

Foreword (1/2)

This slides present a serious of hobbit development topics. These topics include coding,patching,compilation,software packaging,software distribution and auto update for hobbitmon supported OS platforms.

The latest version of this document can be retrieved from

http:
[//hobbitmon.svn.sourceforge.net/viewvc/hobbitmon/branches/tjyang/
trunk/docs/books/hobbit-slides/hobbit-slides-developer.pdf](http://hobbitmon.svn.sourceforge.net/viewvc/hobbitmon/branches/tjyang/trunk/docs/books/hobbit-slides/hobbit-slides-developer.pdf)

Please mail me corrections and suggestions **about this document** at tj_yang@hotmail.com.

Hobbitmon Development

Tyng-Jing Yang
tj_yang@hotmail.com

August 26, 2008

Copyright © 2008 Tyng-Jing Yang
<http://creativecommons.org/licenses/by-sa/2.0/>

Part I

The TWW HPMS and GNU Build System

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Portable Packages

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Sources of Non-Portability in C

Consider C functions...

- that do not exist everywhere (e.g., `strtod()`)
- that have different names (e.g., `strchr()` vs. `index()`)
- that have varying prototypes
(e.g., `int setpgrp(void);` vs. `int setpgrp(int, int);`)
- that can behave differently (e.g., `malloc(0);`)
- that might require other libraries
(is `pow()` in *libm.so* or in *libc.so*?)
- that can be defined in different headers
(*string.h* vs. *strings.h* vs. *memory.h*)

How should a package deal with those?

Possible Solutions

- Slice the code with lots of `#if/#else`
- Create substitution macros
- Create substitution functions

Possible Solutions

- Slice the code with lots of `#if/#else`
- Create substitution macros
- Create substitution functions

The latter two are to be preferred.

Code Cluttered with #if/#else

Excerpt of ffcall-1.10's alloc_trampoline()

```
#if !defined(CODE_EXECUTABLE)
    static long pagesize = 0;
#endif
#if defined(EXECUTABLE_VIA_MMAP_DEVZERO)
    static int zero_fd;
#endif
    if (!pagesize) {
        #if defined(HAVE_MACH_VM)
            pagesize = vm_page_size;
        #else
            pagesize = getpagesize();
        #endif
    }
    #if defined(EXECUTABLE_VIA_MMAP_DEVZERO)
        zero_fd = open("/dev/zero", O_RDONLY, 0644);
        if (zero_fd < 0) {
            fprintf(stderr, "trampoline: _Cannot_open_/dev/zero!\n");
            abort();
        }
    #endif
}
```


Substitution macros

Excerpt of coreutils-5.2.1's *system.h*

```
#if ! HAVE_FSEEKO && ! defined fseeko
# define fseeko(s, o, w) ((o) == (long) (o) \
                        ? fseek (s, o, w) \
                        : (errno = EOVERFLOW, -1))
#endif
```

Then use `fseeko()` whether it exists or not.

Substitution functions

If `strdup()` does not exist, link your program with a replacement definition such as

strdup.c (from the GNU C library)

```
char *
strdup (const char *s)
{
    size_t len = strlen (s) + 1;
    void *new = malloc (len);
    if (new == NULL)
        return NULL;
    return (char *) memcpy (new, s, len);
}
```

Uniform Builds

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Need for Automatic Configuration

- Maintaining a collection of `#define` for each system by hand is cumbersome.
- Requiring users to add the necessary `-D`, `-I`, and `-l` compilation options to *Makefile* is burdensome.
- Complicated builds hinder the acceptance of free software.

Need for Automatic Configuration

- Maintaining a collection of `#define` for each system by hand is cumbersome.
- Requiring users to add the necessary `-D`, `-I`, and `-l` compilation options to *Makefile* is burdensome.
- Complicated builds hinder the acceptance of free software.
- In 1991 people started to write shell scripts to **guess** these settings for some GNU packages.
- Since then the *configure* script is mandatory in any package of the GNU project.

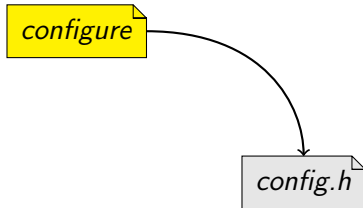
configure's Purpose



configure

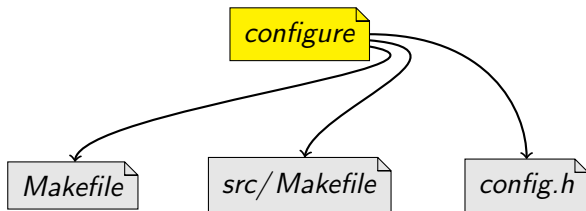
- *configure* probes the systems for required functions, libraries, and tools

configure's Purpose



- *configure* probes the systems for required functions, libraries, and tools
- then it generates a *config.h* file with all `#defines`

configure's Purpose



- `configure` probes the systems for required functions, libraries, and tools
- then it generates a `config.h` file with all `#defines`
- as well as `Makefiles` to build the package

GNU Coding Standards

<http://www.gnu.org/prep/standards/>

Practices that packages of the GNU project should follow:

GNU Coding Standards

<http://www.gnu.org/prep/standards/>

Practices that packages of the GNU project should follow:

- program behavior
 - how to report errors,
 - standard command line options,
 - etc.

GNU Coding Standards

<http://www.gnu.org/prep/standards/>

Practices that packages of the GNU project should follow:

- program behavior
 - how to report errors,
 - standard command line options,
 - etc.
- coding style

GNU Coding Standards

<http://www.gnu.org/prep/standards/>

Practices that packages of the GNU project should follow:

- program behavior
 - how to report errors,
 - standard command line options,
 - etc.
- coding style
- **configuration**

GNU Coding Standards

<http://www.gnu.org/prep/standards/>

Practices that packages of the GNU project should follow:

- program behavior
 - how to report errors,
 - standard command line options,
 - etc.
- coding style
- configuration
- *Makefile* conventions
- etc.

The User Point of View

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz  
~ % cd amhello-1.0
```


Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz  
~ % cd amhello-1.0  
~/amhello-1.0 % ./configure  
...
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % ./configure
...
~/amhello-1.0 % make
...
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % ./configure
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make check
...
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % ./configure
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make check
...
~/amhello-1.0 % su
Password:
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % ./configure
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make check
...
~/amhello-1.0 % su
Password:
/home/adl/amhello-1.0 # make install
...
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % ./configure
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make check
...
~/amhello-1.0 % su
Password:
/home/adl/amhello-1.0 # make install
...
/home/adl/amhello-1.0 # exit
```

Standard Installation Procedure

```
~ % tar xzf amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % ./configure
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make check
...
~/amhello-1.0 % su
Password:
/home/adl/amhello-1.0 # make install
...
/home/adl/amhello-1.0 # exit
~/amhello-1.0 % make installcheck
...
```

Standard Makefile Targets

`'make all'` Build programs, libraries, documentation, etc.
(Same as `'make'`.)

`'make install'` Install what needs to be installed.

`'make install-strip'` Same as `'make install'`, then strip debugging symbols.

`'make uninstall'` The opposite of `'make install'`.

`'make clean'` Erase what has been built (the opposite of `'make all'`).

`'make distclean'` Additionally erase anything `./configure` created.

`'make check'` Run the test suite, if any.

`'make installcheck'` Check the installed programs or libraries, if supported.

`'make dist'` Create *PACKAGE-VERSION.tar.gz*.

Standard File System Hierarchy

Directory variable	Default value
prefix	<i>/usr/local</i>
exec-prefix	prefix
bindir	exec-prefix/ <i>bin</i>
libdir	exec-prefix/ <i>lib</i>
...	
includedir	prefix/ <i>include</i>
datarootdir	prefix/ <i>share</i>
datadir	datarootdir
mandir	datarootdir/ <i>man</i>
infodir	datarootdir/ <i>info</i>
...	

```
~/amhello-1.0 %
```

Standard File System Hierarchy

Directory variable	Default value
prefix	<i>/usr/local</i>
exec-prefix	prefix
bindir	exec-prefix/ <i>bin</i>
libdir	exec-prefix/ <i>lib</i>
...	
includedir	prefix/ <i>include</i>
datarootdir	prefix/ <i>share</i>
datadir	datarootdir
mandir	datarootdir/ <i>man</i>
infodir	datarootdir/ <i>info</i>
...	

```
~/amhello-1.0 % ./configure --prefix ~/usr
```

Standard File System Hierarchy

Directory variable	Default value
prefix	<i>/usr/local</i>
exec-prefix	prefix
bindir	exec-prefix/ <i>bin</i>
libdir	exec-prefix/ <i>lib</i>
...	
includedir	prefix/ <i>include</i>
datarootdir	prefix/ <i>share</i>
datadir	datarootdir
mandir	datarootdir/ <i>man</i>
infodir	datarootdir/ <i>info</i>
...	

```
~/amhello-1.0 % ./configure --prefix ~/usr  
~/amhello-1.0 % make
```

Standard File System Hierarchy

Directory variable	Default value
prefix	<i>/usr/local</i>
exec-prefix	prefix
bindir	exec-prefix/ <i>bin</i>
libdir	exec-prefix/ <i>lib</i>
...	
includedir	prefix/ <i>include</i>
datarootdir	prefix/ <i>share</i>
datadir	datarootdir
mandir	datarootdir/ <i>man</i>
infodir	datarootdir/ <i>info</i>
...	

```
~/amhello-1.0 % ./configure --prefix ~/usr
~/amhello-1.0 % make
~/amhello-1.0 % make install
```

Standard Configuration Variables

'./configure' automatically detects many settings.
You can force some of them using configuration variables.

CC C compiler command

CFLAGS C compiler flags

CXX C++ compiler command

CXXFLAGS C++ compiler flags

LDFlags linker flags

CPPFLAGS C/C++ preprocessor flags

... See './configure --help' for a full list.

```
~/amhello-1.0 %
```

Standard Configuration Variables

'./configure' automatically detects many settings.
You can force some of them using configuration variables.

CC C compiler command

CFLAGS C compiler flags

CXX C++ compiler command

CXXFLAGS C++ compiler flags

LDFlags linker flags

CPPFLAGS C/C++ preprocessor flags

... See './configure --help' for a full list.

```
~/amhello-1.0 % ./configure --prefix ~/usr CC=gcc-3 \  
CPPFLAGS=-I$HOME/usr/include LDFLAGS=-L$HOME/usr/lib
```

The Power User Point of View

1 Goals

- Portable Packages
- **Uniform Builds**

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Overriding Default Configuration Settings with *config.site*

Recall that old command

```
~/amhello-1.0 % ./configure --prefix ~/usr CC=gcc-3 \  
CPPFLAGS=-I$HOME/usr/include LDFLAGS=-L$HOME/usr/lib
```


Overriding Default Configuration Settings with *config.site*

Recall that old command

```
~/amhello-1.0 % ./configure --prefix ~/usr CC=gcc-3 \  
CPPFLAGS=-I$HOME/usr/include LDFLAGS=-L$HOME/usr/lib
```

Common configuration settings can be put in *prefix/share/config.site*

```
~/amhello-1.0 % cat ~/usr/share/config.site  
test -z "$CC" && CC=gcc-3  
test -z "$CPPFLAGS" && CPPFLAGS=-I$HOME/usr/include  
test -z "$LDFLAGS" && LDFLAGS=-L$HOME/usr/lib
```

Overriding Default Configuration Settings with *config.site*

Recall that old command

```
~/amhello-1.0 % ./configure --prefix ~/usr CC=gcc-3 \  
CPPFLAGS=-I$HOME/usr/include LDFLAGS=-L$HOME/usr/lib
```

Common configuration settings can be put in *prefix/share/config.site*

```
~/amhello-1.0 % cat ~/usr/share/config.site  
test -z "$CC" && CC=gcc-3  
test -z "$CPPFLAGS" && CPPFLAGS=-I$HOME/usr/include  
test -z "$LDFLAGS" && LDFLAGS=-L$HOME/usr/lib
```

Reducing the command to...

```
~/amhello-1.0 % ./configure --prefix ~/usr  
configure: loading site script /home/adl/usr/share/config.site  
...
```

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

```
~ % tar xzf ~/amhello-1.0.tar.gz  
~ % cd amhello-1.0
```

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

```
~ % tar xzf ~/amhello-1.0.tar.gz  
~ % cd amhello-1.0  
~/amhello-1.0 % mkdir build && cd build
```

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

```
~ % tar xzf ~/amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % mkdir build && cd build
~/amhello-1.0/build % ../configure
```

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

```
~ % tar xzf ~/amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % mkdir build && cd build
~/amhello-1.0/build % ../configure
~/amhello-1.0/build % make
...
```

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

```
~ % tar xzf ~/amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % mkdir build && cd build
~/amhello-1.0/build % ../configure
~/amhello-1.0/build % make
...
```

Sources files are in *~/amhello-1.0/*,
built files are all in *~/amhello-1.0/build/*.

Parallel Build Trees for Multiple Architectures

Builds for multiple architectures can share the same source tree.

Parallel Build Trees for Multiple Architectures

Builds for multiple architectures can share the same source tree.

Have the source on a (possibly read-only) shared directory

```
~ % cd /nfs/src  
/nfs/src % tar xzf ~/amhello-1.0.tar.gz
```

Parallel Build Trees for Multiple Architectures

Builds for multiple architectures can share the same source tree.

Have the source on a (possibly read-only) shared directory

```
~ % cd /nfs/src  
/nfs/src % tar xzf ~/amhello-1.0.tar.gz
```

Compilation on first host

```
~ % mkdir /tmp/amh && cd /tmp/amh  
/tmp/amh % /nfs/src/amhello-1.0/configure  
/tmp/amh % make && sudo make install
```

Parallel Build Trees for Multiple Architectures

Builds for multiple architectures can share the same source tree.

Have the source on a (possibly read-only) shared directory

```
~ % cd /nfs/src  
/nfs/src % tar xzf ~/amhello-1.0.tar.gz
```

Compilation on first host

```
~ % mkdir /tmp/amh && cd /tmp/amh  
/tmp/amh % /nfs/src/amhello-1.0/configure  
/tmp/amh % make && sudo make install
```

Compilation on second host

```
~ % mkdir /tmp/amh && cd /tmp/amh  
/tmp/amh % /nfs/src/amhello-1.0/configure  
/tmp/amh % make && sudo make install
```

Parallel Build Trees for Multiple Architectures

Builds for multiple architectures can share the same source tree.

Have the source on a (possibly read-only) shared directory

```
~ % cd /nfs/src  
/nfs/src % tar xzf ~/amhello-1.0.tar.gz
```

Compilation on first host

```
~ % mkdir /tmp/amh && cd /tmp/amh  
/tmp/amh % /nfs/src/amhello-1.0/configure  
/tmp/amh % make && sudo make install
```

Compilation on second host, **assuming shared data**

```
~ % mkdir /tmp/amh && cd /tmp/amh  
/tmp/amh % /nfs/src/amhello-1.0/configure  
/tmp/amh % make && sudo make install-exec
```

Two Part Installation

```
'make install'  
=  
'make install-exec'  
+  
'make install-data'
```

Two Part Installation

```
'make install'
=
'make install-exec'  install platform-dependent files
+
'make install-data'
```

Two Part Installation

`'make install'`
=
`'make install-exec'` install platform-dependent files
+
`'make install-data'` install platform-independent files
 (can be shared among multiple machines)

Cross-Compilation

```
~/amhello-1.0 % ./configure
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for gawk... gawk
checking whether make sets $(MAKE)... yes
checking for gcc... gcc
checking for C compiler default output file name... a.out
checking whether the C compiler works... yes
checking whether we are cross compiling... no
checking for suffix of executables...
checking for suffix of object files... o
checking whether we are using the GNU C compiler... yes
checking whether gcc accepts -g... yes
checking for gcc option to accept ANSI C...
...
```

Cross-Compilation

```
~/amhello-1.0 % ./configure
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for gawk... gawk
checking whether make sets $(MAKE)... yes
checking for gcc... gcc
checking for C compiler default output file name... a.out
checking whether the C compiler works... yes
checking whether we are cross compiling... no
checking for suffix of executables...
checking for suffix of object files... o
checking whether we are using the GNU C compiler... yes
checking whether gcc accepts -g... yes
checking for gcc option to accept ANSI C...
...
```

Cross-Compilation

```
~/amhello-1.0 % ./configure --build i686-pc-linux-gnu \  
                --host i586-mingw32msvc  
checking for a BSD-compatible install... /usr/bin/install -c  
checking whether build environment is sane... yes  
checking for gawk... gawk  
checking whether make sets $(MAKE)... yes  
checking for i586-mingw32msvc-strip... i586-mingw32msvc-strip  
checking for i586-mingw32msvc-gcc... i586-mingw32msvc-gcc  
checking for C compiler default output file name... a.exe  
checking whether the C compiler works... yes  
checking whether we are cross compiling... yes  
checking for suffix of executables... .exe  
checking for suffix of object files... o  
checking whether we are using the GNU C compiler... yes  
checking whether i586-mingw32msvc-gcc accepts -g... yes  
checking for i586-mingw32msvc-gcc option to accept ANSI C...  
...
```

Cross-Compilation

```
~/amhello-1.0 % ./configure --build i686-pc-linux-gnu \  
                --host i586-mingw32msvc  
...  
~/amhello-1.0 % make  
...
```

Cross-Compilation

```
~/amhello-1.0 % ./configure --build i686-pc-linux-gnu \  
                  --host i586-mingw32msvc  
...  
~/amhello-1.0 % make  
...  
~/amhello-1.0 % cd src; file hello.exe  
hello.exe: MS Windows PE 32-bit Intel 80386 console executable not relocatable
```

Of course you need a cross-compiler installed first.

Cross-Compilation

```
~/amhello-1.0 % ./configure --build i686-pc-linux-gnu \  
                --host i586-mingw32msvc  
...  
~/amhello-1.0 % make  
...  
~/amhello-1.0 % cd src; file hello.exe  
hello.exe: MS Windows PE 32-bit Intel 80386 console executable not relocatable
```

Of course you need a cross-compiler installed first.

Cross-compilation *configure* options:

'--build=**BUILD**' The system on which the package is built.

'--host=**HOST**' The system where built programs & libraries will run.

'--target=**TARGET**' Only when building compiler tools: the system for which the tools will create output.

For simple cross-compilation, only '--host=**HOST**' is needed.

Renaming Programs at Install Time

Maybe *hello* is already a command on this host?

Renaming Programs at Install Time

Maybe *hello* is already a command on this host?

`--program-prefix=PREFIX`

prepend **PREFIX** to installed program names,

`--program-suffix=SUFFIX`

append **SUFFIX** to installed program names,

`--program-transform-name=PROGRAM`

run `'sed PROGRAM'` on installed program names.

Renaming Programs at Install Time

Maybe *hello* is already a command on this host?

`--program-prefix=PREFIX`

prepend **PREFIX** to installed program names,

`--program-suffix=SUFFIX`

append **SUFFIX** to installed program names,

`--program-transform-name=PROGRAM`

run `'sed PROGRAM'` on installed program names.

```
~/amhello-1.0 % ./configure --program-prefix test-  
~/amhello-1.0 % make  
~/amhello-1.0 % sudo make install
```

Will install *hello* as `/usr/local/bin/test-hello`.

The Packager Point of View

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Building Binary Packages Using DESTDIR

DESTDIR is used to relocate a package at install time.

```
~/amhello-1.0 % ./configure --prefix /usr  
...
```

Building Binary Packages Using DESTDIR

DESTDIR is used to relocate a package at install time.

```
~/amhello-1.0 % ./configure --prefix /usr  
...  
~/amhello-1.0 % make  
...
```

Building Binary Packages Using DESTDIR

DESTDIR is used to relocate a package at install time.

```
~/amhello-1.0 % ./configure --prefix /usr
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make DESTDIR=$HOME/inst install
...
```

Building Binary Packages Using DESTDIR

DESTDIR is used to relocate a package at install time.

```
~/amhello-1.0 % ./configure --prefix /usr
...
~/amhello-1.0 % make
...
~/amhello-1.0 % make DESTDIR=$HOME/inst install
...
~/amhello-1.0 % cd ~/inst
~/inst % tar zcvf ~/amhello-1.0-i686.tar.gz .
./
./usr/
./usr/bin/
./usr/bin/hello
```

... and `~/amhello-1.0-i686.tar.gz` is ready to be uncompressed in / on many hosts.

The Maintainer Point of View

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Preparing Distributions

`'make dist'` Create *PACKAGE-VERSION.tar.gz*

`'make distcheck'` Likewise, with many sanity checks. Prefer this one!

Preparing Distributions

`'make dist'` Create *PACKAGE-VERSION.tar.gz*

`'make distcheck'` Likewise, with many sanity checks. **Prefer this one!**

`'make distcheck'` ensures most of the use cases presented so far work.

- It tests VPATH builds (with read-only source tree)
- It ensures `'make clean'`, `'make distclean'`, and `'make uninstall'` do not omit files,
- It checks that **DESTDIR** installations work,
- It runs the test suite (both `'make check'` and `'make installcheck'`).

Releasing a package that fails `'make distcheck'` means releasing a package that will disappoint many users.

Automatic Dependency Tracking

```
~/amhello-1.0 % ./configure --prefix /usr  
...  
checking dependency style of gcc... gcc3  
...
```

Dependency tracking is performed as a side-effect of compilation.
Several methods are supported, and checked for by *configure*.
(The gcc3 method above is the fastest.)

Automatic Dependency Tracking

```
~/amhello-1.0 % ./configure --prefix /usr  
...  
checking dependency style of gcc... gcc3  
...
```

Dependency tracking is performed as a side-effect of compilation.
Several methods are supported, and checked for by *configure*.
(The gcc3 method above is the fastest.)

Dependency tracking is only needed when the source files change;
it can be safely disabled for throw-away installation builds.
Slow methods must be enabled explicitly.

'--disable-dependency-tracking' speed up one-time builds
'--enable-dependency-tracking' do not reject slow dependency
extractors

Nested Packages

- *Autoconfiscated* packages can be nested to arbitrary depth.
 - A package can distribute a third-party library it uses in a subdirectory.
 - It's possible to gather many packages this way to distribute a set of tools.

Nested Packages

- *Autoconfiscated* packages can be nested to arbitrary depth.
 - A package can distribute a third-party library it uses in a subdirectory.
 - It's possible to gather many packages this way to distribute a set of tools.
- For installers:
 - A single package to configure, build, and install.
 - 'configure' options are passed recursively to sub-packages.
 - 'configure --help=recursive' shows the help of all sub-packages.

Nested Packages

- *Autoconfiscated* packages can be nested to arbitrary depth.
 - A package can distribute a third-party library it uses in a subdirectory.
 - It's possible to gather many packages this way to distribute a set of tools.
- For installers:
 - A single package to configure, build, and install.
 - 'configure' options are passed recursively to sub-packages.
 - 'configure --help=recursive' shows the help of all sub-packages.
- For maintainers:
 - Easier integration.
 - The sub-package is autonomous.

The configure Process

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

The (simplified) *configure* process



Makefile.in

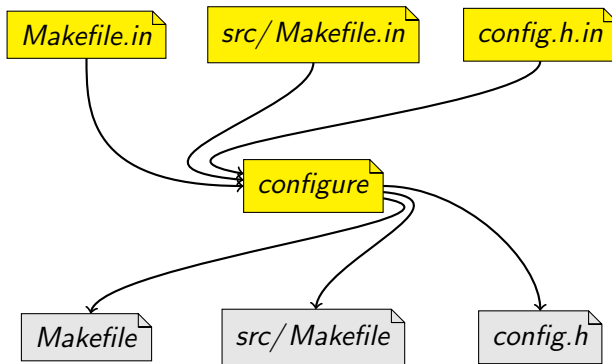
src/Makefile.in

config.h.in

configure

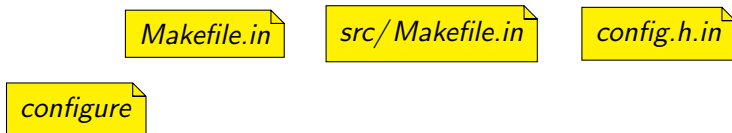
**.in* files are configuration templates

The (simplified) *configure* process

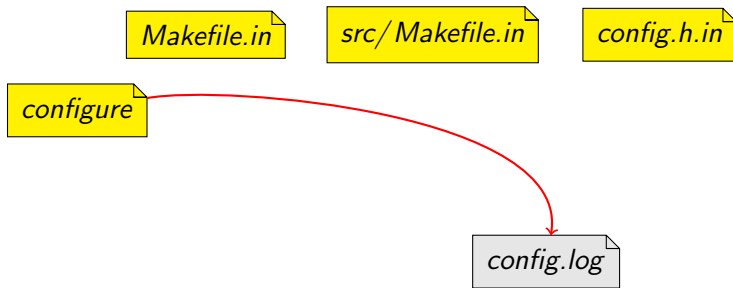


**.in* files are configuration templates
from which *configure* generates the configuration files to use for building

The (real) *configure* process

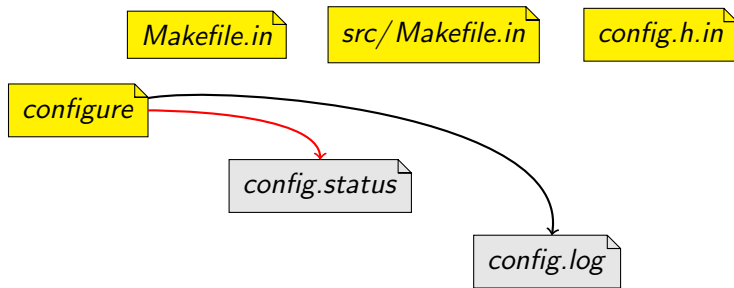


The (real) *configure* process



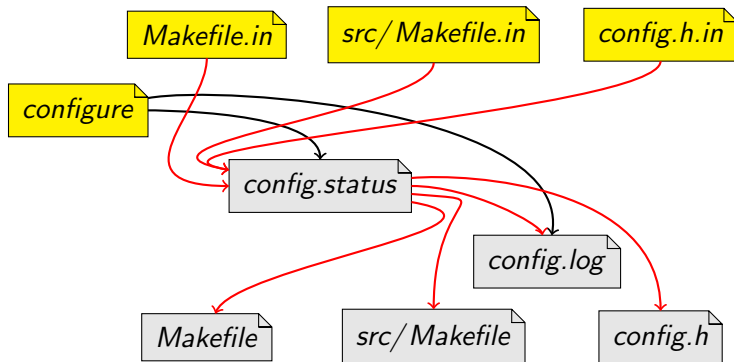
config.log contains a trace of the configuration

The (real) *configure* process



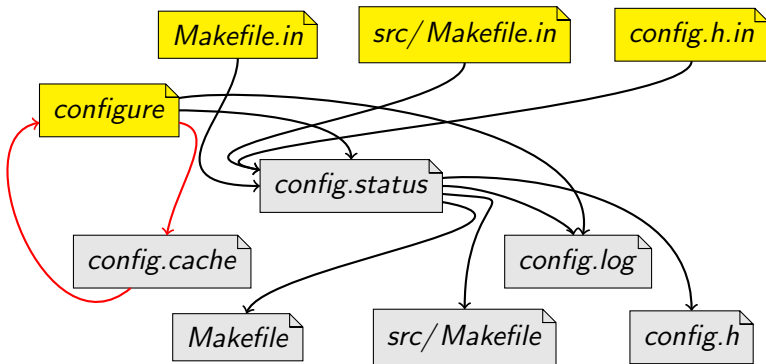
config.status will actually process the templates

The (real) *configure* process



config.status will actually process the templates

The (real) *configure* process



'`configure -C`' caches results in `config.cache` to speed up reconfigurations

Why We Need Tools

1 Goals

- Portable Packages
- Uniform Builds

2 Package Use Cases

- The User Point of View
- The Power User Point of View
- The Packager Point of View
- The Maintainer Point of View

3 The configure Process

4 Why We Need Tools

Why We Need Tools

If you try to mimic this build system by hand, you'll discover that

- The GNU Build System has a lot of features.
Some users may expect features you do not use.

Why We Need Tools

If you try to mimic this build system by hand, you'll discover that

- The GNU Build System has a lot of features.
Some users may expect features you do not use.
- Implementing them portably is difficult, and exhausting.
(Think portable shell scripts, portable *Makefiles*, on systems you may not have handy.)

Why We Need Tools

If you try to mimic this build system by hand, you'll discover that

- The GNU Build System has a lot of features.
Some users may expect features you do not use.
- Implementing them portably is difficult, and exhausting.
(Think portable shell scripts, portable *Makefiles*, on systems you may not have handy.)
- You will have to upgrade your setup to follow changes of the GNU Coding Standards.

Why We Need Tools

If you try to mimic this build system by hand, you'll discover that

- The GNU Build System has a lot of features.
Some users may expect features you do not use.
- Implementing them portably is difficult, and exhausting.
(Think portable shell scripts, portable *Makefiles*, on systems you may not have handy.)
- You will have to upgrade your setup to follow changes of the GNU Coding Standards.

GNU Autotools provide:

Why We Need Tools

If you try to mimic this build system by hand, you'll discover that

- The GNU Build System has a lot of features.
Some users may expect features you do not use.
- Implementing them portably is difficult, and exhausting.
(Think portable shell scripts, portable *Makefiles*, on systems you may not have handy.)
- You will have to upgrade your setup to follow changes of the GNU Coding Standards.

GNU Autotools provide:

- Tools to create the GNU Build System from simple instructions.

Why We Need Tools

If you try to mimic this build system by hand, you'll discover that

- The GNU Build System has a lot of features.
Some users may expect features you do not use.
- Implementing them portably is difficult, and exhausting.
(Think portable shell scripts, portable *Makefiles*, on systems you may not have handy.)
- You will have to upgrade your setup to follow changes of the GNU Coding Standards.

GNU Autotools provide:

- Tools to create the GNU Build System from simple instructions.
- A central place where fixes and improvements are made.
(A bug-fix for a portability issue benefits every package.)

Part II

GNU Autotools

- 5 Hello World
- 6 Introducing Core Autotools
- 7 Hello World Explained
- 8 Using Autoconf
- 9 Using Automake

Hello World

- 5 Hello World
- 6 Introducing Core Autotools
- 7 Hello World Explained
- 8 Using Autoconf
- 9 Using Automake

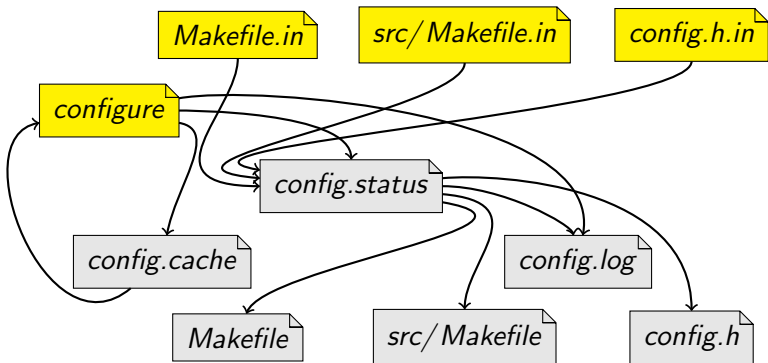
src/main.c for Hello World

src/main.c

```
#include <config.h>
#include <stdio.h>

int
main (void)
{
    puts ("Hello _World!");
    puts ("This _is _" PACKAGE_STRING " .");
    return 0;
}
```


Generating All Template Files



Generating All Template Files



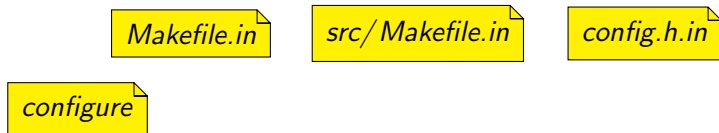
Makefile.in

src/Makefile.in

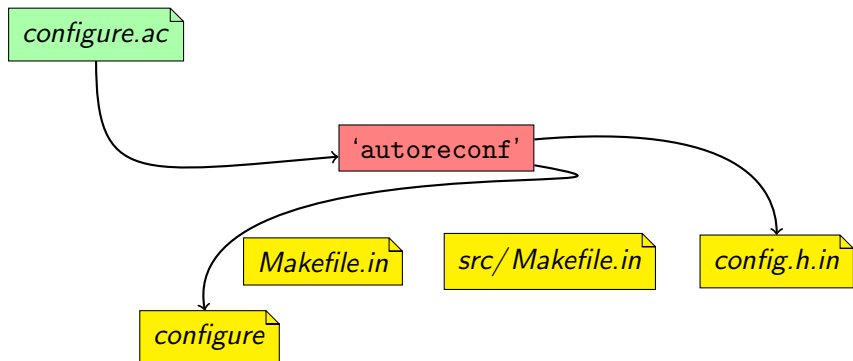
config.h.in

configure

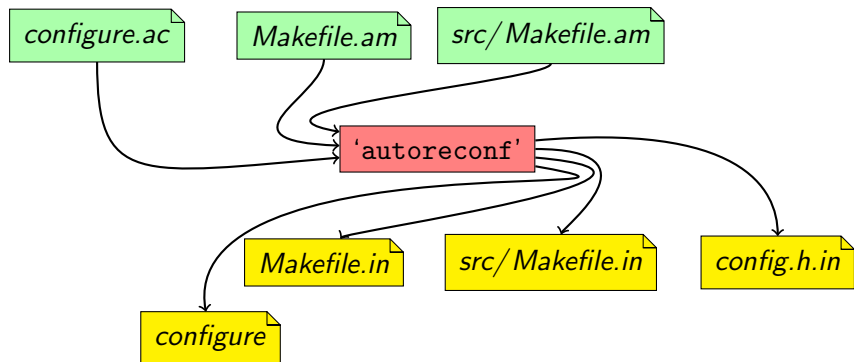
Generating All Template Files



Generating All Template Files



Generating All Template Files



Autotools Inputs

configure.ac

```
AC_INIT([amhello], [1.0],  
        [bug-report@address])  
AM_INIT_AUTOMAKE([  
    -Wall -Werror foreign])  
AC_PROG_CC  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([  
    Makefile  
    src/Makefile  
])  
AC_OUTPUT
```

Autotools Inputs

configure.ac

```
AC_INIT([amhello], [1.0],  
        [bug-report@address])  
AM_INIT_AUTOMAKE([  
    -Wall -Werror foreign])  
AC_PROG_CC  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([  
    Makefile  
    src/Makefile  
])  
AC_OUTPUT
```

Makefile.am

```
SUBDIRS = src
```

Autotools Inputs

configure.ac

```
AC_INIT([amhello], [1.0],  
        [bug-report@address])  
AM_INIT_AUTOMAKE([  
    -Wall -Werror foreign])  
AC_PROG_CC  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([  
    Makefile  
    src/Makefile  
])  
AC_OUTPUT
```

Makefile.am

```
SUBDIRS = src
```

src/Makefile.am

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


Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am  configure.ac  src/

./src:
Makefile.am  main.c
~/amhello %
```

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am  configure.ac  src/

./src:
Makefile.am  main.c
~/amhello % autoreconf --install
configure.ac:4: installing './install-sh'
configure.ac:4: installing './missing'
src/Makefile.am: installing './depcomp'
~/amhello %
```

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am  configure.ac  src/

./src:
Makefile.am  main.c
~/amhello % autoreconf --install
configure.ac:4: installing './install-sh'
configure.ac:4: installing './missing'
src/Makefile.am: installing './depcomp'
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
```

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
config.h.in      src/
configure*

./autom4te.cache:
output.0  requests  traces.1
output.1  traces.0

./src:
Makefile.am  Makefile.in  main.c
```

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
config.h.in      src/          expected configuration templates
configure*

./autom4te.cache:
output.0  requests  traces.1
output.1  traces.0

./src:
Makefile.am  Makefile.in  main.c
```

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
config.h.in      src/
configure*

./autom4te.cache:
output.0  requests  traces.1
output.1  traces.0

./src:
Makefile.am  Makefile.in  main.c
```

definitions for third-party macros
used in *configure.ac*

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
config.h.in      src/          auxiliary tools
configure*       used during the build

./autom4te.cache:
output.0  requests  traces.1
output.1  traces.0

./src:
Makefile.am  Makefile.in  main.c
```

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
config.h.in      src/           Autotools cache files
configure*

./autom4te.cache:
output.0  requests  traces.1
output.1  traces.0

./src:
Makefile.am  Makefile.in  main.c
```


Preparing the Package

```
~/amhello % ./configure
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for gawk... gawk
checking whether make sets $(MAKE)... yes
checking for gcc... gcc
...
checking dependency style of gcc... gcc3
configure: creating ./config.status
config.status: creating Makefile
config.status: creating src/Makefile
config.status: creating config.h
config.status: executing depfiles commands
~/amhello %
```

Preparing the Package

```
~/amhello % ./configure
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for gawk... gawk
checking whether make sets $(MAKE)... yes
checking for gcc... gcc
...
checking dependency style of gcc... gcc3
configure: creating ./config.status
config.status: creating Makefile
config.status: creating src/Makefile
config.status: creating config.h
config.status: executing depfiles commands
~/amhello %
```

Preparing the Package

```
~/amhello % ./configure
checking for a BSD-compatible install... /usr/bin/install -c
checking whether build environment is sane... yes
checking for gawk... gawk
checking whether make sets $(MAKE)... yes
checking for gcc... gcc
...
checking dependency style of gcc... gcc3
configure: creating ./config.status
config.status: creating Makefile
config.status: creating src/Makefile
config.status: creating config.h
config.status: executing depfiles commands
~/amhello % make
...
```

Preparing the Package

```
~/amhello % src/hello  
Hello World!  
This is amhello 1.0.  
~/amhello %
```

Preparing the Package

```
~/amhello % src/hello  
Hello World!  
This is amhello 1.0.  
~/amhello % make distcheck  
...  
=====
```

amhello archives ready for distribution:
amhello-1.0.tar.gz

```
=====
```

~/amhello %

Preparing the Package

```
~/amhello % tar ztf amhello-1.0.tar.gz
amhello-1.0/
amhello-1.0/Makefile.am
amhello-1.0/Makefile.in
amhello-1.0/aclocal.m4
amhello-1.0/config.h.in
amhello-1.0/configure
amhello-1.0/configure.ac
amhello-1.0/depcomp
amhello-1.0/install-sh
amhello-1.0/missing
amhello-1.0/src/
amhello-1.0/src/Makefile.am
amhello-1.0/src/Makefile.in
amhello-1.0/src/main.c
~/amhello %
```

Introducing Core Autotools

- 5 Hello World
- 6 Introducing Core Autotools
- 7 Hello World Explained
- 8 Using Autoconf
- 9 Using Automake

Two Core Packages

GNU Autoconf

GNU Automake

Two Core Packages

GNU Autoconf

'autoconf' Create *configure* from *configure.ac*.

GNU Automake

Two Core Packages

GNU Autoconf

'autoconf' Create *configure* from *configure.ac*.

'autoheader' Create *config.h.in* from *configure.ac*.

GNU Automake

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.

GNU Automake

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.

GNU Automake

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.
- 'autoupdate' Update obsolete macros in *configure.ac*.

GNU Automake

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.
- 'autoupdate' Update obsolete macros in *configure.ac*.
- 'ifnames' Gather identifiers from all `#if/#ifdef/...` directives.

GNU Automake

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.
- 'autoupdate' Update obsolete macros in *configure.ac*.
- 'ifnames' Gather identifiers from all *#if/#ifdef/...* directives.
- 'autom4te' The heart of Autoconf. It drives M4 and implements the features used by most of the above tools. Useful for creating more than just *configure* files.

GNU Automake

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.
- 'autoupdate' Update obsolete macros in *configure.ac*.
- 'ifnames' Gather identifiers from all *#if/#ifdef/...* directives.
- 'autom4te' The heart of Autoconf. It drives M4 and implements the features used by most of the above tools. Useful for creating more than just *configure* files.

GNU Automake

- 'automake' Create *Makefile.ins* from *Makefile.ams* and *configure.ac*.

Two Core Packages

GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.
- 'autoupdate' Update obsolete macros in *configure.ac*.
- 'ifnames' Gather identifiers from all *#if/#ifdef/...* directives.
- 'autom4te' The heart of Autoconf. It drives M4 and implements the features used by most of the above tools. Useful for creating more than just *configure* files.

GNU Automake

- 'automake' Create *Makefile.ins* from *Makefile.ams* and *configure.ac*.
- 'aclocal' Scan *configure.ac* for uses of third-party macros, and gather definitions in *aclocal.m4*.

Two Core Packages

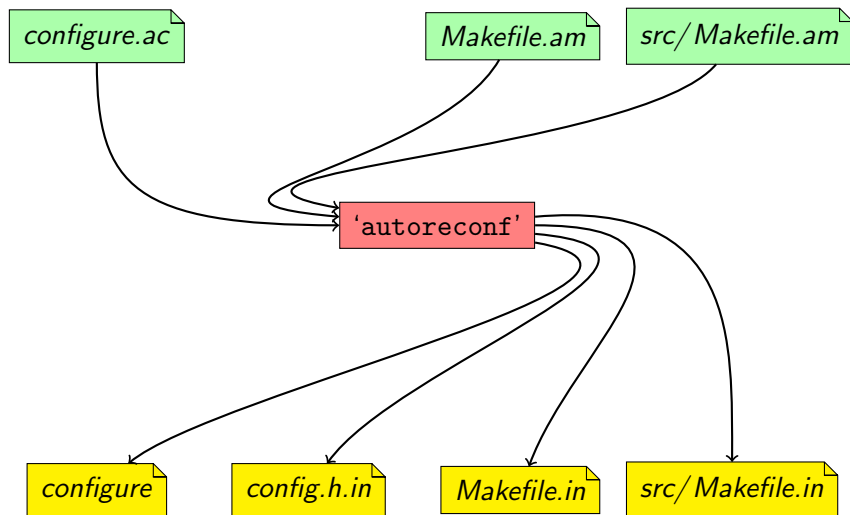
GNU Autoconf

- 'autoconf' Create *configure* from *configure.ac*.
- 'autoheader' Create *config.h.in* from *configure.ac*.
- 'autoreconf' Run all tools in the right order.
- 'autoscan' Scan sources for common portability problems, and related macros missing from *configure.ac*.
- 'autoupdate' Update obsolete macros in *configure.ac*.
- 'ifnames' Gather identifiers from all *#if/#ifdef/...* directives.
- 'autom4te' The heart of Autoconf. It drives M4 and implements the features used by most of the above tools. Useful for creating more than just *configure* files.

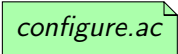
GNU Automake

- 'automake' Create *Makefile.ins* from *Makefile.ams* and *configure.ac*.
- 'aclocal' Scan *configure.ac* for uses of third-party macros, and gather definitions in *aclocal.m4*.

Behind 'autoreconf'



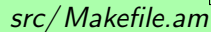
Behind 'autoreconf'



configure.ac



Makefile.am



src/Makefile.am



configure



config.h.in

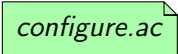


Makefile.in



src/Makefile.in

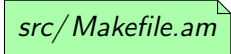
Behind 'autoreconf'



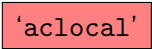
configure.ac



Makefile.am



src/Makefile.am



'aclocal'



configure



config.h.in

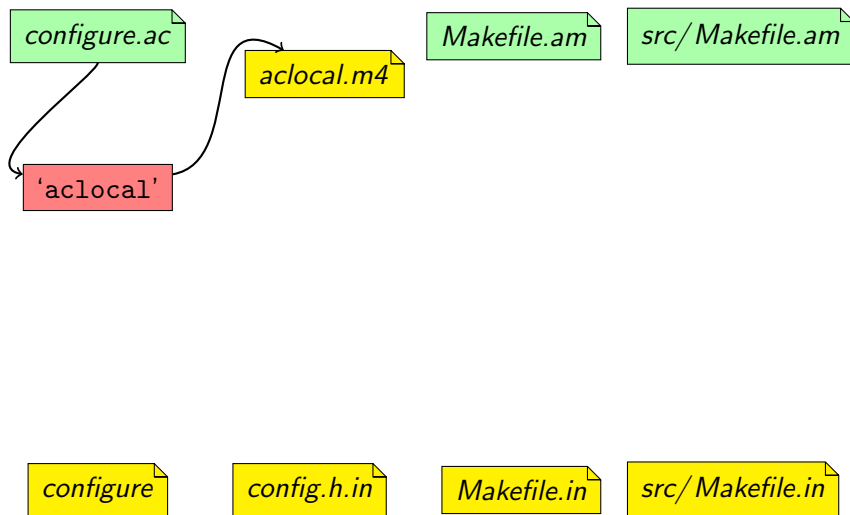


Makefile.in

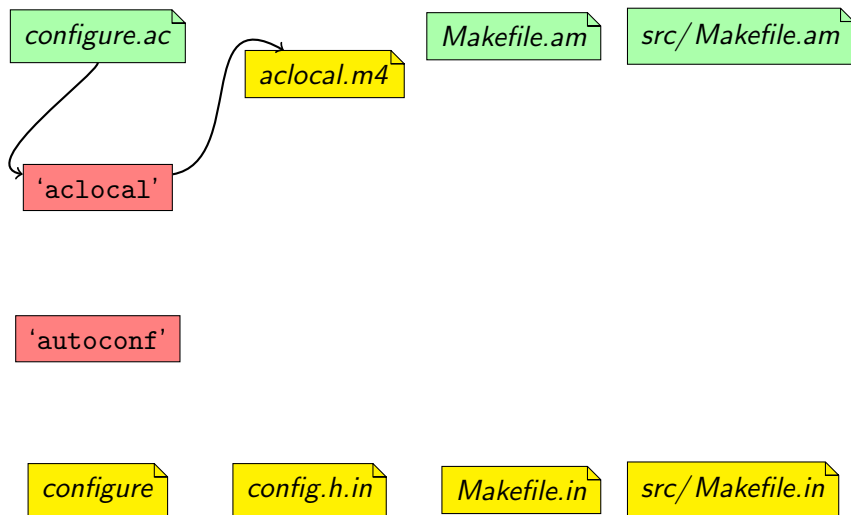


src/Makefile.in

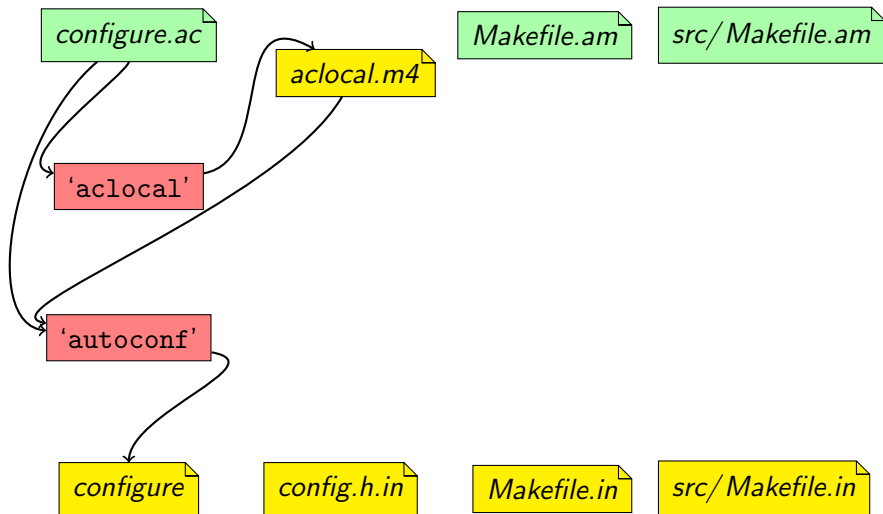
Behind 'autoreconf'



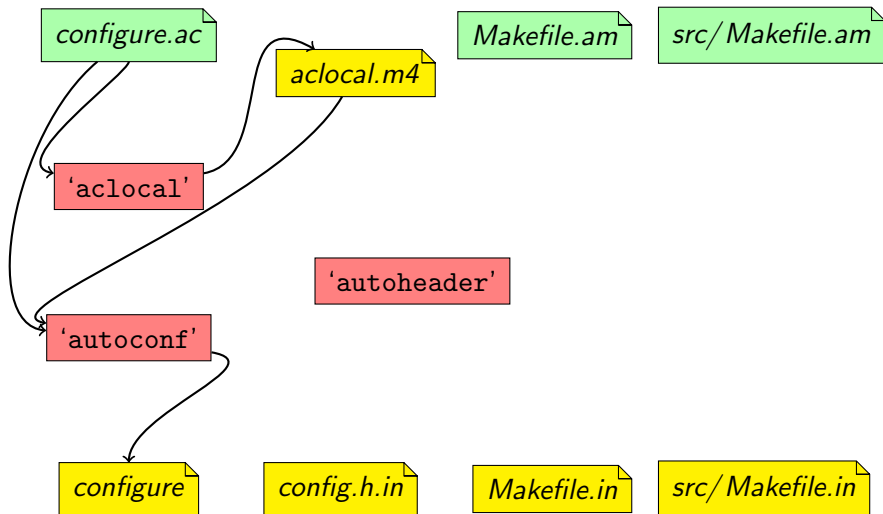
Behind 'autoreconf'



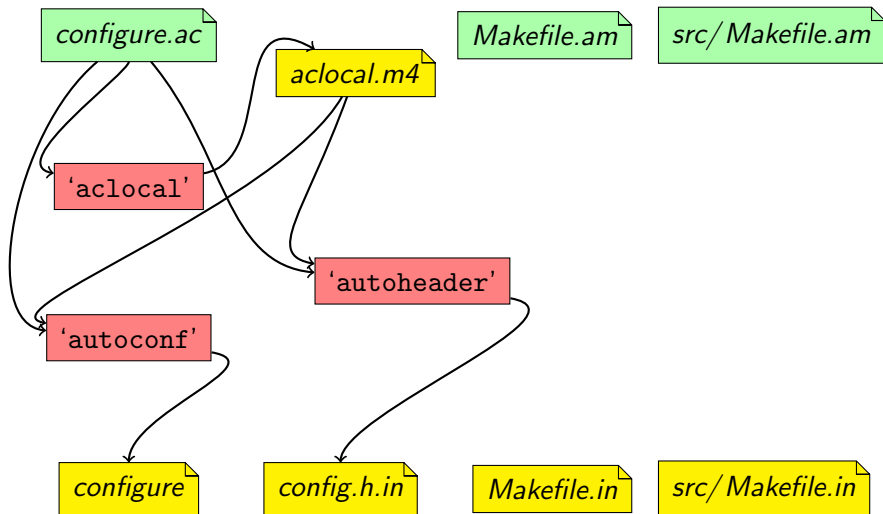
Behind 'autoreconf'



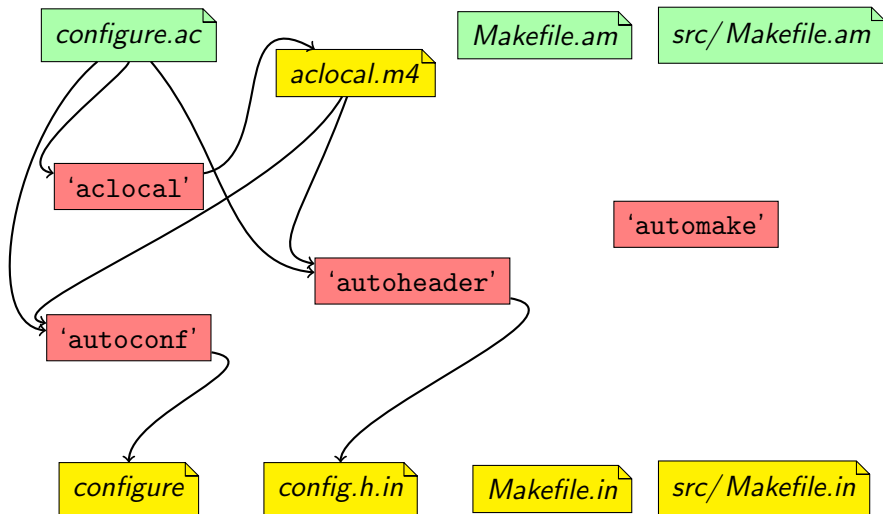
Behind 'autoreconf'



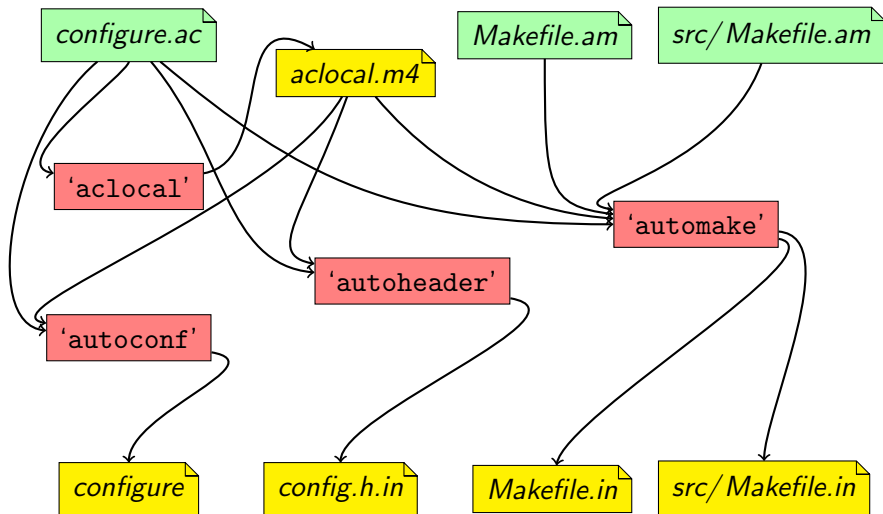
Behind 'autoreconf'



Behind 'autoreconf'



Behind 'autoreconf'



'autoreconf' is Your Friend

In practice,

- You do not have to remember the interaction of all tools.
- Use 'autoreconf --install' to setup the package initially.
- Rely on the rebuild rules (output in *Makefiles*) to rerun the right autotool when you change some input file.
- You only need a rough idea of the purpose of each tool to understand errors. (What tool complains and about what?)

'autoreconf' is Your Friend

In practice,

- You do not have to remember the interaction of all tools.
- Use 'autoreconf --install' to setup the package initially.
- Rely on the rebuild rules (output in *Makefiles*) to rerun the right autotool when you change some input file.
- You only need a rough idea of the purpose of each tool to understand errors. (What tool complains and about what?)

'autoconf' Creates *configure* from *configure.ac*.

'autoheader' Creates *config.h.in* from *configure.ac*.

'automake' Creates *Makefile.in*s from *Makefile.am*s and *configure.ac*.

'aclocal' Scans *configure.ac* for uses of third-party macros, and gather definitions in *aclocal.m4*.

'autom4te' Autoconf driver for M4. All tools that process *configure.ac* do so through 'autom4te'.

Hello World Explained

- 5 Hello World
- 6 Introducing Core Autotools
- 7 Hello World Explained
- 8 Using Autoconf
- 9 Using Automake

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```


amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
AC_PROG_CC  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([Makefile src/Makefile])  
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
AC_PROG_CC  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([Makefile src/Makefile])  
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.
- Initialize Automake. Turn on all Automake warnings and report them as errors. This is a **foreign** package.

foreign Ignores some GNU Coding Standards

configure.ac

...

```
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
```

...

```
~/amhello % autoreconf --install
```

```
configure.ac:2: installing './install-sh'
```

```
configure.ac:2: installing './missing'
```

```
src/Makefile.am: installing './depcomp'
```

foreign Ignores some GNU Coding Standards

configure.ac without the foreign option

```
...  
AM_INIT_AUTOMAKE([-Wall -Werror])  
...
```

```
~/amhello % autoreconf --install  
configure.ac:2: installing './install-sh'  
configure.ac:2: installing './missing'  
src/Makefile.am: installing './depcomp'  
Makefile.am: installing './INSTALL'  
Makefile.am: required file './NEWS' not found  
Makefile.am: required file './README' not found  
Makefile.am: required file './AUTHORS' not found  
Makefile.am: required file './ChangeLog' not found  
Makefile.am: installing './COPYING'  
autoreconf: automake failed with exit status: 1
```

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
AC_PROG_CC  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([Makefile src/Makefile])  
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.
- Initialize Automake. Turn on all Automake warnings and report them as errors. This is a **foreign** package.

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.
- Initialize Automake. Turn on all Automake warnings and report them as errors. This is a foreign package.
- Check for a C compiler.

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.
- Initialize Automake. Turn on all Automake warnings and report them as errors. This is a foreign package.
- Check for a C compiler.
- Declare *config.h* as output header.

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.
- Initialize Automake. Turn on all Automake warnings and report them as errors. This is a foreign package.
- Check for a C compiler.
- Declare *config.h* as output header.
- Declare *Makefile* and *src/Makefile* as output files.

amhello's *configure.ac* explained

configure.ac

```
AC_INIT([amhello], [1.0], [bug-report@address])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

- Initialize Autoconf. Specify package's name, version number, and bug-report address.
- Initialize Automake. Turn on all Automake warnings and report them as errors. This is a foreign package.
- Check for a C compiler.
- Declare *config.h* as output header.
- Declare *Makefile* and *src/Makefile* as output files.
- Actually output all declared files.

amhello's *Makefile.am* explained

Makefile.am

SUBDIRS = **src**

- Build recursively in *src/*.

amhello's *Makefile.am* explained

Makefile.am

```
SUBDIRS = src
```

- Build recursively in *src/*.
- Nothing else is declared for the current directory.
(The top-level *Makefile.am* is usually short.)

amhello's *src/Makefile.am* explained

src/Makefile.am

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

- We are building some programs.

amhello's *src/Makefile.am* explained

src/Makefile.am

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

- We are building some programs.
- These programs will be installed in *bindir*.

Standard File System Hierarchy

Directory variable	Default value
prefix	<i>/usr/local</i>
exec-prefix	prefix
bindir	exec-prefix/ <i>bin</i>
libdir	exec-prefix/ <i>lib</i>
...	
includedir	prefix/ <i>include</i>
datarootdir	prefix/ <i>share</i>
datadir	datarootdir
mandir	datarootdir/ <i>man</i>
infodir	datarootdir/ <i>info</i>
...	

amhello's *src/Makefile.am* explained

src/Makefile.am

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

- We are building some programs.
- These programs will be installed in *bindir*.

amhello's *src/Makefile.am* explained

src/Makefile.am

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

- We are building some programs.
- These programs will be installed in *bindir*.
- There is only one program to build: *hello*.

amhello's *src/Makefile.am* explained

src/Makefile.am

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

- We are building some programs.
- These programs will be installed in *bindir*.
- There is only one program to build: *hello*.
- To create *hello*, just compile *main.c*.

Using Autoconf

- 5 Hello World
- 6 Introducing Core Autotools
- 7 Hello World Explained**
- 8 Using Autoconf
- 9 Using Automake

From *configure.ac* to *configure* and *config.h.in*

- 'autoconf' is a macro processor.
- It converts *configure.ac*, which is a shell script using macro instructions, into *configure*, a full-fledged shell script.

From *configure.ac* to *configure* and *config.h.in*

- 'autoconf' is a macro processor.
- It converts *configure.ac*, which is a shell script using macro instructions, into *configure*, a full-fledged shell script.
- Autoconf offers many macros to perform common configuration checks.
- It is not uncommon to have a *configure.ac* without shell constructs, using only macros.

From *configure.ac* to *configure* and *config.h.in*

- 'autoconf' is a macro processor.
- It converts *configure.ac*, which is a shell script using macro instructions, into *configure*, a full-fledged shell script.
- Autoconf offers many macros to perform common configuration checks.
- It is not uncommon to have a *configure.ac* without shell constructs, using only macros.
- While processing *configure.ac* it is also possible to trace the occurrences of macros. This is how 'autoheader' creates *config.h.in*. It just looks for the macros that `#define` symbols.

From *configure.ac* to *configure* and *config.h.in*

- 'autoconf' is a macro processor.
- It converts *configure.ac*, which is a shell script using macro instructions, into *configure*, a full-fledged shell script.
- Autoconf offers many macros to perform common configuration checks.
- It is not uncommon to have a *configure.ac* without shell constructs, using only macros.
- While processing *configure.ac* it is also possible to trace the occurrences of macros. This is how 'autoheader' creates *config.h.in*. It just looks for the macros that `#define` symbols.
- The real macro processor actually is GNU M4. Autoconf offers some infrastructure on top of that, plus the pool of macros.

Discovering M4

example.m4

```
m4_define(NAME1, Harry)↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

~ %

Discovering M4

example.m4

```
m4_define(NAME1, Harry)↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4
```

```
↵  
↵  
↵
```

```
Harry met Sally↵
```


Discovering M4

example.m4

```
m4_define(NAME1, Harry)↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
m4_define(NAME1, Harry)↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
m4_define(NAME1, Harry)↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4  
↵  
↵  
↵  
Harry met Sally↵
```


Discovering M4

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4
```

```
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4
```

```
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

```
~ % m4 -P example.m4
```

```
↵  
↵  
↵  
Harry met Sally↵
```

Discovering M4

example.m4

↵
↵
↵

MET(NAME1, NAME2)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

MET(Harry, NAME2)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

MET(Harry, NAME2)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

MET(Harry, NAME2)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

MET(Harry, Sally)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

MET(Harry, Sally)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

MET(Harry, Sally)↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

Harry met Sally↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

Harry met Sally↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

Harry met Sally↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

Harry met Sally↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

Discovering M4

example.m4

↵
↵
↵

Harry met Sally↵

~ % m4 -P example.m4

↵
↵
↵

Harry met Sally↵

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using **quotes**.

example.m4

```
m4_define(NAME1, 'Harry, Jr.')
```

```
m4_define(NAME2, Sally)
```

```
m4_define(MET, $1 met $2)
```

```
MET(NAME1, NAME2)
```

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
m4_define(NAME1, 'Harry, Jr.')
```

```
m4_define(NAME2, Sally)
```

```
m4_define(MET, $1 met $2)
```

```
MET(NAME1, NAME2)
```

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
m4_define(NAME1, 'Harry, Jr.')
```

```
m4_define(NAME2, Sally)
```

```
m4_define(MET, $1 met $2)
```

```
MET(NAME1, NAME2)
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
m4_define(NAME1, 'Harry, Jr.')
```

```
m4_define(NAME2, Sally)
```

```
m4_define(MET, $1 met $2)
```

```
MET(NAME1, NAME2)
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
m4_define(NAME1, 'Harry, Jr.')
```

```
m4_define(NAME2, Sally)
```

```
m4_define(MET, $1 met $2)
```

```
MET(NAME1, NAME2)
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
m4_define(NAME1, Harry, Jr.)  
m4_define(NAME2, Sally)  
m4_define(MET, $1 met $2)  
MET(NAME1, NAME2)
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
m4_define(NAME1, Harry, Jr.)  
m4_define(NAME2, Sally)  
m4_define(MET, $1 met $2)  
MET(NAME1, NAME2)
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET(NAME1, NAME2)↵
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(NAME1, NAME2)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., NAME2)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., NAME2)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., NAME2)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., NAME2)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., Sally)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., Sally)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

MET(Harry, Jr., Sally)↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

Harry met Jr.↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

```
␣  
␣  
␣  
␣
```

```
Harry met Jr.␣
```

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵
↵

Harry met Jr.↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

Harry met Jr.↵

Can you guess the output of the above?

M4 Quoting

- The macro's arguments are processed
- Then the macro is expanded
- Finally the output of the macro is processed too
- A string can be protected from processing using quotes.

This is a source of many mistakes for the unwary.

example.m4

↵
↵
↵

Harry met Jr.↵

Can you guess the output of the above?

M4 Quoting Rule of the Thumb

- Quote each macro argument once.

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
m4_define('NAME1', 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET('NAME1', 'NAME2')
```


M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
m4_define('NAME1', 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET('NAME1', 'NAME2')
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
m4_define(NAME1, 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET('NAME1', 'NAME2')
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
m4_define(NAME1, Harry, Jr.)↵  
m4_define('NAME2', 'Sally')↵  
m4_define('MET', '$1 met $2')↵  
MET('NAME1', 'NAME2')↵
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
↵  
m4_define('NAME2', 'Sally')↵  
m4_define('MET', '$1 met $2')↵  
MET('NAME1', 'NAME2')↵
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
↵  
m4_define(NAME2, 'Sally')↵  
m4_define('MET', '$1 met $2')↵  
MET('NAME1', 'NAME2')↵
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
↵  
m4_define(NAME2, Sally)↵  
m4_define('MET', '$1 met $2')↵  
MET('NAME1', 'NAME2')↵
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
↵  
↵  
m4_define('MET', '$1 met $2')↵  
MET('NAME1', 'NAME2')↵
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
↵  
↵  
m4_define(MET, '$1 met $2')↵  
MET('NAME1', 'NAME2')↵
```


M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

```
↵  
↵  
m4_define(MET, $1 met $2)↵  
MET('NAME1', 'NAME2')↵
```

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

MET('NAME1', 'NAME2')↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

MET(NAME1, 'NAME2')↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

MET(NAME1 , NAME2)↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

NAME1 met NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

NAME1 met NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. **met** NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met NAME2↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met Sally↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met Sally↵

M4 Quoting Rule of the Thumb

- Quote each macro argument once.
- So it is processed only after it has been output.

example.m4

↵
↵
↵

Harry, Jr. met Sally↵

Spacing Matters

example.m4

```
m4_define('NAME1', 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET('NAME1', 'NAME2')
```

```
~ % m4 -P example.m4
```

```
↵
```

```
↵
```

```
↵
```

```
Harry, Jr. met Sally
```

Spacing Matters

- The parenthesis must stick to the macro name.

example.m4

```
m4_define('NAME1', 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET_( 'NAME1', 'NAME2')
```

```
~ % m4 -P example.m4
```

```
↵
```

```
↵
```

```
↵
```

```
met_(NAME1, NAME2)
```


Spacing Matters

- The parenthesis must stick to the macro name.
- Spaces after or inside quotes are part of the arguments.

example.m4

```
m4_define('NAME1', 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET('NAME1', 'NAME2')
```

```
~ % m4 -P example.m4
```

```
↵
```

```
↵
```

```
↵
```

```
Harry, Jr. met Sally
```

Spacing Matters

- The parenthesis must stick to the macro name.
- Spaces after or inside quotes are part of the arguments.
- Spaces before quotes are ignored.

example.m4

```
m4_define('NAME1', 'Harry, Jr.')
```

```
m4_define('NAME2', 'Sally')
```

```
m4_define('MET', '$1 met $2')
```

```
MET('NAME1', 'NAME2')
```

```
~ % m4 -P example.m4
```

```
↵
```

```
↵
```

```
↵
```

```
Harry, Jr. met Sally
```

Autoconf on Top of M4

- Autoconf = M4 with more machinery, and many predefined macros.

Autoconf on Top of M4

- Autoconf = M4 with more machinery, and many predefined macros.
- The quotes are [and] (instead of ' and ').

Autoconf on Top of M4

- Autoconf = M4 with more machinery, and many predefined macros.
- The quotes are [and] (instead of ' and ').
- For this reason we use the test command instead of [in shell fragments:

```
if [ "$x" = "$y" ]; then ...
```

Autoconf on Top of M4

- Autoconf = M4 with more machinery, and many predefined macros.
- The quotes are [and] (instead of ' and ').
- For this reason we use the test command instead of [in shell fragments:

```
if test "$x" = "$y"; then ...
```

Autoconf on Top of M4

- Autoconf = M4 with more machinery, and many predefined macros.
- The quotes are [and] (instead of ' and ').
- For this reason we use the test command instead of [in shell fragments:

```
if test "$x" = "$y"; then ...
```

- Macros are defined with AC_DEFUN.

```
AC_DEFUN([NAME1], [Harry, Jr.])  
AC_DEFUN([NAME2], [Sally])  
AC_DEFUN([MET], [$1 met $2])  
MET([NAME1], [NAME2])
```

The Structure of a *configure.ac*

configure.ac

Prelude.

AC_INIT([**PACKAGE**], [**VERSION**], [**BUG-REPORT-ADDRESS**])

Checks for programs.

Checks for libraries.

Checks for header files.

Checks for typedefs, structures, and compiler characteristics.

Checks for library functions.

Output files.

AC_CONFIG_FILES([**FILES**])

AC_OUTPUT

The Structure of a *configure.ac*

configure.ac

Prelude.

AC_INIT([amhello], [1.0], [bug-report@address])

Checks for programs.

Checks for libraries.

Checks for header files.

Checks for typedefs, structures, and compiler characteristics.

Checks for library functions.

Output files.

AC_CONFIG_FILES([FILES])

AC_OUTPUT

The Structure of a *configure.ac*

configure.ac

```
# Prelude.  
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
  
# Checks for programs.  
  
# Checks for libraries.  
# Checks for header files.  
# Checks for typedefs, structures, and compiler characteristics.  
# Checks for library functions.  
# Output files.  
  
AC_CONFIG_FILES([FILES])  
AC_OUTPUT
```

The Structure of a *configure.ac*

configure.ac

```
# Prelude.  
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
# Checks for programs.  
AC_PROG_CC  
# Checks for libraries.  
# Checks for header files.  
# Checks for typedefs, structures, and compiler characteristics.  
# Checks for library functions.  
# Output files.  
  
AC_CONFIG_FILES([FILES])  
AC_OUTPUT
```

The Structure of a *configure.ac*

configure.ac

```
# Prelude.  
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
# Checks for programs.  
AC_PROG_CC  
# Checks for libraries.  
# Checks for header files.  
# Checks for typedefs, structures, and compiler characteristics.  
# Checks for library functions.  
# Output files.  
  
AC_CONFIG_FILES([Makefile src/Makefile])  
AC_OUTPUT
```

The Structure of a *configure.ac*

configure.ac

```
# Prelude.  
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
# Checks for programs.  
AC_PROG_CC  
# Checks for libraries.  
# Checks for header files.  
# Checks for typedefs, structures, and compiler characteristics.  
# Checks for library functions.  
# Output files.  
AC_CONFIG_HEADERS([config.h])  
AC_CONFIG_FILES([Makefile src/Makefile])  
AC_OUTPUT
```

Useful Autoconf Macros for Prelude

`AC_INIT(PACKAGE, VERSION, BUG-REPORT-ADDRESS)`

Mandatory Autoconf initialization.

Useful Autoconf Macros for Prelude

`AC_INIT(PACKAGE, VERSION, BUG-REPORT-ADDRESS)`

Mandatory Autoconf initialization.

`AC_PREREQ(VERSION)`

Useful Autoconf Macros for Prelude

AC_INIT(PACKAGE, VERSION, BUG-REPORT-ADDRESS)

Mandatory Autoconf initialization.

AC_PREREQ(VERSION)

AC_CONFIG_SRCDIR(FILE)

A safety check. **FILE** should be a distributed source file, and this makes sure that 'configure' is not run from outer space. E.g.

`AC_CONFIG_SRCDIR([src/main.c]).`

Useful Autoconf Macros for Prelude

AC_INIT(PACKAGE, VERSION, BUG-REPORT-ADDRESS)

Mandatory Autoconf initialization.

AC_PREREQ(VERSION)

AC_CONFIG_SRCDIR(FILE)

A safety check. **FILE** should be a distributed source file, and this makes sure that 'configure' is not run from outer space. E.g. `AC_CONFIG_SRCDIR([src/main.c])`.

AC_CONFIG_AUX_DIR(DIRECTORY)

Auxiliary scripts such as *install-sh* and *depcomp* should be in **DIRECTORY**. E.g. `AC_CONFIG_AUX_DIR([build-aux])`.

Preparing the Package

```
~/amhello % ls -R
.:
Makefile.am      configure.ac
Makefile.in      depcomp*
aclocal.m4       install-sh*
autom4te.cache/  missing*
config.h.in      src/
configure*       auxiliary tools
                  used during the build

./autom4te.cache:
output.0  requests  traces.1
output.1  traces.0
```

AC_CONFIG_AUX_DIR Example

configure.ac

```
AC_INIT([amhello], [1.1], [bug-report@address])
```

```
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
```

```
AC_PROG_CC
```

```
AC_CONFIG_HEADERS([config.h])
```

```
AC_CONFIG_FILES([Makefile src/Makefile])
```

```
AC_OUTPUT
```

```
% autoreconf --install
```

```
configure.ac:3: installing 'missing'
```

```
configure.ac:3: installing 'install-sh'
```

```
src/Makefile.am: installing 'depcomp'
```

AC_CONFIG_AUX_DIR Example

configure.ac

```
AC_INIT([amhello], [1.1], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

```
% autoreconf --install
configure.ac:3: installing 'build-aux/missing'
configure.ac:3: installing 'build-aux/install-sh'
src/Makefile.am: installing 'build-aux/depcomp'
```

Useful Program Checks

`AC_PROG_CC`, `AC_PROG_CXX`, `AC_PROG_F77`, ...

Compiler checks. (Handle search cross-compilers if needed.)

Useful Program Checks

`AC_PROG_CC`, `AC_PROG_CXX`, `AC_PROG_F77`, ...

Compiler checks. (Handle search cross-compilers if needed.)

`AC_PROG_SED`, `AC_PROG_YACC`, `AC_PROG_LEX`, ...

Find good implementations and set `$SED`, `$YACC`, `$LEX`, etc.

Useful Program Checks

`AC_PROG_CC`, `AC_PROG_CXX`, `AC_PROG_F77`, ...

Compiler checks. (Handle search cross-compilers if needed.)

`AC_PROG_SED`, `AC_PROG_YACC`, `AC_PROG_LEX`, ...

Find good implementations and set `$SED`, `$YACC`, `$LEX`, etc.

`AC_CHECK_PROGS(VAR, PROGS, [VAL-IF-NOT-FOUND])`

Define `VAR` to the first `PROGS` found, or to `VAL-IF-NOT-FOUND` otherwise.

```
AC_CHECK_PROGS([TAR], [tar gtar], [:])
if test "$TAR" = :; then
  AC_MSG_ERROR([This package needs tar.])
fi
```

... and many more

Useful Program Checks

`AC_PROG_CC`, `AC_PROG_CXX`, `AC_PROG_F77`, ...

Compiler checks. (Handle search cross-compilers if needed.)

`AC_PROG_SED`, `AC_PROG_YACC`, `AC_PROG_LEX`, ...

Find good implementations and set `$SED`, `$YACC`, `$LEX`, etc.

`AC_CHECK_PROGS(VAR, PROGS, [VAL-IF-NOT-FOUND])`

Define `VAR` to the first `PROGS` found, or to `VAL-IF-NOT-FOUND` otherwise.

```
AC_CHECK_PROGS([TAR], [tar gtar], [:])
if test "$TAR" = :; then
    AC_MSG_ERROR([This package needs tar.])
fi
```

... and many more

Useful Autoconf Action Macros

`AC_MSG_ERROR(ERROR-DESCRIPTION, [EXIT-STATUS])`

Print `ERROR-DESCRIPTION` (also to *config.log*) and abort
'configure'.

`AC_MSG_WARN(ERROR-DESCRIPTION)`

Likewise, but don't abort.

Useful Autoconf Action Macros

`AC_MSG_ERROR(ERROR-DESCRIPTION, [EXIT-STATUS])`

Print `ERROR-DESCRIPTION` (also to *config.log*) and abort 'configure'.

`AC_MSG_WARN(ERROR-DESCRIPTION)`

Likewise, but don't abort.

`AC_DEFINE(VARIABLE, VALUE, DESCRIPTION)`

Output the following to *config.h*.

```
/* DESCRIPTION */  
#define VARIABLE VALUE
```

Useful Autoconf Action Macros

`AC_MSG_ERROR(ERROR-DESCRIPTION, [EXIT-STATUS])`

Print `ERROR-DESCRIPTION` (also to *config.log*) and abort 'configure'.

`AC_MSG_WARN(ERROR-DESCRIPTION)`

Likewise, but don't abort.

`AC_DEFINE(VARIABLE, VALUE, DESCRIPTION)`

Output the following to *config.h*.

```
/* DESCRIPTION */
#define VARIABLE VALUE
```

`AC_SUBST(VARIABLE, [VALUE])`

Define `$(VARIABLE)` as `VALUE` in *Makefile*.

```
AC_SUBST([FOO], [foo])
```

```
FOO=foo
```

```
AC_SUBST([FOO])
```

```
AC_SUBST([FOO])
```

```
FOO=foo
```

All equivalent.

Checking for Libraries

```
AC_CHECK_LIB(LIBRARY, FUNCT, [ACT-IF-FOUND], [ACT-IF-NOT])
```

Check whether `LIBRARY` exists and contains `FUNCT`.
Execute `ACT-IF-FOUND` if it does, `ACT-IF-NOT` otherwise.

Checking for Libraries

```
AC_CHECK_LIB(LIBRARY, FUNCT, [ACT-IF-FOUND], [ACT-IF-NOT])
```

Check whether **LIBRARY** exists and contains **FUNCT**.
Execute **ACT-IF-FOUND** if it does, **ACT-IF-NOT** otherwise.

```
AC_CHECK_LIB([efence], [malloc], [EFENCELIB=-leference])  
AC_SUBST([EFENCELIB])
```

... we would later use `$(EFENCELIB)` in the link rule.

Checking for Libraries

```
AC_CHECK_LIB(LIBRARY, FUNCT, [ACT-IF-FOUND], [ACT-IF-NOT])
```

Check whether **LIBRARY** exists and contains **FUNCT**.
Execute **ACT-IF-FOUND** if it does, **ACT-IF-NOT** otherwise.

```
AC_CHECK_LIB([efence], [malloc], [EFENCELIB=-leference])  
AC_SUBST([EFENCELIB])
```

... we would later use `$(EFENCELIB)` in the link rule.

If **ACT-IF-FOUND** is not set and the library is found, `AC_CHECK_LIB` will do `LIBS="-lLIBRARY $LIBS"` and `#define HAVE_LIBLIBRARY`.
(Automake uses `$LIBS` for linking everything.)

Checking for Headers

`AC_CHECK_HEADERS(HEADERS...)`

Check for `HEADERS` and `#define HAVE_HEADER_H` for each header found.

Checking for Headers

`AC_CHECK_HEADERS(HEADERS...)`

Check for `HEADERS` and `#define HAVE_HEADER_H` for each header found.

```
AC_CHECK_HEADERS([sys/param.h unistd.h])  
AC_CHECK_HEADERS([wchar.h])
```

Might `#define HAVE_SYS_PARAM_H`, `HAVE_UNISTD_H`, and `HAVE_WCHAR_H`.

Checking for Headers

`AC_CHECK_HEADERS(HEADERS...)`

Check for `HEADERS` and `#define HAVE_HEADER_H` for each header found.

```
AC_CHECK_HEADERS([sys/param.h unistd.h])
AC_CHECK_HEADERS([wchar.h])
```

Might `#define HAVE_SYS_PARAM_H, HAVE_UNISTD_H, and HAVE_WCHAR_H.`

```
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
```

Checking for Headers

`AC_CHECK_HEADERS(HEADERS...)`

Check for `HEADERS` and `#define HAVE_HEADER_H` for each header found.

```
AC_CHECK_HEADERS([sys/param.h unistd.h])
AC_CHECK_HEADERS([wchar.h])
```

Might `#define HAVE_SYS_PARAM_H, HAVE_UNISTD_H, and HAVE_WCHAR_H.`

```
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
```

`AC_CHECK_HEADER(HEADER, [ACT-IF-FOUND], [ACT-IF-NOT])`

Check only one header.

Output Commands

AC_CONFIG_HEADERS(HEADERS...)

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with **AC_DEFINE**.

Output Commands

AC_CONFIG_HEADERS(HEADERS...)

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with **AC_DEFINE**.

```
AC_CONFIG_HEADERS([config.h])
```

Will create *config.h* from *config.h.in*

Output Commands

AC_CONFIG_HEADERS(HEADERS...)

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with AC_DEFINE.

```
AC_CONFIG_HEADERS([config.h:config.hin])
```

Will create *config.h* from *config.hin* (DJGPP supports only 1 dot).

Output Commands

`AC_CONFIG_HEADERS(HEADERS...)`

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with `AC_DEFINE`.

`AC_CONFIG_HEADERS([config.h:config.hin])`

Will create *config.h* from *config.hin* (DJGPP supports only 1 dot).

`AC_CONFIG_FILES(FILES...)`

Create **FILE** for all **FILE.in**.

FILES contain definitions made with `AC_SUBST`.

Output Commands

`AC_CONFIG_HEADERS(HEADERS...)`

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with `AC_DEFINE`.

```
AC_CONFIG_HEADERS([config.h:config.hin])
```

Will create *config.h* from *config.hin* (DJGPP supports only 1 dot).

`AC_CONFIG_FILES(FILES...)`

Create **FILE** for all **FILE.in**.

FILES contain definitions made with `AC_SUBST`.

```
AC_CONFIG_FILES([Makefile sub/Makefile script.sh:script.in])
```

Output Commands

AC_CONFIG_HEADERS(HEADERS...)

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with AC_DEFINE.

```
AC_CONFIG_HEADERS([config.h:config.hin])
```

Will create *config.h* from *config.hin* (DJGPP supports only 1 dot).

AC_CONFIG_FILES(FILES...)

Create **FILE** for all **FILE.in**.

FILES contain definitions made with AC_SUBST.

```
AC_CONFIG_FILES([Makefile sub/Makefile script.sh:script.in])
```

Automake creates **FILE.in** for each **FILE** that has a **FILE.am**.

Output Commands

AC_CONFIG_HEADERS(HEADERS...)

Create **HEADER** for all **HEADER.in**. Use only one such header unless you know what you are doing ('autoheader' creates **HEADER.in** only for the first **HEADER**).

HEADERS contain definitions made with AC_DEFINE.

```
AC_CONFIG_HEADERS([config.h:config.hin])
```

Will create *config.h* from *config.hin* (DJGPP supports only 1 dot).

AC_CONFIG_FILES(FILES...)

Create **FILE** for all **FILE.in**.

FILES contain definitions made with AC_SUBST.

```
AC_CONFIG_FILES([Makefile sub/Makefile script.sh:script.in])
```

Automake creates **FILE.in** for each **FILE** that has a **FILE.am**.

It's legitimate to process non-*Makefile* too.

AC_CONFIG_FILES([script.sh:script.in]) Example

script.in

```
#!/bin/sh
SED='@SED@'
TAR='@TAR@'
d=$1; shift; mkdir "$d"
for f; do
    "$SED" 's/#.*//' "$f" \
    >"$d/$f"
done
"$TAR" cf "$d.tar" "$d"
```

.in files are templates

AC_CONFIG_FILES([script.sh:script.in]) Example

script.in

```
#!/bin/sh
SED='@SED@'
TAR='@TAR@'
d=$1; shift; mkdir "$d"
for f; do
    "$SED" 's/#.*//' "$f" \
    >"$d/$f"
done
"$TAR" cf "$d.tar" "$d"
```

.in files are templates where @XYZ@ are placeholders for AC_SUBST([XYZ]) definitions.

AC_CONFIG_FILES([script.sh:script.in]) Example

script.in

```
#!/bin/sh
SED='@SED@'
TAR='@TAR@'
d=$1; shift; mkdir "$d"
for f; do
    "$SED" 's/#.*//' "$f" \
        >"$d/$f"
done
"$TAR" cf "$d.tar" "$d"
```

script.sh

```
#!/bin/sh
SED='/usr/xpg4/bin/sed'
TAR='/usr/bin/tar'
d=$1; shift; mkdir "$d"
for f; do
    "$SED" 's/#.*//' "$f" \
        >"$d/$f"
done
"$TAR" cf "$d.tar" "$d"
```

.in files are templates where @XYZ@ are placeholders for AC_SUBST([XYZ]) definitions. 'config.status' substitutes them.

AC_CONFIG_FILES([script.sh:script.in]) Example

script.in

```
#!/bin/sh
SED='@SED@'
TAR='@TAR@'
d=$1; shift; mkdir "$d"
for f; do
    "$SED" 's/#.*//' "$f" \
        >"$d/$f"
done
"$TAR" cf "$d.tar" "$d"
```

script.sh

```
#!/bin/sh
SED='/usr/xpg4/bin/sed'
TAR='/usr/bin/tar'
d=$1; shift; mkdir "$d"
for f; do
    "$SED" 's/#.*//' "$f" \
        >"$d/$f"
done
"$TAR" cf "$d.tar" "$d"
```

.in files are templates where **@XYZ@** are placeholders for `AC_SUBST([XYZ])` definitions. 'config.status' substitutes them.

*Makefile.in*s also use **@XYZ@** as placeholders but Automake makes all `XYZ=@XYZ@` definitions and you may simply use `$(XYZ)` as needed.

Using Automake

- 5 Hello World
- 6 Introducing Core Autotools
- 7 Hello World Explained
- 8 Using Autoconf**
- 9 Using Automake

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)
 - Do not use Automake if you do not like the GNU Build System:
Automake will get in your way if you don't fit the mold.

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)
 - Do not use Automake if you do not like the GNU Build System:
Automake will get in your way if you don't fit the mold.
- 'automake' creates complex *Makefile.ins* from simple *Makefile.ams*.

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)
 - Do not use Automake if you do not like the GNU Build System:
Automake will get in your way if you don't fit the mold.
- 'automake' creates **complex** *Makefile.ins* from simple *Makefile.ams*.
 - Consider *Makefile.ins* as internal details.

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)
 - Do not use Automake if you do not like the GNU Build System:
Automake will get in your way if you don't fit the mold.
- 'automake' creates complex *Makefile.ins* from simple *Makefile.ams*.
 - Consider *Makefile.ins* as internal details.
- *Makefile.ams* follow roughly the same syntax as *Makefiles* however they usually contains only variable definitions.

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)
 - Do not use Automake if you do not like the GNU Build System:
Automake will get in your way if you don't fit the mold.
- 'automake' creates complex *Makefile.ins* from simple *Makefile.ams*.
 - Consider *Makefile.ins* as internal details.
- *Makefile.ams* follow roughly the same syntax as *Makefiles* however they usually contains only variable definitions.
 - 'automake' creates build rules from these definitions.

Automake Principles

- Automake helps creating portable and GNU-standard compliant *Makefiles*.
 - You may be used to other kinds of build systems.
(E.g., no VPATH builds, but all objects go into *obj/*.)
 - Do not use Automake if you do not like the GNU Build System:
Automake will get in your way if you don't fit the mold.
- 'automake' creates complex *Makefile.ins* from simple *Makefile.ams*.
 - Consider *Makefile.ins* as internal details.
- *Makefile.ams* follow roughly the same syntax as *Makefiles* however they usually contains only variable definitions.
 - 'automake' creates build rules from these definitions.
 - It's OK to add extra *Makefile* rules in *Makefile.am*:
'automake' will preserve them in the output.

Declaring Automake in *configure.ac*

```
AM_INIT_AUTOMAKE([OPTIONS...])
```

Check for tools needed by 'automake'-generated *Makefiles*.

The Structure of a *configure.ac*

configure.ac

```
# Prelude.  
AC_INIT([amhello], [1.0], [bug-report@address])  
AM_INIT_AUTOMAKE([-Wall -Werror foreign])  
  
# Checks for programs.  
  
# Checks for libraries.  
# Checks for header files.  
# Checks for typedefs, structures, and compiler characteristics.  
# Checks for library functions.  
# Output files.  
  
AC_CONFIG_FILES([FILES])  
AC_OUTPUT
```


Declaring Automake in *configure.ac*

`AM_INIT_AUTOMAKE([OPTIONS...])`

Check for tools needed by 'automake'-generated *Makefiles*.

Useful options:

`-Wall` Turn all warnings on.

`-Werror` Report warnings as errors.

`foreign` Relax some GNU standard requirements.

`dist-bzip2` Also create tar.bz2 archives during 'make dist' and 'make distcheck'.

`tar-ustar` Create tar archives using the ustar format.

Declaring Automake in *configure.ac*

`AM_INIT_AUTOMAKE([OPTIONS...])`

Check for tools needed by 'automake'-generated *Makefiles*.

Useful options:

`-Wall` Turn all warnings on.

`-Werror` Report warnings as errors.

`foreign` Relax some GNU standard requirements.

`dist-bzip2` Also create tar.bz2 archives during 'make dist' and 'make distcheck'.

`tar-ustar` Create tar archives using the ustar format.

`AC_CONFIG_FILES(FILES...)`

Automake creates *FILE.in* for each *FILE* that has a *FILE.am*.

`AC_CONFIG_FILES([Makefile sub/Makefile])`

... and write *Makefile.am* and *sub/Makefile.am*.

where_PRIMARY Convention for Declaring Targets

Makefile.am

```
where_PRIMARY = targets ...
```

where_PRIMARY Convention for Declaring Targets

Makefile.am

```
where_PRIMARY = targets ...
```

targets should be built as...

_PROGRAMS

_LIBRARIES

_LTLIBRARIES (Libtool libraries)

_HEADERS

_SCRIPTS

_DATA

where_PRIMARY Convention for Declaring Targets

Makefile.am

where_PRIMARY = **targets** ...

targets should be installed in...

`bin_ $(bindir)`

`lib_ $(libdir)`

...

targets should be built as...

`_PROGRAMS`

`_LIBRARIES`

`_LTLIBRARIES` (Libtool libraries)

`_HEADERS`

`_SCRIPTS`

`_DATA`

Standard File System Hierarchy

Directory variable	Default value
prefix	<i>/usr/local</i>
exec-prefix	prefix
bindir	exec-prefix/ <i>bin</i>
libdir	exec-prefix/ <i>lib</i>
...	
includedir	prefix/ <i>include</i>
datarootdir	prefix/ <i>share</i>
datadir	datarootdir
mandir	datarootdir/ <i>man</i>
infodir	datarootdir/ <i>info</i>
...	

where_PRIMARY Convention for Declaring Targets

Makefile.am

where_PRIMARY = targets ...

targets should be installed in...

bin_ \$(bindir)

lib_ \$(libdir)

...

targets should be built as...

_PROGRAMS

_LIBRARIES

_LTLIBRARIES (Libtool libraries)

_HEADERS

_SCRIPTS

_DATA

where_PRIMARY Convention for Declaring Targets

Makefile.am

where_PRIMARY = **targets** ...

targets should be installed in...

bin_ \$(bindir)

lib_ \$(libdir)

...

custom_ \$(*customdir*)

You define *customdir*.

targets should be built as...

_PROGRAMS

_LIBRARIES

_LTLIBRARIES (Libtool libraries)

_HEADERS

_SCRIPTS

_DATA

where_PRIMARY Convention for Declaring Targets

Makefile.am

```
where_PRIMARY = targets ...
```

targets should be installed in...

bin_ \$(bindir)

lib_ \$(libdir)

...

custom_ \$(customdir)

You define customdir.

noinst_ Not installed.

targets should be built as...

_PROGRAMS

_LIBRARIES

_LTLIBRARIES (Libtool libraries)

_HEADERS

_SCRIPTS

_DATA

where_PRIMARY Convention for Declaring Targets

Makefile.am

```
where_PRIMARY = targets ...
```

targets should be installed in...

bin_ \$(bindir)

lib_ \$(libdir)

...

custom_ \$(customdir)

You define customdir.

noinst_ Not installed.

check_ Built by 'make check'.

targets should be built as...

_PROGRAMS

_LIBRARIES

_LTLIBRARIES (Libtool libraries)

_HEADERS

_SCRIPTS

_DATA

where_PRIMARY Convention for Declaring Targets

Makefile.am

option_where_PRIMARY = **targets** ...

targets should be installed in...

`bin_ $(bindir)`

`lib_ $(libdir)`

...

`custom_ $(customdir)`

You define customdir.

`noinst_` Not installed.

`check_` Built by 'make check'.

targets should be built as...

`_PROGRAMS`

`_LIBRARIES`

`_LTLIBRARIES` (Libtool libraries)

`_HEADERS`

`_SCRIPTS`

`_DATA`

Optionally: `dist_` Distribute **targets** (if not the default)

`nodist_` Don't.

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.
- The sources of each `program` go into `programs_SOURCES`.

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me
foo_SOURCES = foo.c foo.h print.c print.h
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.
- The sources of each **program** go into `programs_SOURCES`.
- Non-alphanumeric characters are mapped to `'_'`.

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.
- The sources of each **program** go into `programs_SOURCES`.
- Non-alphanumeric characters are mapped to `'_'`.
- Automake automatically computes the list of objects to build and link from these files.

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.
- The sources of each **program** go into `programs_SOURCES`.
- Non-alphanumeric characters are mapped to `'_'`.
- Automake automatically computes the list of objects to build and link from these files.
- Header files are not compiled. We list them only so they get distributed (Automake does not distribute files it does not know about).

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.
- The sources of each **program** go into `programs_SOURCES`.
- Non-alphanumeric characters are mapped to `'_'`.
- Automake automatically computes the list of objects to build and link from these files.
- Header files are not compiled. We list them only so they get distributed (Automake does not distribute files it does not know about).
- It's OK to use the same source for two programs.

Declaring Sources

Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- These programs will be installed in `$(bindir)`.
- The sources of each **program** go into `programs_SOURCES`.
- Non-alphanumeric characters are mapped to `'_'`.
- Automake automatically computes the list of objects to build and link from these files.
- Header files are not compiled. We list them only so they get distributed (Automake does not distribute files it does not know about).
- It's OK to use the same source for two programs.
- Compiler and linker are inferred from the extensions.

(Static) Libraries

- Add `AC_PROG_RANLIB` to *configure.ac*.

(Static) Libraries

- Add AC_PROG_RANLIB to *configure.ac*.

Makefile.am

```
lib_LIBRARIES = libfoo.a libbar.a
libfoo_a_SOURCES = foo.c privfoo.h
libbar_a_SOURCES = bar.c privbar.h
include_HEADERS = foo.h bar.h
```

(Static) Libraries

- Add AC_PROG_RANLIB to *configure.ac*.

Makefile.am

```
lib_LIBRARIES = libfoo.a libbar.a
libfoo_a_SOURCES = foo.c privfoo.h
libbar_a_SOURCES = bar.c privbar.h
include_HEADERS = foo.h bar.h
```

- These libraries will be installed in `$(libdir)`.

(Static) Libraries

- Add AC_PROG_RANLIB to *configure.ac*.

Makefile.am

```
lib_LIBRARIES = libfoo.a libbar.a
libfoo_a_SOURCES = foo.c privfoo.h
libbar_a_SOURCES = bar.c privbar.h
include_HEADERS = foo.h bar.h
```

- These libraries will be installed in $\$(libdir)$.
- Library names must match `lib*.a`.

(Static) Libraries

- Add AC_PROG_RANLIB to *configure.ac*.

Makefile.am

```
lib_LIBRARIES = libfoo.a libbar.a
libfoo_a_SOURCES = foo.c privfoo.h
libbar_a_SOURCES = bar.c privbar.h
include_HEADERS = foo.h bar.h
```

- These libraries will be installed in `$(libdir)`.
- Library names must match `lib*.a`.
- Public headers will be installed in `$(includedir)`.

(Static) Libraries

- Add AC_PROG_RANLIB to *configure.ac*.

Makefile.am

```
lib_LIBRARIES = libfoo.a libbar.a
libfoo_a_SOURCES = foo.c privfoo.h
libbar_a_SOURCES = bar.c privbar.h
include_HEADERS = foo.h bar.h
```

- These libraries will be installed in $\$(libdir)$.
- Library names must match $lib*.a$.
- Public headers will be installed in $\$(includedir)$.
- Private headers are not installed, like ordinary sources files.

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must **all** be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must all be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

- 'make' is run at the top-level.
- *Makefile.am* should fix the order in which to recurse directories using the *SUBDIRS* variable.

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must all be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

- 'make' is run at the top-level.
- *Makefile.am* should fix the order in which to recurse directories using the *SUBDIRS* variable.

Makefile.am

```
SUBDIRS = lib src
```

src/Makefile.am

```
SUBDIRS = dira dirb
```

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must all be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

- 'make' is run at the top-level.
- *Makefile.am* should fix the order in which to recurse directories using the *SUBDIRS* variable.

Makefile.am

```
SUBDIRS = lib src
```

src/Makefile.am

```
SUBDIRS = dira dirb
```

- The current directory is implicitly built after subdirectories.

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must all be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

- 'make' is run at the top-level.
- *Makefile.am* should fix the order in which to recurse directories using the *SUBDIRS* variable.

Makefile.am

```
SUBDIRS = lib src
```

- The current directory is implicitly built after subdirectories.
- You can put '.' where you want to override this.

src/Makefile.am

```
SUBDIRS = dira dirb .
```

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must all be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

- 'make' is run at the top-level.
- *Makefile.am* should fix the order in which to recurse directories using the *SUBDIRS* variable.

Makefile.am

```
SUBDIRS = lib src
```

- The current directory is implicitly built after subdirectories.
- You can put '.' where you want to override this.

src/Makefile.am

```
SUBDIRS = dira . dirb
```

Directory Layout

- You may have one *Makefile* (hence one *Makefile.am*) per directory.
- They must all be declared in *configure.ac*.

configure.ac

```
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile  
                 src/dira/Makefile src/dirb/Makefile])
```

- 'make' is run at the top-level.
- *Makefile.am* should fix the order in which to recurse directories using the *SUBDIRS* variable.

Makefile.am

```
SUBDIRS = lib src
```

- The current directory is implicitly built after subdirectories.
- You can put '.' where you want to override this.

src/Makefile.am

```
SUBDIRS = . dira dirb
```


`$(srcdir)` and VPATH Builds

- Remember VPATH builds: a source file is not necessary in the current directory.

Parallel Build Trees (a.k.a. VPATH Builds)

Objects files, programs, and libraries are built where *configure* was run.

```
~ % tar xzf ~/amhello-1.0.tar.gz
~ % cd amhello-1.0
~/amhello-1.0 % mkdir build && cd build
~/amhello-1.0/build % ../configure
~/amhello-1.0/build % make
...
```

Sources files are in *~/amhello-1.0/*,
built files are all in *~/amhello-1.0/build/*.

`$(srcdir)` and VPATH Builds

- Remember VPATH builds: a source file is not necessary in the current directory.
- There are two twin trees: the **build tree**, and the **source tree**.
 - *Makefile* and objects files are in the build tree.
 - *Makefile.in*, *Makefile.am*, and source files are in the source tree.
 - If './configure' is run in the current directory, the two trees are one.

`$(srcdir)` and VPATH Builds

- Remember VPATH builds: a source file is not necessary in the current directory.
- There are two twin trees: the **build tree**, and the **source tree**.
 - *Makefile* and objects files are in the build tree.
 - *Makefile.in*, *Makefile.am*, and source files are in the source tree.
 - If './configure' is run in the current directory, the two trees are one.
- In each *Makefile*, 'config.status' will define `$(srcdir)`: the path to the matching source directory.

`$(srcdir)` and `VPATH` Builds

- Remember `VPATH` builds: a source file is not necessary in the current directory.
- There are two twin trees: the **build tree**, and the **source tree**.
 - `Makefile` and objects files are in the build tree.
 - `Makefile.in`, `Makefile.am`, and source files are in the source tree.
 - If `./configure` is run in the current directory, the two trees are one.
- In each `Makefile`, `'config.status'` will define `$(srcdir)`: the path to the matching source directory.
- When referring to sources files or targets in Automake variables, you do not have to worry about *source* vs. *build*, because `'make'` will check both directories.

\$(srcdir) and VPATH Builds

- Remember VPATH builds: a source file is not necessary in the current directory.
- There are two twin trees: the **build tree**, and the **source tree**.
 - *Makefile* and objects files are in the build tree.
 - *Makefile.in*, *Makefile.am*, and source files are in the source tree.
 - If './configure' is run in the current directory, the two trees are one.
- In each *Makefile*, 'config.status' will define $\$(srcdir)$: the path to the matching source directory.
- When referring to sources files or targets in Automake variables, you do not have to worry about *source* vs. *build*, because 'make' will check both directories.
- You may need $\$(srcdir)$ when specifying flags for tools, or writing custom commands. E.g., to tell the compiler to include headers from *dir/*, you should write `-I$(srcdir)/dir`, not `-Idir`. (`-Idir` would fetch headers from the build tree.)

Convenience Libraries

lib/Makefile.am

```
noinst_LIBRARIES = libcompat.a  
libcompat_a_SOURCES = xalloc.c xalloc.h
```

Convenience Libraries

lib/Makefile.am

```
noinst_LIBRARIES = libcompat.a  
libcompat_a_SOURCES = xalloc.c xalloc.h
```

- This is a convenience library, used only when building the package.

Convenience Libraries

lib/Makefile.am

```
noinst_LIBRARIES = libcompat.a  
libcompat_a_SOURCES = xalloc.c xalloc.h
```

- This is a convenience library, used only when building the package.

src/Makefile.am

```
LDADD = ../lib/libcompat.a  
AM_CPPFLAGS = -I$(srcdir)/../lib  
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

Convenience Libraries

lib/Makefile.am

```
noinst_LIBRARIES = libcompat.a  
libcompat_a_SOURCES = xalloc.c xalloc.h
```

- This is a convenience library, used only when building the package.

src/Makefile.am

```
LDADD = ../lib/libcompat.a  
AM_CPPFLAGS = -I$(srcdir)/../lib  
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- **LDADD** is added when linking all programs.

Convenience Libraries

lib/Makefile.am

```
noinst_LIBRARIES = libcompat.a  
libcompat_a_SOURCES = xalloc.c xalloc.h
```

- This is a convenience library, used only when building the package.

src/Makefile.am

```
LDADD = ../lib/libcompat.a  
AM_CPPFLAGS = -I$(srcdir)/../lib  
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c
```

- **LDADD** is added when linking all programs.
- **AM_CPPFLAGS** contains additional preprocessor flags.

Convenience Libraries

lib/Makefile.am

```
noinst_LIBRARIES = libcompat.a  
libcompat_a_SOURCES = xalloc.c xalloc.h
```

- This is a convenience library, used only when building the package.

src/Makefile.am

```
bin_PROGRAMS = foo run-me  
foo_SOURCES = foo.c foo.h print.c print.h  
run_me_SOURCES = run.c run.h print.c  
run_me_LDADD = ../lib/libcompat.a  
run_me_CPPFLAGS = -I$(srcdir)/../lib
```

- **LDADD** is added when linking all programs.
- **AM_CPPFLAGS** contains additional preprocessor flags.
- You can use per-target variables: they apply to a single program.

Per-Target Flags

Assuming `foo` is a program or library:

`foo_CFLAGS` Additional C compiler flags

`foo_CPPFLAGS` Additional preprocessor flags (`-Is` and `-Ds`)

The default value for `foo_XXXFLAGS` is `$(AM_XXXFLAGS)`.

Per-Target Flags

Assuming `foo` is a program or library:

`foo_CFLAGS` Additional C compiler flags

`foo_CPPFLAGS` Additional preprocessor flags (`-Is` and `-Ds`)

`foo_LDADD` Additional link objects, `-ls` and `-Ls` (if `foo` is a program)

`foo_LIBADD` Additional link objects, `-ls` and `-Ls` (if `foo` is a library)

`foo_LDFLAGS` Additional linker flags

The default value for `foo_XXXFLAGS` is `$(AM_XXXFLAGS)`.

Per-Target Flags

Assuming `foo` is a program or library:

- `foo_CFLAGS` Additional C compiler flags
- `foo_CPPFLAGS` Additional preprocessor flags (`-Is` and `-Ds`)
- `foo_LDADD` Additional link objects, `-ls` and `-Ls` (if `foo` is a program)
- `foo_LIBADD` Additional link objects, `-ls` and `-Ls` (if `foo` is a library)
- `foo_LDFLAGS` Additional linker flags

The default value for `foo_XXXFLAGS` is `$(AM_XXXFLAGS)`.

Use plain file names to refer to libraries inside your package (keep `-ls` and `-Ls` for external libraries only).

src/Makefile.am

```
bin_PROGRAMS = foo run-me
foo_SOURCES = foo.c foo.h print.c print.h
run_me_SOURCES = run.c run.h print.c
run_me_CPPFLAGS = -I$(srcdir)/../lib
run_me_LDADD = ../lib/libcompat.a
```

Checking for Libraries

```
AC_CHECK_LIB(LIBRARY, FUNCT, [ACT-IF-FOUND], [ACT-IF-NOT])
```

Check whether `LIBRARY` exists and contains `FUNCT`.
Execute `ACT-IF-FOUND` if it does, `ACT-IF-NOT` otherwise.

```
AC_CHECK_LIB([efence], [malloc], [EFENCELIB=-leference])  
AC_SUBST([EFENCELIB])
```

... we would later use `$(EFENCELIB)` in the link rule.

Per-Target Flags

Assuming `foo` is a program or library:

- `foo_CFLAGS` Additional C compiler flags
- `foo_CPPFLAGS` Additional preprocessor flags (`-Is` and `-Ds`)
- `foo_LDADD` Additional link objects, `-ls` and `-Ls` (if `foo` is a program)
- `foo_LIBADD` Additional link objects, `-ls` and `-Ls` (if `foo` is a library)
- `foo_LDFLAGS` Additional linker flags

The default value for `foo_XXXFLAGS` is `$(AM_XXXFLAGS)`.

Use plain file names to refer to libraries inside your package (keep `-ls` and `-Ls` for external libraries only).

src/Makefile.am

```
bin_PROGRAMS = foo run-me
foo_SOURCES = foo.c foo.h print.c print.h
run_me_SOURCES = run.c run.h print.c
run_me_CPPFLAGS = -I$(srcdir)/../lib
run_me_LDADD = ../lib/libcompat.a $(EFENCELIB)
```

What Gets Distributed

'make dist' and 'make distcheck' create a tarball containing:

- All sources declared using `..._SOURCES`
- All headers declared using `..._HEADERS`

What Gets Distributed

'make dist' and 'make distcheck' create a tarball containing:

- All sources declared using `..._SOURCES`
- All headers declared using `..._HEADERS`
- All scripts declared with `dist...._SCRIPTS`
- All data files declared with `dist...._DATA`
- ...

What Gets Distributed

'make dist' and 'make distcheck' create a tarball containing:

- All sources declared using `..._SOURCES`
- All headers declared using `..._HEADERS`
- All scripts declared with `dist...._SCRIPTS`
- All data files declared with `dist...._DATA`
- ...
- Common files such as *ChangeLog*, *NEWS*, etc.
See 'automake --help' for a list of those files.

What Gets Distributed

'make dist' and 'make distcheck' create a tarball containing:

- All sources declared using `..._SOURCES`
- All headers declared using `..._HEADERS`
- All scripts declared with `dist...._SCRIPTS`
- All data files declared with `dist...._DATA`
- ...
- Common files such as *ChangeLog*, *NEWS*, etc.
See 'automake --help' for a list of those files.
- Extra files or directories listed into `EXTRA_DIST`.

What Gets Distributed

'make dist' and 'make distcheck' create a tarball containing:

- All sources declared using `..._SOURCES`
- All headers declared using `..._HEADERS`
- All scripts declared with `dist..._SCRIPTS`
- All data files declared with `dist..._DATA`
- ...
- Common files such as *ChangeLog*, *NEWS*, etc.
See 'automake --help' for a list of those files.
- Extra files or directories listed into `EXTRA_DIST`.

Makefile.am

```
SUBDIRS = lib src  
EXTRA_DIST = HACKING
```

... will additionally distribute *HACKING*.

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
  bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```


Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
  bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```

Conditional Sources

```
bin_PROGRAMS = foo
foo_SOURCES = foo.c
if WANT_BAR
  foo_SOURCES += bar.c
endif
```

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
  bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```

- *bar* is built iff *WANT_BAR* is true.

Conditional Sources

```
bin_PROGRAMS = foo
foo_SOURCES = foo.c
if WANT_BAR
  foo_SOURCES += bar.c
endif
```

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
  bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```

Conditional Sources

```
bin_PROGRAMS = foo
foo_SOURCES = foo.c
if WANT_BAR
  foo_SOURCES += bar.c
endif
```

- *bar* is built iff *WANT_BAR* is true.
- *bar.o* is linked in *foo* iff *WANT_BAR* is true.

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
  bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```

Conditional Sources

```
bin_PROGRAMS = foo
foo_SOURCES = foo.c
if WANT_BAR
  foo_SOURCES += bar.c
endif
```

- *bar* is built iff *WANT_BAR* is true.
- *bar.o* is linked in *foo* iff *WANT_BAR* is true.
- In all cases *foo.c* and *bar.c* are distributed regardless of *WANT_BAR*.

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
  bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```

Conditional Sources

```
bin_PROGRAMS = foo
foo_SOURCES = foo.c
if WANT_BAR
  foo_SOURCES += bar.c
endif
```

- *bar* is built iff *WANT_BAR* is true.
- *bar.o* is linked in *foo* iff *WANT_BAR* is true.
- In all cases *foo.c* and *bar.c* are distributed regardless of *WANT_BAR*.
- This is portable. 'config.status' will comment rules of *Makefile.in* that must be disabled.

Conditionals: Usage

- *Conditionals* allow for conditional builds and unconditional distribution.

Conditional Programs

```
bin_PROGRAMS = foo
if WANT_BAR
    bin_PROGRAMS += bar
endif
foo_SOURCES = foo.c
bar_SOURCES = bar.c
```

Conditional Sources

```
bin_PROGRAMS = foo
foo_SOURCES = foo.c
if WANT_BAR
    foo_SOURCES += bar.c
endif
```

- *bar* is built iff *WANT_BAR* is true.
- *bar.o* is linked in *foo* iff *WANT_BAR* is true.
- In all cases *foo.c* and *bar.c* are distributed regardless of *WANT_BAR*.
- This is portable. 'config.status' will comment rules of *Makefile.in* that must be disabled.
- *WANT_BAR* must be declared and valued in *configure.ac*.

Conditionals: Declaration

`AM_CONDITIONAL(NAME, CONDITION)`

Declare conditional `NAME`. `CONDITION` should be a shell instruction that succeeds iff `NAME` should be enabled.

Conditionals: Declaration

`AM_CONDITIONAL(NAME, CONDITION)`

Declare conditional `NAME`. `CONDITION` should be a shell instruction that succeeds iff `NAME` should be enabled.

configure.ac

```
AC_CHECK_HEADER([bar.h], [use_bar=yes])  
AM_CONDITIONAL([WANT_BAR], [test "$use_bar" = yes])
```

Will enable `WANT_BAR` only if `bar.h` is present on the system.

Extending Automake Rules

- The contents of *Makefile.am* is copied almost verbatim to *Makefile.in*.
- 'automake' adds new rules and variables in *Makefile.in*, to achieve the semantics of the special variables you have defined.
- Some minor rewriting is done to handle constructs like conditionals or += portably.

Extending Automake Rules

- The contents of *Makefile.am* is copied almost verbatim to *Makefile.in*.
- 'automake' adds new rules and variables in *Makefile.in*, to achieve the semantics of the special variables you have defined.
- Some minor rewriting is done to handle constructs like conditionals or += portably.
- It's OK to define your own rules in *Makefile.am*.

Extending Automake Rules

- The contents of *Makefile.am* is copied almost verbatim to *Makefile.in*.
- 'automake' adds new rules and variables in *Makefile.in*, to achieve the semantics of the special variables you have defined.
- Some minor rewriting is done to handle constructs like conditionals or += portably.
- It's OK to define your own rules in *Makefile.am*.
 - Helpful maintenance targets ('make style-check')
 - Build idiosyncratic files (generate a *FAQ* from some random source)
 - ...

Extending Automake Rules

- The contents of *Makefile.am* is copied almost verbatim to *Makefile.in*.
- 'automake' adds new rules and variables in *Makefile.in*, to achieve the semantics of the special variables you have defined.
- Some minor rewriting is done to handle constructs like conditionals or += portably.
- It's OK to define your own rules in *Makefile.am*.
 - Helpful maintenance targets ('make style-check')
 - Build idiosyncratic files (generate a *FAQ* from some random source)
 - ...
- It's OK to define variables that are meaningless to Automake.
 - For use in custom rules.

Extending Automake Rules

- The contents of *Makefile.am* is copied almost verbatim to *Makefile.in*.
- 'automake' adds new rules and variables in *Makefile.in*, to achieve the semantics of the special variables you have defined.
- Some minor rewriting is done to handle constructs like conditionals or += portably.
- It's OK to define your own rules in *Makefile.am*.
 - Helpful maintenance targets ('make style-check')
 - Build idiosyncratic files (generate a *FAQ* from some random source)
 - ...
- It's OK to define variables that are meaningless to Automake.
 - For use in custom rules.
- **Beware of conflicts:** your definitions (of variables or rules) will override those of Automake.
 - -Wall will diagnose these.

Recommendations

- Use `-Wall -Werror`.

Recommendations

- Use `-Wall -Werror`.
- Keep Your Setup Simple (KYSS!).
 - You will spend a large part of time debugging your cunning tricks if you try to automatize too much.

Recommendations

- Use `-Wall -Werror`.
- Keep Your Setup Simple (KYSS!).
 - You will spend a large part of time debugging your cunning tricks if you try to automatize too much.
- Do not lie to Automake.
 - Automake can be annoying, but when you lie it gets worse!

Lost? 'autoreconf' is Still Your Friend

If 'make' fails to rebuild configuration files, run 'autoreconf' manually.

```
~/amhello % autoreconf --install
```

Lost? 'autoreconf' is Still Your Friend

If 'make' fails to rebuild configuration files, run 'autoreconf' manually.

```
~/amhello % autoreconf --install
```

If this does not help, try harder.

```
~/amhello % autoreconf --install --force
```

Lost? 'autoreconf' is Still Your Friend

If 'make' fails to rebuild configuration files, run 'autoreconf' manually.

```
~/amhello % autoreconf --install
```

If this does not help, try harder.

```
~/amhello % autoreconf --install --force
```

If this still does not help, try even harder.

```
~/amhello % make -k maintainer-clean  
~/amhello % autoreconf --install --force
```

Do this only when necessary. Each of these commands will cause your package to take longer to reconfigure and recompile.

Part III

More Autotools

- 10 Writing and Managing Custom Macros
 - Writing Autoconf Macros
 - Managing Custom Macros with 'aclocal'
- 11 Libtool
- 12 Gettext
 - Introducing Gettext
 - Internationalizing a Package, Start to Finish
 - Localizing a Package
- 13 Nested Packages
- 14 The End

Writing Autoconf Macros

10 Writing and Managing Custom Macros

- Writing Autoconf Macros
- Managing Custom Macros with 'aclocal'

11 Libtool

12 Gettext

- Introducing Gettext
- Internationalizing a Package, Start to Finish
- Localizing a Package

13 Nested Packages

14 The End

Writing an Autoconf Macro? Why? How?

Two fundamentally different types of new macros:

- Macros that factor related tests in a single reusable entity.
- Macros that implements new tests.

Writing an Autoconf Macro? Why? How?

Two fundamentally different types of new macros:

- Macros that factor related tests in a single reusable entity.
 - High-level.
 - Combination of existing lower-level macros.
 - May not use shell code at all.
- Macros that implements new tests.

Writing an Autoconf Macro? Why? How?

Two fundamentally different types of new macros:

- Macros that factor related tests in a single reusable entity.
 - High-level.
 - Combination of existing lower-level macros.
 - May not use shell code at all.
- Macros that implements new tests.
 - Low-level.
 - Actually code the check.
 - Need to bother with caching values.

Defining Macros

```
AC_DEFUN(MACRO-NAME, MACRO-BODY)
```

Define MACRO-NAME as MACRO-BODY.

Avoid names that may conflict.

Defining Macros

AC_DEFUN(**MACRO-NAME**, **MACRO-BODY**)

Define **MACRO-NAME** as **MACRO-BODY**.

Avoid names that may conflict. Macro name spaces:

m4_ Original M4 macros, plus M4sugar macros.

AS_ M4sh macros (macroized shell constructs)

AH_ **Autoheader** macros

AC_ **Autoconf** macros (written on top of the above layers)

AM_ **Automake** macros

AT_ **Autotest** macros

Defining Macros

AC_DEFUN(**MACRO-NAME**, **MACRO-BODY**)

Define **MACRO-NAME** as **MACRO-BODY**.

Avoid names that may conflict. Macro name spaces:

m4_ Original M4 macros, plus M4sugar macros.

AS_ M4sh macros (macroized shell constructs)

AH_ **Auto**header macros

AC_ **Auto**conf macros (written on top of the above layers)

AC_CHECK_ Generic checks.

AC_FUNC_ Specific function checks.

AC_HEADER_ Specific header checks.

AC_PROG_ Specific program checks.

 ...

AM_ **Auto**make macros

AT_ **Auto**test macros

`mkdir()` Example

- POSIX systems define `mkdir()` with two arguments.
- On Mingw32 (at least), `mkdir()` takes only one argument.
- On Win32 (at least), the name is `_mkdir()` with one argument.

mkdir() Example

- POSIX systems define `mkdir()` with two arguments.
- On Mingw32 (at least), `mkdir()` takes only one argument.
- On Win32 (at least), the name is `_mkdir()` with one argument.

```
#if HAVE_MKDIR
# if MKDIR_ONE_ARG
#   define mkdir(a,b) mkdir(a)
# endif
#else
# if HAVE__MKDIR
#   define mkdir(a,b) _mkdir(a)
# else
#   error "Don't know how to create a directory."
# endif
#endif
```

mkdir() Example

- POSIX systems define `mkdir()` with two arguments.
- On Mingw32 (at least), `mkdir()` takes only one argument.
- On Win32 (at least), the name is `_mkdir()` with one argument.

```
#if HAVE_MKDIR
# if MKDIR_ONE_ARG
#   define mkdir(a,b) mkdir(a)
# endif
#else
# if HAVE__MKDIR
#   define mkdir(a,b) _mkdir(a)
# else
#   error "Don't know how to create a directory."
# endif
#endif
```

Let's write an Autoconf macro to define **these C macros**

Writing a High-Level Macro: AX_FUNC_MKDIR

```
AC_DEFUN([AX_FUNC_MKDIR],  
[AC_CHECK_FUNCS([mkdir _mkdir])  
AC_CHECK_HEADERS([io.h])  
AX_FUNC_MKDIR_ONE_ARG  
)
```

Writing a High-Level Macro: AX_FUNC_MKDIR

```
AC_DEFUN([AX_FUNC_MKDIR],  
[AC_CHECK_FUNCS([mkdir _mkdir])  
AC_CHECK_HEADERS([io.h])  
AX_FUNC_MKDIR_ONE_ARG  
)
```

- Suggested name space for extension macros.

Writing a High-Level Macro: AX_FUNC_MKDIR

```
AC_DEFUN([AX_FUNC_MKDIR],  
[AC_CHECK_FUNCS([mkdir _mkdir])  
AC_CHECK_HEADERS([io.h])  
AX_FUNC_MKDIR_ONE_ARG  
)
```

- Suggested name space for extension macros.
- Use same convention as Autoconf for categorizing macros.

Writing a High-Level Macro: AX_FUNC_MKDIR

```
AC_DEFUN([AX_FUNC_MKDIR],  
[AC_CHECK_FUNCS([mkdir _mkdir])  
AC_CHECK_HEADERS([io.h])  
AX_FUNC_MKDIR_ONE_ARG  
)
```

- Suggested name space for extension macros.
- Use same convention as Autoconf for categorizing macros.
- Defines HAVE_MKDIR and HAVE__MKDIR.

Writing a High-Level Macro: AX_FUNC_MKDIR

```
AC_DEFUN([AX_FUNC_MKDIR],  
[AC_CHECK_FUNCS([mkdir _mkdir])  
AC_CHECK_HEADERS([io.h])  
AX_FUNC_MKDIR_ONE_ARG  
)
```

- Suggested name space for extension macros.
- Use same convention as Autoconf for categorizing macros.
- Defines HAVE_MKDIR and HAVE__MKDIR.
- Defines HAVE_IO_H if *io.h* exists.
(mkdir() may also be defined there, and *sys/stat.h* and *unistd.h* are always tested by AC_PROG_CC)

Writing a High-Level Macro: `AX_FUNC_MKDIR`

```
AC_DEFUN([AX_FUNC_MKDIR],  
[AC_CHECK_FUNCS([mkdir _mkdir])  
AC_CHECK_HEADERS([io.h])  
AX_FUNC_MKDIR_ONE_ARG  
])
```

- Suggested name space for extension macros.
- Use same convention as Autoconf for categorizing macros.
- Defines `HAVE_MKDIR` and `HAVE__MKDIR`.
- Defines `HAVE_IO_H` if *io.h* exists.
(`mkdir()` may also be defined there, and *sys/stat.h* and *unistd.h* are always tested by `AC_PROG_CC`)
- Will define `MKDIR_ONE_ARG...` once written.

Checking mkdir()'s number of arguments

```
# _AX_FUNC_MKDIR_ONE_ARG(IF-ONE-ARG, IF-TWO-ARGS)
# -----
# Execute IF-TWO-ARGS if mkdir() accepts two
# arguments; execute IF-ONE-ARG otherwise.
AC_DEFUN([_AX_FUNC_MKDIR_ONE_ARG],
[AC_TRY_COMPILE([
#include <sys/stat.h>
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
#if HAVE_IO_H
# include <io.h>
#endif
], [mkdir (".", 0700);], [$2], [$1]))]
```

Checking mkdir()'s number of arguments

```
# _AX_FUNC_MKDIR_ONE_ARG(IF-ONE-ARG, IF-TWO-ARGS)
# -----
# Execute IF-TWO-ARGS if mkdir() accepts two
# arguments; execute IF-ONE-ARG otherwise.
AC_DEFUN([_AX_FUNC_MKDIR_ONE_ARG],
[AC_TRY_COMPILE([
#include <sys/stat.h>
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
#if HAVE_IO_H
# include <io.h>
#endif
], [mkdir (".", 0700);], [$2], [$1]))]
```

Comments

Showcase of the traditional style used to document autoconf macros.

Checking mkdir()'s number of arguments

```
# _AX_FUNC_MKDIR_ONE_ARG(IF-ONE-ARG, IF-TWO-ARGS)
# -----
# Execute IF-TWO-ARGS if mkdir() accepts two
# arguments; execute IF-ONE-ARG otherwise.
AC_DEFUN([_AX_FUNC_MKDIR_ONE_ARG],
[AC_TRY_COMPILE([
#include <sys/stat.h>
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
#if HAVE_IO_H
# include <io.h>
#endif
], [mkdir (".", 0700);], [$2], [$1]))]
```

AC_TRY_COMPILE

Creates a small program and attempt to compile it. In our case it will execute one of the `_AX_FUNC_MKDIR_ONE_ARG` arguments depending on whether the program compiled or not.

Checking `mkdir()`'s number of arguments

```
# _AX_FUNC_MKDIR_ONE_ARG(IF-ONE-ARG, IF-TWO-ARGS)
# -----
# Execute IF-TWO-ARGS if mkdir() accepts two
# arguments; execute IF-ONE-ARG otherwise.
AC_DEFUN([_AX_FUNC_MKDIR_ONE_ARG],
[AC_TRY_COMPILE([
#include <sys/stat.h>
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
#if HAVE_IO_H
# include <io.h>
#endif
], [mkdir (".", 0700);], [$2], [$1]))]
```

- Wait! That's not enough for an Autoconf check: we should also add some *checking whether...* message on top of this.

Checking `mkdir()`'s number of arguments

```
# _AX_FUNC_MKDIR_ONE_ARG(IF-ONE-ARG, IF-TWO-ARGS)
# -----
# Execute IF-TWO-ARGS if mkdir() accepts two
# arguments; execute IF-ONE-ARG otherwise.
AC_DEFUN([_AX_FUNC_MKDIR_ONE_ARG],
[AC_TRY_COMPILE([
#include <sys/stat.h>
#if HAVE_UNISTD_H
# include <unistd.h>
#endif
#if HAVE_IO_H
# include <io.h>
#endif
], [mkdir (".", 0700);], [$2], [$1]))
```

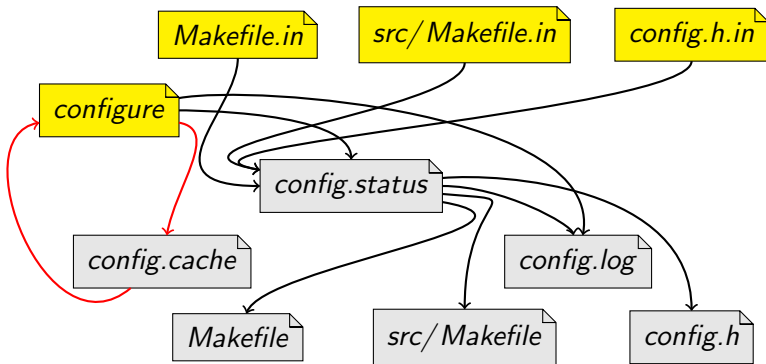
- Wait! That's not enough for an Autoconf check: we should also add some *checking whether...* message on top of this.
- We use the `_AX` prefix for helper macros not meant to be used directly.

Writing a Low-Level Macro

Low-level macros need to

- print a *checking whether...* message
- do the actual check
- cache the result of the check

The (real) *configure* process



'`configure -C`' caches results in `config.cache` to speed up reconfigurations

Writing a Low-Level Macro

Low-level macros need to

- print a *checking whether...* message
- do the actual check
- cache the result of the check

Most of this is achieved via the `AC_CACHE_CHECK` macro.

```
AC_DEFUN(MACRO-NAME,  
[AC_CACHE_CHECK(WHETHER-MESSAGE,  
                CACHE-VARIABLE,  
                CODE-TO-SET-CACHE-VARIABLE)  
CODE-USING-CACHE-VARIABLE])
```

Writing a Low-Level Macro

Low-level macros need to

- print a *checking whether...* message
- do the actual check
- cache the result of the check

Most of this is achieved via the `AC_CACHE_CHECK` macro.

```
AC_DEFUN(MACRO-NAME,  
[AC_CACHE_CHECK(WHETHER-MESSAGE,  
                CACHE-VARIABLE,  
                CODE-TO-SET-CACHE-VARIABLE)  
CODE-USING-CACHE-VARIABLE])
```

- The `CACHE-VARIABLE` should match `*_cv_*`.

Writing a Low-Level Macro

Low-level macros need to

- print a *checking whether...* message
- do the actual check
- cache the result of the check

Most of this is achieved via the `AC_CACHE_CHECK` macro.

```
AC_DEFUN(MACRO-NAME,  
[AC_CACHE_CHECK(WHETHER-MESSAGE,  
                CACHE-VARIABLE,  
                CODE-TO-SET-CACHE-VARIABLE)  
CODE-USING-CACHE-VARIABLE])
```

- The `CACHE-VARIABLE` should match `*_cv_*`.
- `CODE-TO-SET-CACHE-VARIABLE` should contain the check. It will be skipped when the cache is used.

Writing a Low-Level Macro

Low-level macros need to

- print a *checking whether...* message
- do the actual check
- cache the result of the check

Most of this is achieved via the `AC_CACHE_CHECK` macro.

```
AC_DEFUN(MACRO-NAME,  
[AC_CACHE_CHECK(WHETHER-MESSAGE,  
                CACHE-VARIABLE,  
                CODE-TO-SET-CACHE-VARIABLE)  
CODE-USING-CACHE-VARIABLE])
```

- The `CACHE-VARIABLE` should match `*_cv_*`.
- `CODE-TO-SET-CACHE-VARIABLE` should contain the check. It will be skipped when the cache is used.
- `CODE-USING-CACHE-VARIABLE` is always executed, use `AC_SUBST` and `AC_DEFINE` here.

A Low-Level Macro: AX_FUNC_MKDIR_ONE_ARG

```
AC_DEFUN([AX_FUNC_MKDIR_ONE_ARG],
[AC_CACHE_CHECK([whether mkdir takes one argument],
    [ax_cv_mkdir_one_arg],
[_AX_FUNC_MKDIR_ONE_ARG([ax_cv_mkdir_one_arg=yes],
    [ax_cv_mkdir_one_arg=no])])
if test x"$ax_cv_mkdir_one_arg" = xyes; then
    AC_DEFINE([MKDIR_ONE_ARG], 1,
        [Define if mkdir takes only one argument.])
fi]) # AX_FUNC_MKDIR_ONE_ARG
```


A Low-Level Macro: AX_FUNC_MKDIR_ONE_ARG

```
AC_DEFUN([AX_FUNC_MKDIR_ONE_ARG],  
[AC_CACHE_CHECK([whether mkdir takes one argument],  
                [ax_cv_mkdir_one_arg],  
                [_AX_FUNC_MKDIR_ONE_ARG([ax_cv_mkdir_one_arg=yes],  
                                         [ax_cv_mkdir_one_arg=no]))]  
if test x"$ax_cv_mkdir_one_arg" = xyes; then  
    AC_DEFINE([MKDIR_ONE_ARG], 1,  
              [Define if mkdir takes only one argument.])  
fi]) # AX_FUNC_MKDIR_ONE_ARG
```

- AC_CACHE_CHECK

- prints *checking whether mkdir...*
- does the check (unless already done)
- cache the result in `ax_cv_mkdir_one_arg`

A Low-Level Macro: AX_FUNC_MKDIR_ONE_ARG

```
AC_DEFUN([AX_FUNC_MKDIR_ONE_ARG],  
[AC_CACHE_CHECK([whether mkdir takes one argument],  
    [ax_cv_mkdir_one_arg],  
    [_AX_FUNC_MKDIR_ONE_ARG([ax_cv_mkdir_one_arg=yes],  
        [ax_cv_mkdir_one_arg=no])])]  
if test x"$ax_cv_mkdir_one_arg" = xyes; then  
    AC_DEFINE([MKDIR_ONE_ARG], 1,  
        [Define if mkdir takes only one argument.])  
fi]) # AX_FUNC_MKDIR_ONE_ARG
```

- AC_CACHE_CHECK
 - prints *checking whether mkdir...*
 - does the check (unless already done)
 - cache the result in `ax_cv_mkdir_one_arg`
- Keep configuration actions outside AC_CACHE_CHECK: they have to be executed whether the check is run or cached.

Recommendations for Writing Autoconf Macros

- Test for features, not for systems.
 - E.g., check whether `mkdir()` takes one argument, not whether you are compiling for Win32.
 - Your package will be more likely to adapt to untested systems.

Recommendations for Writing Autoconf Macros

- Test for features, not for systems.
 - E.g., check whether `mkdir()` takes one argument, not whether you are compiling for Win32.
 - Your package will be more likely to adapt to untested systems.
- Avoid writing tests that are conditional on previous tests.
 - Have unconditional tests, with conditional actions.
 - E.g., check for `_mkdir()` even if `mkdir()` exists.

Recommendations for Writing Autoconf Macros

- Test for features, not for systems.
 - E.g., check whether `mkdir()` takes one argument, not whether you are compiling for Win32.
 - Your package will be more likely to adapt to untested systems.
- Avoid writing tests that are conditional on previous tests.
 - Have unconditional tests, with conditional actions.
 - E.g., check for `_mkdir()` even if `mkdir()` exists.
- Do not reinvent the wheel.
 - Autoconf comes with a lot of well-tested macros. Use them.

Recommendations for Writing Autoconf Macros

- Test for features, not for systems.
 - E.g., check whether `mkdir()` takes one argument, not whether you are compiling for Win32.
 - Your package will be more likely to adapt to untested systems.
- Avoid writing tests that are conditional on previous tests.
 - Have unconditional tests, with conditional actions.
 - E.g., check for `_mkdir()` even if `mkdir()` exists.
- Do not reinvent the wheel.
 - Autoconf comes with a lot of well-tested macros. Use them.
- Remember to `[quote]`.
- Read the *Portable Shell* section of the Autoconf manual, before writing shell code.

Recommendations for Writing Autoconf Macros

- Test for features, not for systems.
 - E.g., check whether `mkdir()` takes one argument, not whether you are compiling for Win32.
 - Your package will be more likely to adapt to untested systems.
- Avoid writing tests that are conditional on previous tests.
 - Have unconditional tests, with conditional actions.
 - E.g., check for `_mkdir()` even if `mkdir()` exists.
- Do not reinvent the wheel.
 - Autoconf comes with a lot of well-tested macros. Use them.
- Remember to [quote].
- Read the *Portable Shell* section of the Autoconf manual, before writing shell code.
- Test your macros on different systems.
 - Check test results in [config.log](#).
 - Get accounts on foreign systems:
<http://www.testdrive.hp.com/>
<http://sourceforge.net/docs/E02/>

Managing Custom Macros with 'aclocal'

10 Writing and Managing Custom Macros

- Writing Autoconf Macros
- Managing Custom Macros with 'aclocal'

11 Libtool

12 Gettext

- Introducing Gettext
- Internationalizing a Package, Start to Finish
- Localizing a Package

13 Nested Packages

14 The End

aclocal.m4 and Third-Party Macros

- 'autoconf' knows only the macros it provides.
(`m4_*`, `AS_*`, `AH_*`, `AC_*`, `AT_*`).
- 'autoconf' knows nothing about macro supplied by third-party tools
(e.g., Automake's `AM_*` macros).

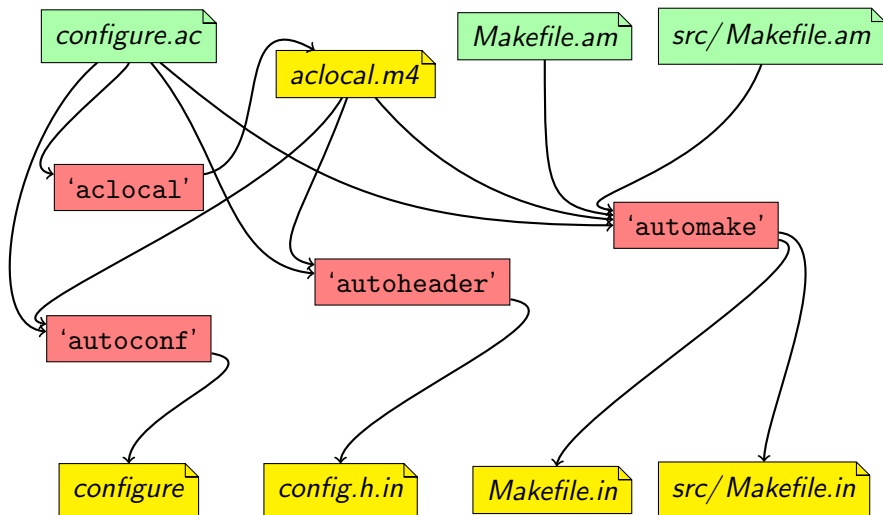
aclocal.m4 and Third-Party Macros

- 'autoconf' knows only the macros it provides. (`m4_*`, `AS_*`, `AH_*`, `AC_*`, `AT_*`).
- 'autoconf' knows nothing about macro supplied by third-party tools (e.g., Automake's `AM_*` macros).
- 'autoconf' reads *aclocal.m4* in addition to *configure.ac*.
- *aclocal.m4* should define the extra macros required by *configure.ac*.

aclocal.m4 and Third-Party Macros

- 'autoconf' knows only the macros it provides. (`m4_*`, `AS_*`, `AH_*`, `AC_*`, `AT_*`).
- 'autoconf' knows nothing about macro supplied by third-party tools (e.g., Automake's `AM_*` macros).
- 'autoconf' reads *aclocal.m4* in addition to *configure.ac*.
- *aclocal.m4* should define the extra macros required by *configure.ac*.
- 'aclocal' automates the construction of *aclocal.m4* from various sources.

Behind 'autoreconf'



aclocal.m4 and Third-Party Macros

- 'autoconf' knows only the macros it provides. (*m4_**, *AS_**, *AH_**, *AC_**, *AT_**).
- 'autoconf' knows nothing about macro supplied by third-party tools (e.g., Automake's *AM_** macros).
- 'autoconf' reads *aclocal.m4* in addition to *configure.ac*.
- *aclocal.m4* should define the extra macros required by *configure.ac*.
- 'aclocal' automates the construction of *aclocal.m4* from various sources.

'aclocal' searches macros in

- directories specified with *-I* options
- a system-wide directory (usually */usr/share/aclocal/*) where third-party packages may install their macros
- Automake's own private macro directory

Managing Custom Macros in Your Package

- Create a `m4/` subdirectory.
- Put your macros there.
E.g., define `AX_FUNC_MKDIR` and `AX_FUNC_MKDIR_ONE_ARG` in `m4/mkdir.m4`.
(The extension *must* be `*.m4`)

Managing Custom Macros in Your Package

- Create a `m4/` subdirectory.
- Put your macros there.
E.g., define `AX_FUNC_MKDIR` and `AX_FUNC_MKDIR_ONE_ARG` in `m4/mkdir.m4`.
(The extension *must* be `*.m4`)
- Add `ACLOCAL_AMFLAGS = -I m4` to the top-level `Makefile.am`.
- Add `AC_CONFIG_MACRO_DIR([m4])` to `configure.ac`. (This is not strictly needed yet, but let's be future-proof.)

The `ACLOCAL_AMFLAGS` are used by 'autoreconf' and by the `Makefile` rebuild rule when they need to run 'aclocal'.

Managing Custom Macros in Your Package

- Create a `m4/` subdirectory.
- Put your macros there.
E.g., define `AX_FUNC_MKDIR` and `AX_FUNC_MKDIR_ONE_ARG` in `m4/mkdir.m4`.
(The extension *must* be `*.m4`)
- Add `ACLOCAL_AMFLAGS = -I m4` to the top-level `Makefile.am`.
- Add `AC_CONFIG_MACRO_DIR([m4])` to `configure.ac`. (This is not strictly needed yet, but let's be future-proof.)
- Use your macros in `configure.ac`.

The `ACLOCAL_AMFLAGS` are used by 'autoreconf' and by the `Makefile` rebuild rule when they need to run 'aclocal'.

Local macros that are used are automatically distributed. (Those that are not used are simply ignored.)

Managing Custom Macros in Your Package

- Create a `m4/` subdirectory.
- Put your macros there.
E.g., define `AX_FUNC_MKDIR` and `AX_FUNC_MKDIR_ONE_ARG` in `m4/mkdir.m4`.
(The extension *must* be `*.m4`)
- Add `ACLOCAL_AMFLAGS = -I m4` to the top-level `Makefile.am`.
- Add `AC_CONFIG_MACRO_DIR([m4])` to `configure.ac`. (This is not strictly needed yet, but let's be future-proof.)
- Use your macros in `configure.ac`.

The `ACLOCAL_AMFLAGS` are used by 'autoreconf' and by the `Makefile` rebuild rule when they need to run 'aclocal'.

Local macros that are used are automatically distributed. (Those that are not used are simply ignored.)

You need such a setup to use Gettext, and the upcoming Libtool 2.0.

Libtool

10 Writing and Managing Custom Macros

- Writing Autoconf Macros
- Managing Custom Macros with 'aclocal'

11 Libtool

12 Gettext

- Introducing Gettext
- Internationalizing a Package, Start to Finish
- Localizing a Package

13 Nested Packages

14 The End

Shared Libraries: A Portability Hell

- Almost each system has its own format of shared library
 - *libhello.so*
 - *libhello.dll*
 - *libhello.sl*
 - *libhello.dylib*
 - ...

Shared Libraries: A Portability Hell

- Almost each system has its own format of shared library
 - *libhello.so*
 - *libhello.dll*
 - *libhello.sl*
 - *libhello.dylib*
 - ...
- Building will require different flags
 - -fPIC, -shared
 - -KPIC, -G
 - -bM:SRE
 - ...

Shared Libraries: A Portability Hell

- Almost each system has its own format of shared library
 - *libhello.so*
 - *libhello.dll*
 - *libhello.sl*
 - *libhello.dylib*
 - ...
- Building will require different flags
 - -fPIC, -shared
 - -KPIC, -G
 - -bM:SRE
 - ...
- Linking against the library may also require specific flags.

Shared Libraries: A Portability Hell

- Almost each system has its own format of shared library
 - *libhello.so*
 - *libhello.dll*
 - *libhello.sl*
 - *libhello.dylib*
 - ...
- Building will require different flags
 - -fPIC, -shared
 - -KPIC, -G
 - -bM:SRE
 - ...
- Linking against the library may also require specific flags.
- There is no way for a developer to keep track of all these details.
 - Quiz: match each of the above example with its OS.

Shared Libraries: A Portability Hell

- Almost each system has its own format of shared library
 - *libhello.so*
 - *libhello.dll*
 - *libhello.sl*
 - *libhello.dylib*
 - ...
- Building will require different flags
 - -fPIC, -shared
 - -KPIC, -G
 - -bM:SRE
 - ...
- Linking against the library may also require specific flags.
- There is no way for a developer to keep track of all these details.
 - Quiz: match each of the above example with its OS.
- Not all systems support shared libraries.

Shared Libraries: Libtool's Solution

- A new library format that abstracts all the others
 - libhello.la (libtool archive)

Shared Libraries: Libtool's Solution

- A new library format that abstracts all the others
 - *libhello.la* (libtool archive)
- A wrapper script for the compiler and linker
 - translates operations involving *libhello.la* into the correct operation for the current system using the real library

Shared Libraries: Libtool's Solution

- A new library format that abstracts all the others
 - *libhello.la* (libtool archive)
- A wrapper script for the compiler and linker
 - translates operations involving *libhello.la* into the correct operation for the current system using the real library
- In a *Makefile.am*, you simply create and link against **.la* files.
- These operations are translated appropriately.

Setting Up Libtool: Roadmap

- Call `AC_PROG_LIBTOOL` in *configure.ac*.

Setting Up Libtool: Roadmap

- Call AC_PROG_LIBTOOL in *configure.ac*.
- Use _LTLIBRARIES to declare libtool archives in *Makefile.am*

Makefile.am

```
lib_LTLIBRARIES = libfoo.la  
libfoo_la_SOURCES = foo.c foo.h etc.c
```

Setting Up Libtool: Roadmap

- Call AC_PROG_LIBTOOL in *configure.ac*.
- Use _LTLIBRARIES to declare libtool archives in *Makefile.am*
- Use _LDADD to link against local libtool archives.

Makefile.am

```
lib_LTLIBRARIES = libfoo.la
libfoo_la_SOURCES = foo.c foo.h etc.c

bin_PROGRAMS = runme
runme_SOURCES = main.c
runme_LDADD = libfoo.la
```

Hello World Using Libtool: C Files

lib/say.c

```
#include <config.h>
#include <stdio.h>

void say_hello (void)
{
    puts ("Hello World!");
    puts ("This is " PACKAGE_STRING ".");
}
```

lib/say.h

```
void say_hello (void);
```

src/main.c

```
#include "say.h"

int main (void)
{
    say_hello ();
    return 0;
}
```

Hello World Using Libtool: *Makefile.ams*

lib/Makefile.am

```
lib_LTLIBRARIES = libhello.la  
libhello_la_SOURCES = say.c say.h
```

src/Makefile.am

```
AM_CPPFLAGS = -I$(srcdir)/../lib  
bin_PROGRAMS = hello  
hello_SOURCES = main.c  
hello_LDADD = ../lib/libhello.la
```

Makefile.am

```
SUBDIRS = lib src
```

Hello World Using Libtool: *configure.ac*

configure.ac

```
AC_INIT([amhello], [2.0], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_LIBTOOL
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile lib/Makefile src/Makefile])
AC_OUTPUT
```


Hello World Using Libtool: 'autoreconf'

```
~/amhello % ls -R
```

Hello World Using Libtool: 'autoreconf'

```
~/amhello % ls -R
.:
Makefile.am  configure.ac  lib/  src/

./lib:
Makefile.am  say.c  say.h

./src:
Makefile.am  main.c
```

Hello World Using Libtool: 'autoreconf'

```
~/amhello % autoreconf --install
```

Hello World Using Libtool: 'autoreconf'

```
~/amhello % autoreconf --install
```

```
Putting files in AC_CONFIG_AUX_DIR, 'build-aux'.
```

```
configure.ac: installing 'build-aux/install-sh'
```

```
configure.ac: installing 'build-aux/missing'
```

```
lib/Makefile.am: installing 'build-aux/depcomp'
```

```
~/amhello %
```

Hello World Using Libtool: 'autoreconf'

```
~/amhello % autoreconf --install  
Putting files in AC_CONFIG_AUX_DIR, 'build-aux'.  
configure.ac: installing 'build-aux/install-sh'  
configure.ac: installing 'build-aux/missing'  
lib/Makefile.am: installing 'build-aux/depcomp'  
~/amhello % ./configure --prefix ~/test  
...  
~/amhello %
```

Hello World Using Libtool: 'autoreconf'

```
~/amhello % autoreconf --install
Putting files in AC_CONFIG_AUX_DIR, 'build-aux'.
configure.ac: installing 'build-aux/install-sh'
configure.ac: installing 'build-aux/missing'
lib/Makefile.am: installing 'build-aux/depcomp'
~/amhello % ./configure --prefix ~/test
...
~/amhello % make make install
...
~/amhello %
```

Hello World Using Libtool: 'autoreconf'

```
~/amhello % autoreconf --install
Putting files in AC_CONFIG_AUX_DIR, 'build-aux'.
configure.ac: installing 'build-aux/install-sh'
configure.ac: installing 'build-aux/missing'
lib/Makefile.am: installing 'build-aux/depcomp'
~/amhello % ./configure --prefix ~/test
...
~/amhello % make && make install
...
~/amhello % ~/test/bin/hello
Hello World!
This is amhello 2.0.
~/amhello %
```

What Was Built and Installed

```
~/amhello % ls -R ~/test
/home/adl/test:
bin/  lib/
/home/adl/test/bin:
hello*
/home/adl/test/lib:
libhello.a      libhello.so@    libhello.so.0.0.0*
libhello.la*    libhello.so.0@
~/amhello %
```


What Was Built and Installed

```
~/amhello % ls -R ~/test
/home/adl/test:
bin/  lib/
/home/adl/test/bin:
hello*
/home/adl/test/lib:
libhello.a      libhello.so@      libhello.so.0.0.0*
libhello.la*    libhello.so.0@
~/amhello % ldd ~/test/bin/hello
libhello.so.0 => /home/adl/test/lib/libhello.so.0 (0xb7fe7000)
libc.so.6 => /lib/tls/libc.so.6 (0xb7e9c000)
lib/ld-linux.so.2 => /lib/ld-linux.so.2 (0xb7fea000)
~/amhello %
```

What Was Built and Installed

```
~/amhello % ls -R ~/test
/home/adl/test:
bin/  lib/
/home/adl/test/bin:
hello*
/home/adl/test/lib:
libhello.a      libhello.so@      libhello.so.0.0.0*
libhello.la*    libhello.so.0@
~/amhello % ldd ~/test/bin/hello
libhello.so.0 => /home/adl/test/lib/libhello.so.0 (0xb7fe7000)
libc.so.6 => /lib/tls/libc.so.6 (0xb7e9c000)
lib/ld-linux.so.2 => /lib/ld-linux.so.2 (0xb7fea000)
~/amhello % ldd src/hello
not a dynamic executable
~/amhello %
```

What Was Built and Installed

```
~/amhello % ls -R ~/test
/home/adl/test:
bin/  lib/
/home/adl/test/bin:
hello*
/home/adl/test/lib:
libhello.a      libhello.so@    libhello.so.0.0.0*
libhello.la*    libhello.so.0@
~/amhello % ldd ~/test/bin/hello
libhello.so.0 => /home/adl/test/lib/libhello.so.0 (0xb7fe7000)
libc.so.6 => /lib/tls/libc.so.6 (0xb7e9c000)
lib/ld-linux.so.2 => /lib/ld-linux.so.2 (0xb7fea000)
~/amhello % ldd src/hello
not a dynamic executable
~/amhello % file src/hello
src/hello: Bourne shell script text executable
```

Building Shared or Static Libraries

- By default, both static and shared libraries are built.
- This default can be changed in a package using two macros:
`AC_DISABLE_SHARED` do not build shared libraries by default
`AC_DISABLE_STATIC` do not build static libraries by default

Building Shared or Static Libraries

- By default, both static and shared libraries are built.
- This default can be changed in a package using two macros:
`AC_DISABLE_SHARED` do not build shared libraries by default
`AC_DISABLE_STATIC` do not build static libraries by default
- The installer can override these settings using *configure* options.
 - `--enable-shared` build shared libraries
 - `--disable-shared` don't
 - `--enable-static` build static libraries
 - `--disable-static` don't

Building Shared or Static Libraries

- By default, both static and shared libraries are built.
- This default can be changed in a package using two macros:
`AC_DISABLE_SHARED` do not build shared libraries by default
`AC_DISABLE_STATIC` do not build static libraries by default
- The installer can override these settings using *configure* options.
 - `--enable-shared` build shared libraries
 - `--disable-shared` don't
 - `--enable-static` build static libraries
 - `--disable-static` don't
- At least one flavor is built, always.
- Some systems don't leave any choice.

The *src/hello* Wrapper Script

- *src/hello* can be a wrapper script
 - Depending on Libtool's configuration.

The *src/hello* Wrapper Script

- *src/hello* can be a wrapper script
 - Depending on Libtool's configuration.
- The real binary has been built elsewhere
 - Libtool hides it in the build tree (don't bother about it)

The *src/hello* Wrapper Script

- *src/hello* can be a wrapper script
 - Depending on Libtool's configuration.
- The real binary has been built elsewhere
 - Libtool hides it in the build tree (don't bother about it)
- This wrapper script runs the real binary, and arranges so it finds the not-yet-installed libraries
 - This way *src/hello* can be run, for instance in a test suite

The *src/hello* Wrapper Script

- *src/hello* can be a wrapper script
 - Depending on Libtool's configuration.
- The real binary has been built elsewhere
 - Libtool hides it in the build tree (don't bother about it)
- This wrapper script runs the real binary, and arranges so it finds the not-yet-installed libraries
 - This way *src/hello* can be run, for instance in a test suite

Do not debug the shell script!

```
~/amhello % gdb -q src/hello  
"src/hello": not in executable format: File format not recognized  
(gdb)
```

The *src/hello* Wrapper Script

- *src/hello* can be a wrapper script
 - Depending on Libtool's configuration.
- The real binary has been built elsewhere
 - Libtool hides it in the build tree (don't bother about it)
- This wrapper script runs the real binary, and arranges so it finds the not-yet-installed libraries
 - This way *src/hello* can be run, for instance in a test suite

Do not debug the shell script!

```
~/amhello % gdb -q src/hello  
"src/hello": not in executable format: File format not recognized  
(gdb)
```

Prefix such commands with *libtool --mode=execute*

```
~/amhello % libtool --mode=execute gdb -q src/hello
```

Versioning Libtool Libraries: Interfaces

- Versioning libraries allow several versions to coexist.
- It ensures programs use the library that implements the interface they require.

Interface = public variables and functions, I/O, formats, protocols, ...

Versioning Libtool Libraries: Interfaces

- Versioning libraries allow several versions to coexist.
- It ensures programs use the library that implements the interface they require.

Interface = public variables and functions, I/O, formats, protocols, ...

- Interfaces are identified using integers.
- A program remembers the interface numbers of the libraries it was linked against.

Versioning Libtool Libraries: Interfaces

- Versioning libraries allow several versions to coexist.
- It ensures programs use the library that implements the interface they require.

Interface = public variables and functions, I/O, formats, protocols, ...

- Interfaces are identified using integers.
- A program remembers the interface numbers of the libraries it was linked against.
- A library can implement several interfaces.
 - E.g., adding new functions changes the interface, but does not break old interfaces.
- Hence libtool's versioning format encodes **a range of supported interfaces**.

Versioning Libtool Libraries: Interfaces

- Versioning libraries allow several versions to coexist.
- It ensures programs use the library that implements the interface they require.

Interface = public variables and functions, I/O, formats, protocols, ...

- Interfaces are identified using integers.
- A program remembers the interface numbers of the libraries it was linked against.
- A library can implement several interfaces.
 - E.g., adding new functions changes the interface, but does not break old interfaces.
- Hence libtool's versioning format encodes a range of supported interfaces.

Interface numbers are not release numbers.

Versioning Libtool Libraries: Version Triplets

CURRENT The latest interface implemented.

REVISION The implementation number of **CURRENT**
(read: number of bugs fixed...)

AGE The number of interfaces implemented, minus one.
The library supports all interfaces between **CURRENT** – **AGE**
and **CURRENT**.

Versioning Libtool Libraries: Version Triplets

CURRENT The latest interface implemented.

REVISION The implementation number of **CURRENT**
(read: number of bugs fixed...)

AGE The number of interfaces implemented, minus one.
The library supports all interfaces between **CURRENT** – **AGE**
and **CURRENT**.

These numbers should be specified using `-version-info`.

lib/Makefile.am

```
lib_LTLIBRARIES = libhello.la
libhello_la_SOURCES = say.c say.h
libhello_la_LDFLAGS = -version-info CURRENT:REVISION:AGE
```

Versioning Libtool Libraries: Version Triplets

CURRENT The latest interface implemented.

REVISION The implementation number of **CURRENT**
(read: number of bugs fixed...)

AGE The number of interfaces implemented, minus one.
The library supports all interfaces between **CURRENT** – **AGE**
and **CURRENT**.

These numbers should be specified using `-version-info`.

lib/Makefile.am

```
lib_LTLIBRARIES = libhello.la
libhello_la_SOURCES = say.c say.h
libhello_la_LDFLAGS = -version-info 0:0:0
```

The default version is 0:0:0. It's also a good initial version.

Versioning Libtool Libraries: Bumping Versions

Remember to bump library versions before a release.

Suppose the old version was **CURRENT** **REVISION** **AGE**.

If you have	bump the version to
not changed the interface (bug fixes)	CURRENT : REVISION + 1 : AGE
augmented the interface (new functions)	CURRENT + 1 : 0 : AGE + 1
broken old interface (e.g. removed functions)	CURRENT + 1 : 0 : 0

Introducing Gettext

10 Writing and Managing Custom Macros

- Writing Autoconf Macros
- Managing Custom Macros with 'aclocal'

11 Libtool

12 Gettext

- Introducing Gettext
- Internationalizing a Package, Start to Finish
- Localizing a Package

13 Nested Packages

14 The End

Introducing Gettext

- Internationalization

- Localization

Introducing Gettext

- Internationalization

Changing a program to support for multiple languages and cultural habits.

- Localization

Introducing Gettext

- Internationalization

Changing a program to support for multiple languages and cultural habits.

- Localization

Providing an internationalized package the necessary bits to support one's native language and cultural habits.

Introducing Gettext

- **Internationalization** = I18n

Changing a program to support for multiple languages and cultural habits.

- **Localization** = L10n

Providing an internationalized package the necessary bits to support one's native language and cultural habits.

Introducing Gettext

- Internationalization = I18n

Changing a program to support for multiple languages and cultural habits.

- Character handling (unicode...)
- Locale awareness (date formats, currencies, numbers, time zones, etc.)
- Localizability
 - Isolate localizable items (messages, pictures, etc.)
 - Implement infrastructure necessary for localizing above items.

- Localization = L10n

Providing an internationalized package the necessary bits to support one's native language and cultural habits.

Introducing Gettext

- Internationalization = I18n

Changing a program to support for multiple languages and cultural habits.

- Character handling (unicode...)
- Locale awareness (date formats, currencies, numbers, time zones, etc.)
- Localizability
 - Isolate localizable items (messages, pictures, etc.)
 - Implement infrastructure necessary for localizing above items.

- Localization = L10n

Providing an internationalized package the necessary bits to support one's native language and cultural habits.

- Translate localizable items (messages, pictures, etc.) for one language.

Introducing Gettext

- Internationalization = I18n

Changing a program to support for multiple languages and cultural habits.

- Character handling (unicode...)
- Locale awareness (date formats, currencies, numbers, time zones, etc.)
- Localizability
 - Isolate localizable items (messages, pictures, etc.)
 - Implement infrastructure necessary for localizing above items.

The programmer's work.

- Localization = L10n

Providing an internationalized package the necessary bits to support one's native language and cultural habits.

- Translate localizable items (messages, pictures, etc.) for one language.

The translator's work.

Introducing Gettext

- Internationalization = I18n

Changing a program to support for multiple languages and cultural habits.

- Character handling (unicode...)
- Locale awareness (date formats, currencies, numbers, time zones, etc.)
- **Localizability**
 - **Isolate localizable items** (messages, pictures, etc.)
 - **Implement infrastructure necessary for localizing above items.**

The programmer's work.

- Localization = L10n

Providing an internationalized package the necessary bits to support one's native language and cultural habits.

- Translate localizable items (messages, pictures, etc.) for one language.

The translator's work.

Gettext = complete toolset for translating messages output by programs.

Translating Messages Made Easy

```
#include <config.h>
#include <stdio.h>

void say_hello (void)
{
    puts ("Hello World!");
    puts ("This is " PACKAGE_STRING ".");
}
```

- The program is written in English.

Translating Messages Made Easy

```
#include <config.h>
#include <stdio.h>
#include "gettext.h"
#define _(string) gettext (string)
void say_hello (void)
{
    puts (_("Hello World!"));
    printf (_("This is %s.\n"), PACKAGE_STRING);
}
```

- The program is written in English.
- Messages that must be translated are marked with `_(...)`.
 - 'xgettext' builds catalogs of translatable messages from such strings.
 - Translators will provide translated catalogs for their locale.

Translating Messages Made Easy

```
#include <config.h>
#include <stdio.h>
#include "gettext.h"
#define _(string) gettext (string)
void say_hello (void)
{
    puts (_("Hello World!"));
    printf (_("This is %s.\n"), PACKAGE_STRING);
}
```

- The program is written in English.
- Messages that must be translated are marked with `_(...)`.
 - 'xgettext' builds catalogs of translatable messages from such strings.
 - Translators will provide translated catalogs for their locale.
- **gettext** looks up the translation of the English message in the current locale's catalog.

Internationalizing a Package, Start to Finish

10 Writing and Managing Custom Macros

- Writing Autoconf Macros
- Managing Custom Macros with 'aclocal'

11 Libtool

12 Gettext

- Introducing Gettext
- Internationalizing a Package, Start to Finish
- Localizing a Package

13 Nested Packages

14 The End

Internationalizing a Package, Start to Finish

Roadmap:

- 1 Start with a non-internationalized Hello World.
- 2 Invoke `AM_GNU_GETTEXT` from *configure.ac*
- 3 Run 'gettextize' to provide the basic infrastructure.
- 4 Fill in the configuration files left by 'gettextize'.
- 5 Update *src/Makefile.am* to link *hello* with the necessary library.
- 6 Update the code:
 - Initialize Gettext in `main()`
 - Mark translatable strings.
- 7 Generate messages catalogs automatically.

We'll talk about localization once this is done.

Non Internationalized Hello World (1/2)

src/main.c

```
#include "say.h"

int
main (void)
{
    say_hello ();
    return 0;
}
```

src/say.h

```
#ifndef AMHELLO_SAY_H
# define AMHELLO_SAY_H
void say_hello (void);
#endif
```

src/say.c

```
#include <config.h>
#include <stdio.h>

void say_hello (void)
{
    puts ("Hello World!");
    puts ("This is " PACKAGE_STRING ".");
}
```

Non Internationalized Hello World (2/2)

configure.ac

```
AC_INIT([amhello], [3.0], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

Makefile.am

```
SUBDIRS = src
```

src/Makefile.am

```
bin_PROGRAMS = hello
hello_SOURCES = main.c say.c say.h
```

Update *configure.ac* for Gettext

configure.ac

```
AC_INIT([amhello], [3.0], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AM_GNU_GETTEXT([external])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

Update *configure.ac* for Gettext

configure.ac

```
AC_INIT([amhello], [3.0], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AM_GNU_GETTEXT([external])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

- `AM_GNU_GETTEXT_VERSION` = *exactly* which Gettext version to use.

Update *configure.ac* for Gettext

configure.ac

```
AC_INIT([amhello], [3.0], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AM_GNU_GETTEXT([external])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile])
AC_OUTPUT
```

- `AM_GNU_GETTEXT_VERSION` = *exactly* which Gettext version to use.
- `AM_GNU_GETTEXT([external])`
 - the GNU libc or an external (= not distributed) Gettext library will be used if found
 - NLS (Native Language System) will be disabled otherwise

Running 'gettextize'

You should run 'gettextize':

- A first time, to install the Gettext infrastructure in your package.
- Each time you upgrade Gettext to a new version.

```
~/amhello %
```

Running 'gettextize'

You should run 'gettextize':

- A first time, to install the Gettext infrastructure in your package.
- Each time you upgrade Gettext to a new version.

```
~/amhello % gettextize --copy --no-changelog  
[...]  
~/amhello %
```

- Install most of the Gettext infrastructure.

Running 'gettextize'

You should run 'gettextize':

- A first time, to install the Gettext infrastructure in your package.
- Each time you upgrade Gettext to a new version.

```
~/amhello % gettextize --copy --no-changelog  
[...]  
~/amhello % cp /usr/share/gettext/gettext.h src
```

- Install most of the Gettext infrastructure.
- Copy *gettext.h* in the source tree, it will be distributed.

Gettextize Updated Some Files

configure.ac

```
AC_INIT([amhello], [3.0], [bug-report@address])
AC_CONFIG_AUX_DIR([build-aux])
AM_GNU_GETTEXT([external])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_FILES([Makefile src/Makefile po/Makefile.in])
AC_OUTPUT
```

Makefile.am

```
SUBDIRS = po src
ACLOCAL_AMFLAGS = -I m4
EXTRA_DIST = ...
```

src/Makefile.am

```
bin_PROGRAMS = hello
hello_SOURCES = main.c say.c say.h
```

po/Makevars and *po/POTFILES.in*

Fill *po/Makevars.template* and rename it as *po/Makevars*:

po/Makevars

```
DOMAIN = $(PACKAGE)
subdir = po
top_builddir = ..
XGETTEXT_OPTIONS = --keyword=_ --keyword=N_
COPYRIGHT HOLDER = Your Name or Your Employer
MSGID_BUGS_ADDRESS = $(PACKAGE_BUGREPORT)
EXTRA_LOCALE_CATEGORIES =
```

po/Makevars and *po/POTFILES.in*

Fill *po/Makevars.template* and rename it as *po/Makevars*:

po/Makevars

```
DOMAIN = $(PACKAGE)
subdir = po
top_builddir = ..
XGETTEXT_OPTIONS = --keyword=_ --keyword=N_
COPYRIGHT HOLDER = Your Name or Your Employer
MSGID_BUGS_ADDRESS = $(PACKAGE_BUGREPORT)
EXTRA_LOCALE_CATEGORIES =
```

\$(PACKAGE_BUGREPORT) is the third argument of AC_INIT. Some packages use a mailing list dedicated to translation issues instead.

po/Makevars and *po/POTFILES.in*

Fill *po/Makevars.template* and rename it as *po/Makevars*:

po/Makevars

```
DOMAIN = $(PACKAGE)
subdir = po
top_builddir = ..
XGETTEXT_OPTIONS = --keyword=_ --keyword=N_
COPYRIGHT HOLDER = Your Name or Your Employer
MSGID_BUGS_ADDRESS = $(PACKAGE_BUGREPORT)
EXTRA_LOCALE_CATEGORIES =
```

List source files that (may) contain translatable strings in *POTFILES.in*.

po/POTFILES.in

```
src/main.c
src/say.c
```

What's Next?

Done:

- ① Start with a non-internationalized Hello World.
- ② Invoke `AM_GNU_GETTEXT` from *configure.ac*
- ③ Run 'gettextize' to provide the basic infrastructure.
- ④ Fill in the configuration files left by 'gettextize'.

Now, 'autoreconf --install; ./configure; make' should work.

What's Next?

Done:

- 1 Start with a non-internationalized Hello World.
- 2 Invoke `AM_GNU_GETTEXT` from *configure.ac*
- 3 Run 'gettextize' to provide the basic infrastructure.
- 4 Fill in the configuration files left by 'gettextize'.

Now, 'autoreconf --install; ./configure; make' should work.

To do:

- 5 Update *src/Makefile.am* to link *hello* with the necessary library.
- 6 Update the code:
 - Initialize Gettext in `main()`
 - Mark translatable strings.
- 7 Generate messages catalogs automatically.

Updating *src/Makefile.am*

src/Makefile.am

```
bin_PROGRAMS = hello  
hello_SOURCES = main.c say.c say.h
```


Updating *src/Makefile.am*

src/Makefile.am

```
bin_PROGRAMS = hello
hello_SOURCES = main.c say.c say.h
hello_LDADD = $(LIBINTL)
```

- `$(LIBINTL)` lists the libraries any internationalized program should be linked against.

Updating *src/Makefile.am*

src/Makefile.am

```
bin_PROGRAMS = hello
hello_SOURCES = main.c say.c say.h
LDADD = $(LIBINTL)
```

- `$(LIBINTL)` lists the libraries any internationalized program should be linked against.
- We can strip the leading `hello_` and use the global `LDADD` instead.

Updating *src/Makefile.am*

src/Makefile.am

```
bin_PROGRAMS = hello
hello_SOURCES = main.c say.c say.h gettext.h
LDADD = $(LIBINTL)
```

- `$(LIBINTL)` lists the libraries any internationalized program should be linked against.
- We can strip the leading `hello_` and use the global `LDADD` instead.
- Mention *gettext.h* (we will use it shortly) so it is distributed.

Updating *src/Makefile.am*

src/Makefile.am

```
AM_CPPFLAGS = -DLOCALEDIR=\"$(localedir)\"  
bin_PROGRAMS = hello  
hello_SOURCES = main.c say.c say.h gettext.h  
LDADD = $(LIBINTL)
```

- `$(LIBINTL)` lists the libraries any internationalized program should be linked against.
- We can strip the leading `hello_` and use the global `LDADD` instead.
- Mention [*gettext.h*](#) (we will use it shortly) so it is distributed.
- `$(LOCALEDIR)` is the place where message catalogs are installed. This is needed during initialization.

Initializing Gettext

src/main.c

```
#include "say.h"
int
main (void)
{

    say_hello();
    return 0;
}
```

Initializing Gettext

src/main.c

```
#include <locale.h>

#include "say.h"
int
main (void)
{
    setlocale (LC_ALL, "");

    say_hello();
    return 0;
}
```

- Initialize the locale as specified in the environment.
(E.g., the user sets LANG=fr_FR in the environment to get French messages.)

Initializing Gettext

src/main.c

```
#include <config.h>
#include <locale.h>
#include "gettext.h"
#include "say.h"
int
main (void)
{
    setlocale (LC_ALL, "");
    bindtextdomain (PACKAGE,
                   LOCALEDIR);
    textdomain (PACKAGE);
    say_hello();
    return 0;
}
```

- Initialize the locale as specified in the environment.
(E.g., the user sets LANG=fr_FR in the environment to get French messages.)
- Tell Gettext where to find message catalogs for this program.
(All programs in the same package usually share the same message catalog.)

Marking Strings for Translation

src/say.c

```
#include <config.h>
#include <stdio.h>

void say_hello (void)
{
    puts ("Hello World!");
    puts ("This is " PACKAGE_STRING ".");
}
```


Marking Strings for Translation

src/say.c

```
#include <config.h>
#include <stdio.h>
#include "gettext.h"
#define _(string) gettext (string)
void say_hello (void)
{
    puts (_("Hello World!"));
    printf (_("This is %s.\n"), PACKAGE_STRING);
}
```

- Messages that must be translated are marked with `_(...)`.

Marking Strings for Translation

src/say.c

```
#include <config.h>
#include <stdio.h>
#include "gettext.h"
#define _(string) gettext (string)
void say_hello (void)
{
    puts (_("Hello World!"));
    printf (_("This is %s.\n"), PACKAGE_STRING);
}
```

- Messages that must be translated are marked with `_(...)`.
- NLS (Native Language System) can be disabled.
 - Explicitly with `./configure --disable-nls`
 - Implicitly if no gettext implementation is installed.

Then [gettext.h](#) defines `gettext()`, `textdomain()`, ..., as no-ops.

Building the Whole Shebang

Our Hello World is now internationalized.

```
~/amhello % autoreconf --install  
...  
~/amhello % ./configure  
...  
~/amhello % make  
...
```

Building the Whole Shebang

Our Hello World is now internationalized.

```
~/amhello % autoreconf --install
...
~/amhello % ./configure
...
~/amhello % make
...
Making all in po
make amhello.pot-update
...
```

The *po/* directory contains messages catalogs.

po/amhello.pot is the template message catalog.

Updating *po/amhello.pot* is costly and occurs only before releases (e.g., during 'make distcheck') or if the file did not exist (our case above).

It can be updated explicitly with 'cd po; make update-po'.

Localizing a Package

10 Writing and Managing Custom Macros

- Writing Autoconf Macros
- Managing Custom Macros with 'aclocal'

11 Libtool

12 Gettext

- Introducing Gettext
- Internationalizing a Package, Start to Finish
- Localizing a Package

13 Nested Packages

14 The End

po/amhello.pot: The PO Template File

```
# ... COMMENTS ...
#, fuzzy
msgid ""
msgstr ""
"Project-Id-Version: PACKAGE VERSION\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: YEAR-MO-DA HO:MI+ZONE\n"
"Last-Translator: FULL NAME <EMAIL@ADDRESS>\n"
"Language-Team: LANGUAGE <LL@li.org>\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=CHARSET\n"
"Content-Transfer-Encoding: 8bit\n"

#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

po/amhello.pot: The PO Template File

```
# ... COMMENTS ...
#, fuzzy
msgid ""
msgstr ""
"Project-Id-Version: PACKAGE VERSION\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: YEAR-MO-DA HO:MI+ZONE\n"
"Last-Translator: FULL NAME <EMAIL@ADDRESS>\n"
"Language-Team: LANGUAGE <LL@li.org>\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=CHARSET\n"
"Content-Transfer-Encoding: 8bit\n"
```

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""
```

```
#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

po/amhello.pot: List of Messages

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```


po/amhello.pot: List of Messages

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

- msgids identify all strings in the package

po/amhello.pot: List of Messages

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

- msgids identify all strings in the package
- empty msgstrs are placeholders for translations

po/amhello.pot: List of Messages

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

- `msgid`s identify all strings in the package
- empty `msgstr`s are placeholders for translations
- the location of each string is shown, so the translator can check the context if needed

po/amhello.pot: List of Messages

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

- msgids identify all strings in the package
- empty msgstrs are placeholders for translations
- the location of each string is shown, so the translator can check the context if needed
- additional flags can be used

po/amhello.pot: The PO Template File

```
# ... COMMENTS ...
#, fuzzy
msgid ""
msgstr ""
"Project-Id-Version: PACKAGE VERSION\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: YEAR-MO-DA HO:MI+ZONE\n"
"Last-Translator: FULL NAME <EMAIL@ADDRESS>\n"
"Language-Team: LANGUAGE <LL@li.org>\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=CHARSET\n"
"Content-Transfer-Encoding: 8bit\n"
```

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""
```

```
#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

po/amhello.pot: The PO Template File

```
# ... COMMENTS ...
#, fuzzy
msgid ""
msgstr ""
"Project-Id-Version: PACKAGE VERSION\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: YEAR-MO-DA HO:MI+ZONE\n"
"Last-Translator: FULL NAME <EMAIL@ADDRESS>\n"
"Language-Team: LANGUAGE <LL@li.org>\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=CHARSET\n"
"Content-Transfer-Encoding: 8bit\n"

#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

po/amhello.pot: The Header Entry

```
msgid ""  
msgstr ""  
"Project-Id-Version: PACKAGE VERSION\n"  
"Report-Msgid-Bugs-To: bug-report@address\n"  
"POT-Creation-Date: 2005-03-05 00:27+0100\n"  
"PO-Revision-Date: YEAR-MO-DA HO:MI+ZONE\n"  
"Last-Translator: FULL NAME <EMAIL@ADDRESS>\n"  
"Language-Team: LANGUAGE <LL@li.org>\n"  
"MIME-Version: 1.0\n"  
"Content-Type: text/plain; charset=CHARSET\n"  
"Content-Transfer-Encoding: 8bit\n"
```

The translation of the empty string is a special entry that will be filled with administrative information.

How to Add a New Language?

- 1 Initialize *po/LL.po* or *po/LL_CC.po* from *po/amhello.pot*, using 'msginit'.

LL is your language code, and CC is your country code

pt is Portuguese

pt_BR is Brazilian Portuguese

(The annexes of the Gettext manual show lists of LLs and CCs.)

- 2 Fill in *po/LL.po* (or *po/LL_CC.po*)
- 3 List the new translation in *po/LINGUAS*

How to Add a New Language?

- 1 Initialize *po/LL.po* or *po/LL_CC.po* from *po/amhello.pot*, using 'msginit'.
LL is your language code, and CC is your country code
pt is Portuguese
pt_BR is Brazilian Portuguese
(The annexes of the Gettext manual show lists of LLs and CCs.)
- 2 Fill in *po/LL.po* (or *po/LL_CC.po*)
- 3 List the new translation in *po/LINGUAS*

Let's add a French translation for *amhello*.






Preparing *po/fr.po*

```
~/amhello % cd po  
~/amhello/po % msginit -l fr  
...  
~/amhello/po % emacs fr.po &
```

Preparing *po/fr.po*

```
~/amhello % cd po  
~/amhello/po % msginit -l fr  
...  
~/amhello/po % emacs fr.po &
```

The PO mode of 'emacs' ( po-mode):

- The buffer is modified only indirectly.
-  on a message will open a buffer to edit the translation.
- Use   after you have completed the translation, to get back to the updated *amhello.pot* buffer.
- Once all strings are translated, use  to save and check the file.
- Use  to remove fuzzy attributes.

po/fr.po: Message Translations

```
#: src/say.c:9
msgid "Hello World!"
msgstr ""

#: src/say.c:10
#, c-format
msgid "This is %s.\n"
msgstr ""
```

po/fr.po: Message Translations

```
#: src/say.c:9  
msgid "Hello World!"  
msgstr "Bonjour Monde !"
```

```
#: src/say.c:10  
#, c-format  
msgid "This is %s.\n"  
msgstr "Ceci est %s.\n"
```

po/fr.po: Header

```
msgid ""  
msgstr ""  
"Project-Id-Version: amhello 3.0\n"  
"Report-Msgid-Bugs-To: bug-report@address\n"  
"POT-Creation-Date: 2005-03-05 00:27+0100\n"  
"PO-Revision-Date: 2005-03-15 20:54+0100\n"  
"Last-Translator: Tyng-Jing Yang <tj_yang@hotmail.com>\n"  
"Language-Team: French\n"  
"MIME-Version: 1.0\n"  
"Content-Type: text/plain; charset=ASCII\n"  
"Content-Transfer-Encoding: 8bit\n"  
"Plural-Forms: nplurals=2; plural=(n > 1);\n"
```

- ‘msginit’ filled these fields.

po/fr.po: Header

```
msgid ""
msgstr ""
"Project-Id-Version: amhello 3.0\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: 2005-03-15 20:54+0100\n"
"Last-Translator: Tyng-Jing Yang <tj_yang@hotmail.com>\n"
"Language-Team: French\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=ASCII\n"
"Content-Transfer-Encoding: 8bit\n"
"Plural-Forms: nplurals=2; plural=(n > 1);\n"
```

- ‘msginit’ filled these fields.

po/fr.po: Header

```
msgid ""
msgstr ""
"Project-Id-Version: amhello 3.0\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: 2005-03-15 20:54+0100\n"
"Last-Translator: Tyng-Jing Yang <tj_yang@hotmail.com>\n"
"Language-Team: French\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=iso-8859-1\n"
"Content-Transfer-Encoding: 8bit\n"
"Plural-Forms: nplurals=2; plural=(n > 1);\n"
```

- 'msginit' filled these fields.
- You may have to customize it a bit.

po/fr.po: Header

```
msgid ""
msgstr ""
"Project-Id-Version: amhello 3.0\n"
"Report-Msgid-Bugs-To: bug-report@address\n"
"POT-Creation-Date: 2005-03-05 00:27+0100\n"
"PO-Revision-Date: 2005-03-15 20:54+0100\n"
"Last-Translator: Tyng-Jing Yang <tj_yang@hotmail.com>\n"
"Language-Team: French\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=iso-8859-1\n"
"Content-Transfer-Encoding: 8bit\n"
"Plural-Forms: nplurals=2; plural=(n > 1);\n"
```

- 'msginit' filled these fields.
- You may have to customize it a bit.
- The revision date will also be updated on save.

po/fr.po: Validation and Addition

Once *po/fr.po* is completed, hit . This will:

- 1 Update the revision date
- 2 Save the file
- 3 Run `'msgfmt --statistics --check'` on *po/fr.po*, to validate it.

po/fr.po: Validation and Addition

Once *po/fr.po* is completed, hit . This will:

- 1 Update the revision date
- 2 Save the file
- 3 Run `'msgfmt --statistics --check'` on *po/fr.po*, to validate it.

We can now register the language.

```
~/amhello/po % echo fr >> LINGUAS
```

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test  
~/amhello %
```

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test  
~/amhello % make  
~/amhello %
```

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test  
~/amhello % make  
~/amhello % cd po  
~/amhello/po %
```

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test  
~/amhello % make  
~/amhello % cd po  
~/amhello/po % make update-po  
~/amhello/po %
```

update-po

This step is needed because we just created *fr.po*, and it has to be compiled. This happens automatically during 'make dist'.

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test  
~/amhello % make  
~/amhello % cd po  
~/amhello/po % make update-po  
~/amhello/po % cd ..  
~/amhello %
```


hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test  
~/amhello % make  
~/amhello % cd po  
~/amhello/po % make update-po  
~/amhello/po % cd ..  
~/amhello % make install  
~/amhello %
```

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test
~/amhello % make
~/amhello % cd po
~/amhello/po % make update-po
~/amhello/po % cd ..
~/amhello % make install
~/amhello % ~/test/bin/hello
Hello World!
This is amhello 3.0.
~/amhello %
```

hello now Speaks French!

```
~/amhello % ./configure --prefix ~/test
~/amhello % make
~/amhello % cd po
~/amhello/po % make update-po
~/amhello/po % cd ..
~/amhello % make install
~/amhello % ~/test/bin/hello
Hello World!
This is amhello 3.0.
~/amhello % LANG=fr_FR ~/test/bin/hello
Bonjour Monde !
Ceci est amhello 3.0.
```

Updating Message Catalogs

Because maintainers can change the strings marked for translation, the messages catalogs are varying, and are not always up-to-date.

Updating Message Catalogs

Because maintainers can change the strings marked for translation, the messages catalogs are varying, and are not always up-to-date.

Varying messages. `update-po` modify `*.po` file:

- New messages are added with a blank translation.
- Obsolete translations, not used anymore, are commented.
- Messages with tiny changes keep their translation, but are marked fuzzy.

Translators remove fuzzy attributes (`<Tab>`) after verification.

Updating Message Catalogs

Because maintainers can change the strings marked for translation, the messages catalogs are varying, and are not always up-to-date.

Varying messages. `update-po` modify `*.po` file:

- New messages are added with a blank translation.
- Obsolete translations, not used anymore, are commented.
- Messages with tiny changes keep their translation, but are marked fuzzy.

Translators remove fuzzy attributes (`⌘Tab`) after verification.

Not up-to-date. `gettext` copes with incomplete translations as follows.

- Untranslated messages are output untranslated.
- Fuzzy messages are also output untranslated. (Better output the original sentence, rather than an inappropriate translation.)

Updating Message Catalogs

Because maintainers can change the strings marked for translation, the messages catalogs are varying, and are not always up-to-date.

Varying messages. `update-po` modify **.po* file:

- New messages are added with a blank translation.
- Obsolete translations, not used anymore, are commented.
- Messages with tiny changes keep their translation, but are marked fuzzy.

Translators remove fuzzy attributes (`(\u2013Tab)`) after verification.

Not up-to-date. `gettext` copes with incomplete translations as follows.

- Untranslated messages are output untranslated.
- Fuzzy messages are also output untranslated. (Better output the original sentence, rather than an inappropriate translation.)

Good practice: the string freeze. Two weeks before a release, run ‘`make update-po`’ and send the **.pot* file to translators. Don’t change or add strings from this point on. Let translators send you updated **.po* files.

Language Teams & The Translation Project

`http://www.iro.umontreal.ca/translation/`

The Translation Project provides an infrastructure for package maintainers and translators to exchange messages catalogs.

Language Teams & The Translation Project

<http://www.iro.umontreal.ca/translation/>

The Translation Project provides an infrastructure for package maintainers and translators to exchange messages catalogs.

- Translators gather in *Language Teams* (consider joining the team of your own language) to discuss issues.
- Maintainer submit **.pot* files and are notified when **.po* files are updated.
- Pages in The Translation Project will show where work is needed (consider adopting an orphan **.po* file.)

Language Teams & The Translation Project

<http://www.iro.umontreal.ca/translation/>

The Translation Project provides an infrastructure for package maintainers and translators to exchange messages catalogs.

- Translators gather in *Language Teams* (consider joining the team of your own language) to discuss issues.
- Maintainer submit **.pot* files and are notified when **.po* files are updated.
- Pages in The Translation Project will show where work is needed (consider adopting an orphan **.po* file.)

This is only one way of getting a project translated. A lot of packages have dedicated translators and deal with them directly.

Nested Packages

- 10 Writing and Managing Custom Macros
 - Writing Autoconf Macros
 - Managing Custom Macros with 'aclocal'
- 11 Libtool
- 12 Gettext
 - Introducing Gettext
 - Internationalizing a Package, Start to Finish
 - Localizing a Package
- 13 Nested Packages
- 14 The End

Nested Packages

- *Autoconfiscated* packages can be nested to arbitrary depth.
 - A package can distribute a third-party library it uses in a subdirectory.
 - It's possible to gather many packages this way to distribute a set of tools.
- For installers:
 - A single package to configure, build, and install.
 - 'configure' options are passed recursively to sub-packages.
 - 'configure --help=recursive' shows the help of all sub-packages.
- For maintainers:
 - Easier integration.
 - The sub-package is autonomous.

Setting Up Nested Packages

- A sub-package should appear as an ordinary directory.

Setting Up Nested Packages

- A sub-package should appear as an ordinary directory.
- In *Makefile.am*, this directory must appear in **SUBDIRS** so 'make' recurses into it.

Setting Up Nested Packages

- A sub-package should appear as an ordinary directory.
- In *Makefile.am*, this directory must appear in **SUBDIRS** so 'make' recurses into it.
- *configure.ac* should also declare this directory

```
AC_CONFIG_SUBDIRS([subdir])
```

so 'configure' calls *subdir/configure* recursively.

Nested Packages Example

The *arm* program links with an *hand* library, a nested package in *hand/*.

arm's configure.ac

```
AC_INIT([arm], [1.0])
AM_INIT_AUTOMAKE([-Wall -Werror foreign])
AC_PROG_CC
AC_CONFIG_FILES([Makefile src/Makefile])
AC_CONFIG_SUBDIRS([hand])
AC_OUTPUT
```

arm's Makefile.am

```
SUBDIRS = hand src
```

arm's src/Makefile.am

```
AM_CPPFLAGS = -I$(top_srcdir)/hand
bin_PROGRAMS = arm
arm_SOURCES = arm.c
arm_LDADD = ../hand/libhand.a
```


The End

- 10 Writing and Managing Custom Macros
 - Writing Autoconf Macros
 - Managing Custom Macros with 'aclocal'
- 11 Libtool
- 12 Gettext
 - Introducing Gettext
 - Internationalizing a Package, Start to Finish
 - Localizing a Package
- 13 Nested Packages
- 14 The End

Where to go Now?

- Locate the reference manuals in your preferred format.
 - Autoconf, Automake, Libtool, and Gettext all install reference manuals in the Info format. (Try 'info Autoconf', 'info Automake', etc.)
 - The web pages of these tools also have [.html](#) or [.pdf](#) versions.
 - These manuals may not be easy introductions to the tools, but they make good and up-to-date references.

Where to go Now?

- Locate the reference manuals in your preferred format.
 - Autoconf, Automake, Libtool, and Gettext all install reference manuals in the Info format. (Try 'info Autoconf', 'info Automake', etc.)
 - The web pages of these tools also have [.html](#) or [.pdf](#) versions.
 - These manuals may not be easy introductions to the tools, but they make good and up-to-date references.
- Subscribe to these tools' mailing lists, to see other people's uses of the tools.

Where to go Now?

- Locate the reference manuals in your preferred format.
 - Autoconf, Automake, Libtool, and Gettext all install reference manuals in the Info format. (Try 'info Autoconf', 'info Automake', etc.)
 - The web pages of these tools also have [.html](#) or [.pdf](#) versions.
 - These manuals may not be easy introductions to the tools, but they make good and up-to-date references.
- Subscribe to these tools' mailing lists, to see other people's uses of the tools.
- Pick a package that uses these tools and dissect its setup.
 - Try picking something written by somebody who isn't just another neophyte!
 - I recommend looking at *GNU Coreutils*.