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Introduction to CMake

Projektmanagement im Softwarebereich

OpenMS & SeqAn

CMake – what is it?

Family of tools

CMake → Generates native build environments

CTest → Unit and Suite test system / reporting

CDash → Online reporting system for tests

CPack → Create installers for binary distribution of software

CMake:

Generates native build environments

- UNIX/Linux → Makefiles
- Windows → Visual Studio Projects, NMake,
- Apple → Xcode

Support for Macros

Custom targets/commands

Cross-Platform

OpenSource

Finding/configuring software (Qt, Doxygen, Boost, …)

Who uses it?

SecondLIFE

KDE

OpenMS

SeqAn

Why use a Build System?

You write an application (source code) and need to:

- Compile the source (cross-platform)
- Link to other libraries
- Do compiler specific stuff

You would also love if you were able to:

- Run tests on your software
- Run test of the redistributable package
- See the results of that online (for multiple platforms)

What Build Systems are out there?

Autotools

- Autohell
- Bourne s
- Unix plat
- Depende

Jam

- Cross pl
- Not wide

SCons

Bjam (Boost)

aclocal.m4 152.1 KB
configure.ac 21.6 KB
configure 0.7 MB

MAKEDEP_CXX_SUFFIX="|egrep
\"(${OpenMS_PATH}|^[[^/]]*\$\$)\"
${MAKEDEP_CXX_SUFFIX}“

\ to escape the damned shell
[] to escape m4
$$ to escape make

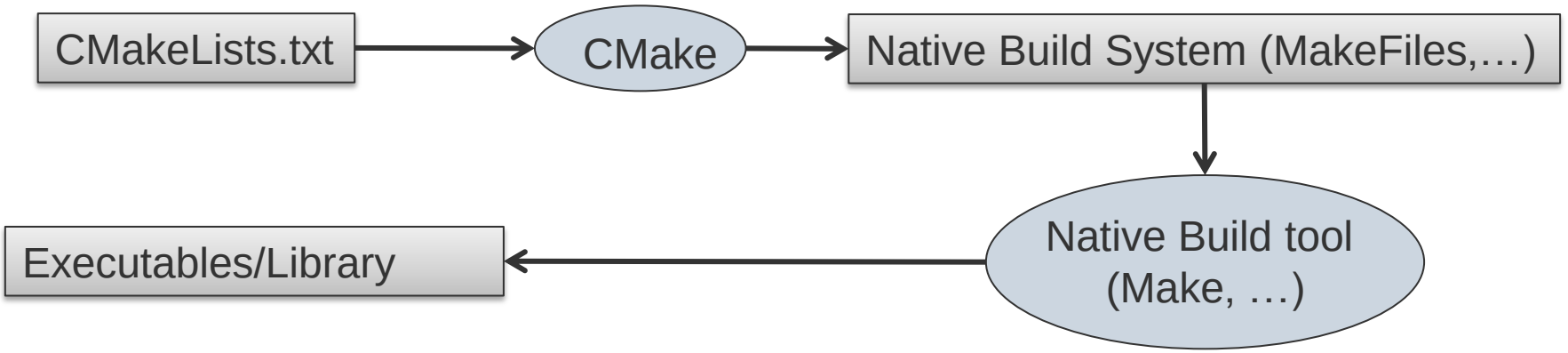
CMake in Detail

Meta-Build System for:

Visual C++, Kdevelop3, Eclipse, XCode, *makefiles* (Unix, NMake, Borland, Watcom, MinGW, MSYS, Cygwin), Code::Blocks etc

→ Generator!

Projects are described in CMakeLists.txt



In-Source vs. Out-of-Source

Where to build?

In-source:

- helloapp/hello.cpp
- helloapp/CMakeLists.txt
- helloapp/CMakeCache.txt
- helloapp/hello.exe

Out-of-source:

- helloapp/hello.cpp
- helloapp/CMakeLists.txt
- helloappbuild/CMakeCache.txt
- helloappbuild/hello.exe

Binary tree

CMakeLists.txt

myProject
- hello.cpp
- CMakeLists.txt

```
PROJECT( helloworld )
ADD_EXECUTABLE( hello hello.cpp )
```

```
PROJECT( helloworld )
SET( sources hello.cpp )
ADD_EXECUTABLE( hello ${sources } )
```

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How to add a library? (.dll, .lib, .so, .a)

```
PROJECT( mylibrary )
SET( lib_sources library_1.cpp library_2.cpp )
ADD_LIBRARY( my SHARED ${lib_sources } )
```

CMakeLists.txt - Syntax

This is a comment

– Commands syntax: COMMAND(arg1 arg2 ...)

– Lists A;B;C # semi-colon separated values

– Variables ${VAR}

– Regular expressions (check CMake FAQ for details...)

```
foreach (qtlib ${QT_LIBRARIES})
  message(STATU
  …
```

```
if ( WIN32 )
  message(STATUS „we‘re on Windows“)
elseif ( APPLE )
  message(FATAL_ERROR „Mac is not supported …)
endif()
```

```
set(STL_DEBUG OFF
if (STL_DEBUG)
  if (CMAKE_COMPILE
            add_definitio
            Message(ST
  else()
            Message(WARNING "STL debug mode is supported for compiler GCC only")
  endif()
endif()
```

Most common commands

SET(VAR value [CACHE TYPE DOCSTRING [FORCE]])

ADD_EXECUTABLE

ADD_LIBRARY

MESSAGE

LIST(APPEND|INSERT|LENGTH|GET|REMOVE_ITEM|REMOVE_AT|SORT ...)

FIND_FILE

FIND_LIBRARY

FIND_PROGRAM

FIND_PACKAGE

EXEC_PROGRAM(bin [work_dir] ARGS <..> [OUTPUT_VARIABLE var] [RETURN_VALUE var])

OPTION(OPTION_VAR “description string” [initial value])

CMakeCache.txt

- Populated/Updated during configuration phase
- Contains Entries VAR:TYPE=VALUE
- Speeds up build process
- GUI can be used to change values
- There should be no need to edit it manually!!

As a User…

Create a build directory (“out-of-source-build” concept)

– mkdir OpenMS_build ; cd OpenMS_build

- **Configure the package for your system:**

– cmake [options] <source_tree>


cmake ..\OpenMS


cmake –G “Visual Studio 9 2008 Win64“ ..\OpenMS

- **Build the package:**


make


devenv #(open Visual Studio)

- **Install it:**

– make install

As a User…

Modify your build using CMake Flags

- some are inherent to Cmake

CMAKE_BUILD_TYPE -- Type of build (Debug, Release, ...)

- some are provided by the software that uses CMake

STL_DEBUG -- Enable STL Debug mode

cmake –D CMAKE_BUILD_TYPE =“Release” …

```
cd <path_to_contrib_build>
cmake -G "<generator>" "<path_to_contrib>“


cd <path_to_OpenMS_build>
cmake -D CONTRIB_CUSTOM_DIR:PATH="<path_to_contrib_build>" -G
                                          "<generator>" "<path_to_OpenMS>"
```

CTest

```
ENABLE_TESTING()
ADD_TEST( testname testexecutable args )
```

CDash

CDash aggregates, analyzes and displays the results of software testing processes submitted from clients.

For example, build a piece of software on

Linux, Windows, Mac OS X, Solaris and AIX

Usually, you want two kinds of information:

- Build results on all platforms
- Test (Ctest) results on all platforms

Customizable using XSL

CDash

Web www-bs2.informatik.uni-tuebingen.de/services/OpenMS/CDash/index.php Search withGoogle

My CDash | All Dashboards | Log Out Monday, April 11 2011 08:02:08 CEST

OPENMS Dashboard

DASHBOARD CALENDAR PREVIOUS CURRENT PROJECT ADMINISTRATION

No file changed as of **Monday, April 11 2011 01:00:00 CEST** Help

[Show Filters]

Nightly

Site	Build Name	Update		Configure			Build			Test				Build Time
		Files	Min	Error	Warn	Min	Error	Warn	Min	NotRun	Fail	Pass	Min	
iguana.imp.fu-berlin.de	linux-2.6.26-2-x86_64-gcc4.3.2-1.1-coverage	0	0.2	0	0	0.6	1	13	26.3	7	0	674	42.2	2011-04-11T02:37:20 CEST
knecht.imp.fu-berlin.de	linux-2.6.32-bpo.2-amd64-clang-2.9_122567-debug	0	0.1	0	0	0.4	2	50	20.8	7	2	860 +1 -1	6.4	2011-04-11T02:30:07 CEST
knecht.imp.fu-berlin.de	linux-2.6.32-bpo.2-amd64-clang-2.9_122567-release	0	0.1	0	0	0.3	2	50	16.3	7	2	860	2.6	2011-04-11T02:45:50 CEST
knecht.imp.fu-berlin.de	linux-2.6.32-bpo.2-amd64-gcc-4.3.2-1.1-release	0	0.1	0	0	0.3	1	7	2.7	0	0	869 +1 -2	2.7	2011-04-11T04:06:34 CEST
knecht.imp.fu-berlin.de	linux-2.6.32-bpo.2-amd64-gcc4.6.0-debug	0	0.1	0	0	0.3	46	0	20.3	7	5	857	6.4	2011-04-11T03:33:38 CEST
knecht.imp.fu-berlin.de	linux-2.6.32-bpo.2-amd64-gcc4.6.0-release	0	0.1	0	0	0.3	46	0	17.6	7	6	856	2.8	2011-04-11T03:44:20 CEST
diazepam.informatik.uni-tuebingen.de	linux-32-gcc4.4-make-debug-stl			0	0	0.7	0	2	43.5	0	3	867 +1	37.1	2011-04-11T01:33:26 CEST
diazepam.informatik.uni-tuebingen.de	linux-32-gcc4.4-make-release			0	0	0.9	0	2	29.5	0	2	868 +1	6	2011-04-11T01:01:30 CEST
microcebus.mi.fu-berlin.de	osx-10.6-gcc-4.2-qt47-64bit-debug	0	0.2	0	0	0.3	39	13	18.8	7	5	862	7.8	2011-04-11T02:29:00 CEST
microcebus.mi.fu-berlin.de	osx-10.6-gcc-4.2-qt47-64bit-release	0	0.2	0	0	0.2	39	13	15.1	7	5	862	4.9	2011-04-11T03:55:36 CEST
microcebus.mi.fu-berlin.de	osx-10.6-gcc-4.2-qt47-release	0	0.2	0	0	0.2	39	13	14.7	7	5	867 -1	5.5	2011-04-11T05:17:03 CEST

CDash

Login | All Dashboards

Monday, April 11 2011 09:25:25

OPENMS Dashboard

DASHBOARD | BACK | CALENDAR | PREVIOUS | CURRENT | PROJECT

Site: microcebus.mi.fu-berlin.de
Build Name: osx-10.6-gcc-4.2-qt47-release
Build Time: 2011-04-11T05:17:03 CEST

Found **39** Errors
Warnings are here.

CVS/SVN	http://open-ms.svn.sourceforge.net/viewvc/open-ms/OpenMS//source/VISUAL/Spectrum2DCanvas.C?view=log
Build Log Line	51
Error	Scanning dependencies of target AverageLinkage_test [34%] Building CXX object source/TEST/CMakeFiles/AverageLinkage_test.dir/AverageLinkage_test.C.o Linking CXX executable bin/AverageLinkage_test [34%] Built target AverageLinkage_test Scanning dependencies of target AveragePosition_test [34%] Building CXX object source/TEST/CMakeFiles/AveragePosition_test.dir/AveragePosition_test.C.o Linking CXX executable bin/AveragePosition_test [34%] Built target AveragePosition_test [34%] Building CXX object CMakeFiles/OpenMS_GUI.dir/source/VISUAL/Spectrum2DCanvas.C.o /.../trunk/source/VISUAL/Spectrum2DCanvas.C: In member function 'virtual void OpenMS::Spectrum2DCanvas::contextMenuEvent(QContextMenuEvent*)': **/.../trunk/source/VISUAL/Spectrum2DCanvas.C:2384: error: conversion from 'long unsigned int' to 'const QVariant' is ambiguous**

CVS/SVN	http://open-ms.svn.sourceforge.net/viewvc/open-ms/OpenMS///?view=log
Build Log Line	60
Error	**i686-apple-darwin10-g++-4.2.1: CMakeFiles/OpenMS_GUI.dir/source/VISUAL/Spectrum2DCanvas.C.o: No such file or directory** [59%] Built target OpenMS_GUI Scanning dependencies of target AxisTickCalculator_test [60%] Building CXX object source/TEST/CMakeFiles/AxisTickCalculator_test.dir/AxisTickCalculator_test.C.o

CPack

CPack generates installing packages:

- RPM, DEB, GZip and Bzip2 distributions of both binaries and source code
- NSIS installers (for Microsoft Windows)
- Mac OS X packages (.dmg)

```
add_executable(myexe ${my_src})
install(TARGETS myexe)
install(FILES     ${PROJECT_BINARY_DIR}/doc/index.html  DESTINATION share/OpenMS/doc COMPONENT doc)
install(DIRECTORY ${PROJECT_BINARY_DIR}/doc/html      DESTINATION share/OpenMS/doc COMPONENT doc)

INCLUDE(CPack)
```

```
cmake -D INSTALL_PREFIX=/usr  -D PACKAGE_TYPE=rpm …
make package
```

More information

http://www.cmake.org

http://www.elpauer.org/stuff/learning_cmake.pdf

http://www-flc.desy.de/ldcoptimization/documents/talks/CMake_Tutorial.pdf