COMP 2355 Introduction to Systems Programming

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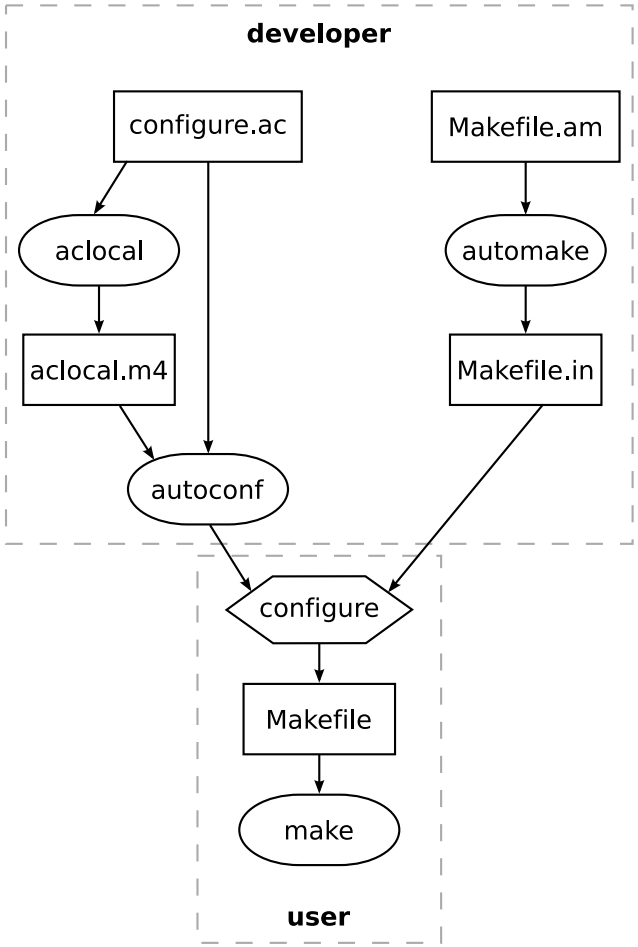
autotools


developer
configure.ac
Makefile.am
aclocal
automake
aclocal.m4
Makefile.in
autoconf
configure
Makefile
make
user

Makefile Basics

'make' reads instructions from a file 'Makefile'. A Makefile is essentially a list of rules. Each rule has the form:

```
TARGET: DEPENDENCIES
TAB COMMAND
TAB .....
TAB .....
```

The first target is the default target.

Makefile Example (1/2)

```
hello: hello.c
TAB gcc -o hello hello.c

clean:
TAB rm -f hello hello.o

install: hello
TAB mkdir -p /usr/local/bin
TAB rm -f /usr/local/bin/hello
TAB cp hello /usr/local/bin/hello
```

Makefile Example (2/2)

```
hello: hello.o
TAB gcc -o hello hello.o

hello.o: hello.c
TAB gcc -c hello.c
```

Makefile Variables

```
variable1=value
variable2=value
target:
TAB gcc -o $(variable1) $(variable2).c
```

Dependencies

Sometimes the source file X needs to be recompiled because the source file Y has changed.

- We say that X depends on Y
- Cyclic dependencies are possible
- Makefiles can be used to specify dependencies
- For C/C++, the compiler can determine dependencies
- For Java, no efficient way to determine dependencies exists

Beyond Makefiles

- Writing Makefiles can become messy
- Manually determining dependencies is error-prone
- Re-compiling everything all the time is not feasible for large projects

$\Rightarrow$ autotools generate Makefiles that use gcc's dependency information

Makefile.am Syntax

```
bin_PROGRAMS = myapp
myapp_SOURCES = app1.c app2.c app3.c app4.c app.
```

`Makefile.am` will be compiled by `autoconf` to `Makefile.in`. `Makefile.in` will be translated to `Makefile` by `configure`.

`Makefile` will support targets `all`, `clean`, `install`, `dist`.

Hello World with Autotools (1/4)

```
#include <stdio.h>
int main(int argc, char * const * argv) {
  printf("Howdy world!\n");
  return 0;
}
```

Makefile.am:

```
bin_PROGRAMS = hello
hello_SOURCES = hello.c
```

Hello World with Autotools (2/4)

configure.ac:

```
AC_INIT(hello.c)
AM_INIT_AUTOMAKE(hello,0.1)
AC_PROG_CC
AC_PROG_INSTALL
AC_OUTPUT(Makefile)
```

Hello World with Autotools (3/4)

```
$ autoreconf -fi
$ ./configure --prefix=$HOME
$ make
$ make install
$ make dist
```

Hello World with Autotools (4/4)

```
$ tar xvfz hello-0.1.tar.gz
$ cd hello-0.1
$ configure
$ make
$ make install
$ ~/bin/hello
```

Other things to do

- Organize project in subdirectories
- Add testcases
- Install non-binary files (for example, images)
- Check for dependencies
- Generate C headers to include (`config.h`)
- Conditional targets

Common directory structure

src source code

doc documentation

m4 macros required by autoconf

po message translations

contrib auxiliary files (for example, images)

Top-level files

README description of the software

AUTHORS summary list of all contributors

ChangeLog detailed list of changes for developers

COPYING copyright (alternatively called LICENSE)

INSTALL general installation instructions

NEWS list of recent changes for end-users

Less-common Directories

src/include installed headers

intl/ GNU gettext

libltdl/ GNU libtool's libltdl (for plugins)

debian/ files for building a Debian package

doc/man/ man pages

Autotools Summary

- Automatic configuration for different platforms
- Automatic Makefile generation with dependencies
- Support for test suite (`make check`)
- Support for source distribution (`make dist`)
- Support for creating shared libraries
- User does **not** need to have autoconf/automake

Writing Testcases

```
check_PROGRAMS  = test1 test2 test3 ....
TESTS           = $(check_PROGRAMS)
test1_SOURCES = test1.c
```

Creating Libraries

```
lib_LTLIBRARIES = libfoo.so
libfoo_la_SOURCES = foo.c
libfoo_la_LDFLAGS = -version-info 1:4:1
libfoo_la_LIBADD = libbar.la
noinst_LTLIBRARIES = libbar.so
libbar_la_SOURCES = bar.c
```

Linking against Libraries

```
bin_PROGRAMS = prog
prog_SOURCES = prog.c
prog_LDFLAGS = -lz
prog_LDADD = $(top_builddir)/src/bar/libbar.la
```

Installing Headers

```
include_HEADERS = foo.h
```

Adding Files to Package

```
EXTRA_DIST = ABOUT-NLS
```

Adding Manpages

```
man_MANS = foo.1 libbar.3
EXTRA_DIST = $(man_MANS)
```

Processing Subdirectories

```
SUBDIRS  = m4 src doc po
```

Examples

- http://www.gnu.org/software/hello/
- https://gnunet.org/svn/libmicrohttpd/
- https://gnunet.org/svn/gnunet-gtk/

Homework

Study the tutorial "Learning the GNU development tools" and read at least chapters 1, 4, 5 and 6 of the "GNU autoconf, automake and libtool" manual.

Questions

?

Task

Setup an autotools-based build-system for your project. Begin with a simple directory structure (`src/` and `doc/man/`) and a minimal C application.

Generate a draft of your `configure.ac` file with the `autoscan` tool (the generated file will be called `configure.scan` and must be manually renamed).

Test your build system using the minimal code. Then write a test-testcase before writing any actual code.

Questions

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