CMake build system for CPython

Simple with built-in support for cross-compilation.

Jean-Christophe Fillion-Robin, Matt McCormick

Kitware

Developing cross-platform CPython extensions

1. Create simple **examplemodule/CMakeLists.txt** describing the extension

```
cmake_minimum_required(VERSION 2.8.9)

project(examplemodule)

find_package(Python REQUIRED CONFIG)
include_directories(${PYTHON_INCLUDE_DIRS})

add_library(example MODULE examplemodule.cxx)
target_link_libraries(example ${PYTHON_LIBRARIES})
set_target_properties(example PROPERTIES PREFIX "")
```

2. Create **examplemodule.cxx** implementing the extension

3. Configure and build

```
mkdir examplemodule && cd $_
cmake -DPython_DIR=${HOME}/scratch/python-build ../examplemodule
make -j4
```

Require CMake >= 2.8.9

github.com/jcfr/python-cmake-custom-extension

What is CMake ?

- One simple language for all platforms
- Generates native build system
- Cross-platform
- Open-source - BSD-like license
- Self-contained - No dependencies
- Large community

Motivation

- Maintainable build system
- Easy embedding of CPython
- Built-in support for cross-compilation
- First class support for Visual Studio

CMake generators

A CMake Generator is responsible for writing the input files for a native build system.

Use cmake `-G` option to specify the generator for a new build tree.

Extra Generators for auxiliary IDE

```
CodeBlocks
CodeLite
Eclipse CDT4
KDevelop3
Kate
Sublime Text 2
```

Command-Line Build Tool Generators

```
Borland Makefiles
MSYS Makefiles
MinGW Makefiles
NMake Makefiles
NMake Makefiles JOM
Ninja
Unix Makefiles
Watcom WMake
```

IDE Build Tool Generators

```
Visual Studio 6
Visual Studio 7
Visual Studio 7 .NET 2003
Visual Studio 8 2005
Visual Studio 9 2008
Visual Studio 10 2010
Visual Studio 11 2012
Visual Studio 12 2013
Xcode
```

Download

- ✔ Python source [0]
- ✔ CMake [1]
- ✔ Python CMake build system [2]

Configure

Support for **cross-compilation**

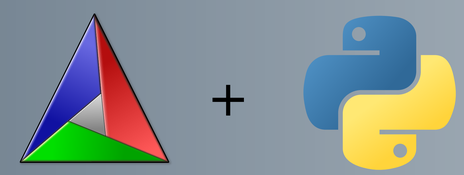
libpython: **shared** and/or **static**

Python modules: **shared** or **built-in**

Dependencies: **system** or **explicit**

Support for **in** or **out** of source build

Configurable install prefix



davidsansome/python-cmake-buildsystem

Install

Install tree layout similar to "Autoconf" one

Generation of pkg-config file

Configurable install prefix

```
cmake \
  -DCMAKE_INSTALL_PREFIX=/path/to/python-install
make install
```

Build

Unix/Ubuntu build
(see ReadMe for Windows and others)

```
# Install build tools
sudo apt-get install build-essential cmake git

# Create directory
mkdir ~/scratch && cd $_

# Download python source
wget python.org/ftp/python/2.7.3/Python-2.7.3.tgz
tar -xzvf Python-2.7.3.tgz

# Download buildsystem
git clone git@github.com:\
davidsansome/python-cmake-buildsystem.git

# Configure
mkdir python-install && mkdir python-build && cd $_
cmake \
  -DCMAKE_INSTALL_PREFIX=${HOME}/scratch/python-install

# Build
make -j4

# Install
make install
```

Test

Run tests

```
$ ctest -D Experimental -j10
Test project /home/jchris/scratch/python-build
      Start   1: test_site
[...]
391/392 Test #374: test_poll ......................   Passed   10.16 sec
392/392 Test #255: test_io ........................   Passed   38.07 sec

100% tests passed, 0 tests failed out of 392

Total Test time (real) =  66.09 sec
```

Test results submitted to CDash [3]

Website similar to buildbot [4] with built-in support for cmake and ctest.

Cross-compiling for RaspberryPi

1. Build the toolchain using crosstool-ng [5]

2. Create **Toolchain-RaspberryPi.cmake** [6]

```
[...]
set(CMAKE_C_COMPILER
  ${toolchain}/bin/arm-unknown-linux-gnueabi-gcc)
set(CMAKE_FIND_ROOT_PATH
  ${toolchain}/arm-unknown-linux-gnueabi/sysroot)
[...]
```

3. Configure

```
mkdir python-install-pi && mkdir python-build-pi && cd $_
cmake -DCMAKE_TOOLCHAIN_FILE=/path/to/Toolchain-RaspberryPi.cmake \
  -DCMAKE_INSTALL_PREFIX=/home/jchris/sratch/python-install-pi      \
  ../python-cmake-buildsystem
```

4. Edit **TryRunResults.cmake** with expected values

5. Re-configure

```
cmake -C TryRunResults.cmake                                  \
  -DCMAKE_TOOLCHAIN_FILE=Toolchain-RaspberryPi.cmake          \
  -DCMAKE_INSTALL_PREFIX=/home/jchris/sratch/python-install-pi \
  ../python-cmake-buildsystem
```

6. Cross-compile

```
make -j4
make install
```

7. Upload to target

Ubuntu 13.10 / CMake 2.8.9

Future work

Support 2.7.8 and 3.x

Document CMake buildsystem using sphinx.

Setup Travis CI

Setup dashboard for RaspberryPi

First class support for frozen module [7].

Integrate SetupTools with CMake

Contributing

Follow the Github flow [7]:

- Create a branch
- Open a Pull Request
- Test
- Discuss and review
- Merge

Acknowledgments

Build system based on the original work of David Sansome, Alex Neundorf and David DeMarle.

RaspberryPi cross compilation based on work of Luis Ibañez [5][6].

Thanks to David Thompson for his poster feedback, and thanks to Mysha Sissine for her support.

Much of this work was supported by the National Institutes of Health,

References

[0] http://www.python.org
[1] http://www.cmake.org
[2] https://github.com/davidsansome/python-cmake-buildsystem
[3] http://open.cdash.org/index.php?project=CPython
[4] http://buildbot.python.org/all/waterfall
[5] http://www.kitware.com/blog/home/post/426
[6] http://www.kitware.com/blog/home/post/428
[7] http://conference.scipy.org/scipy2013/presentation_detail.php?id=129
[8] https://guides.github.com/introduction/flow/index.html