

add_executable(test-program test.cpp)
```

- Compiles `test.cpp` into the program `test-program`

A simple library

```
project("test-library")

enable_language(CXX)

add_library(test-library SHARED test.cpp test.h)
set_target_properties(test-library PROPERTIES VERSION
    "1.0.0")

add_executable(test-program main.cpp)

target_link_libraries(test-program test-library)
```

- Compiles `test.cpp` into the library `test-library`
- Adds ABI version number to `test-library`
- Compiles `main.cpp` into the program `test-program`
- Links `test-program` with `test-library`

Variables, conditionals, loops

```
set(var value)
if(var)
  message(STATUS "The value of var is ${var}")
else()
  message(WARNING "var is unset")
endif()

set(var "a;b;c")
list(APPEND var d e)
foreach(v ${var})
  message(STATUS "List item value is ${v}")
endforeach()
```

- Variables are lists of strings of 0, 1 or multiple values

Feature tests

```
find_program(DOXYGEN_EXECUTABLE doxygen DOC "Doxygen
    API documentation tool")

find_path(BOOST_INCLUDE_DIR
          NAMES "boost/filesystem.hpp"
          DOC "Boost.Filesystem header directory")

find_library(XERCES_LIBRARY xerces-c
             DOC "Xerces-C shared library")
```

- Feature tests probe system capabilities and adapt the build to the system

Built-in feature tests

```
find_package(Doxygen "1.7.0")
find_package(Boost REQUIRED COMPONENTS filesystem
    system)
find_package(Xerces REQUIRED)
```

- CMake provides an extensive set of feature tests
- Custom feature tests can be written if needed

Advanced feature tests

```
include(CheckCXXSourceCompiles)

check_cxx_source_compiles("
void foo() noexcept{}
int main() { foo(); }
" HAVE_NOEXCEPT)

check_cxx_source_compiles("
#include <array>
int main() { std::array<int,3> a; a[0] = 5; }
" HAVE_ARRAY)
```

- Checking for header or library existence is sometimes insufficient
- Checks can compile, link and execute test code
- Test specific implementation details

Package options

```
option(test "Enable unit tests (requires gtest)" ON)
set(BUILD_TESTS ${test})
option(extended-tests "Enable extended tests (more
    comprehensive, longer run time)" ON)
set(EXTENDED_TESTS ${extended-tests})

message(STATUS "Build tests: ${BUILD_TESTS}")
message(STATUS "Extended tests: ${EXTENDED_TESTS}")
```

- User-configurable options
- Customise any aspect of CMake operation

Unit tests

```
enable_testing()

enable_language(CXX)

add_executable(test-program test.cpp)

add_test(simple-test/test-program test-program)
```

- Unit tests are simple programs

Installation

```
include(GNUInstallDirs)

install(TARGETS test-library LIBRARY
        DESTINATION "${CMAKE_INSTALL_FULL_LIBDIR}")

install(FILES test.h
        DESTINATION "${CMAKE_INSTALL_FULL_INCLUDEDIR}")

install(TARGETS test-program RUNTIME
        DESTINATION "${CMAKE_INSTALL_FULL_BINDIR}")
```

- Any target or file can be installed
- Installation prefix or any install category may be customised

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Strategic Award