CS 35L Software Construction Lab
Week 3 – Modifying and Rewriting Software

How to Install Software

- Linux
  - rpm (Redhat Package Management)
    - RedHat Linux (.rpm)
  - apt-get (Advanced Package Tool)
    - Debian Linux, Ubuntu Linux (.deb)
  - **Good old build process**
    - **configure, make, make install**

Decompressing Files

- Generally, you receive Linux software in the tarball format (.tgz) or (.gz)

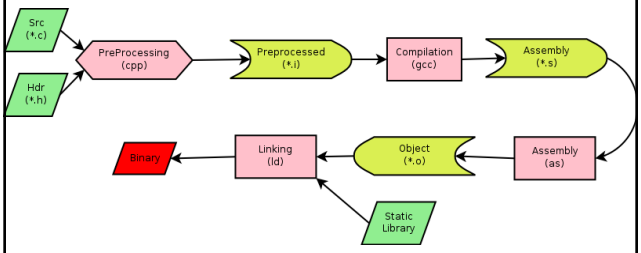
Decompress file in current directory:

- $ tar –xzvf filename.tar.gz
  - –Option –x: --extract
  - –Option –z: --gzip
  - –Option –v: --verbose
  - –Option –f: --file

Build Process

- **configure**
  - Script that checks details about the machine before installation
    - Dependency between packages
  - Creates 'Makefile'
- **make**
  - Requires 'Makefile' to run
  - Compiles all the program code and creates executables in current temporary directory
- **make install**
  - make utility searches for a label named install within the Makefile, and executes only that section of it
  - executables are copied into the final directories (system directories)

GCC Compilation Process



Command-Line Compilation

- item.h
- item.c
  - #includes item.h
- shoppingList.h
  - #includes item.h
- shoppingList.c
  - #includes shoppingList.h
- shop.h
- shop.c
  - #includes shoppingList.h and shop.h
- How to compile?
  - **gcc -Wall shoppingList.c item.c shop.c –o shop**

Expanding the command

- gcc - compiler program
- -Wall - turn all warnings on
- -o - to name the executable as the name given instead of a.out

What if…

- **We change one of the header or source files?**
  - Rerun command to generate new executable
- **We only made a small change to item.c?**
  - not efficient to recompile shoppinglist.c and shop.c
  - Solution: avoid waste by producing a separate object code file for each source file
    - gcc -Wall –c item.c… (for each source file)
    - gcc item.o shoppingList.o shop.o –o shop (combine)
    - Less work for compiler, saves time but more commands

What if…

- **We change item.h?**
  - Need to recompile every source file that includes it & every source file that includes a header that includes it. Here: item.c and shop.c
  - Difficult to keep track of files when project is large
    - Windows 7 ~40 million lines of code
    - Google ~2 billion lines of code

=> Make

Make

- Utility for managing large software projects
- Compiles files and keeps them up-to-date
- Efficient Compilation (only files that need to be recompiled)

Makefile Example

```
# Makefile - A Basic Example
all : shop  #usually first
shop : item.o shoppingList.o shop.o
        gcc -Wall -o shop item.o shoppingList.o shop.o
item.o : item.cpp item.h
        gcc -Wall -c item.cpp
shoppingList.o : shoppingList.cpp shoppingList.h
        gcc -Wall -c shoppingList.cpp
shop.o : shop.cpp item.h shoppingList.h
        gcc -Wall -c shop.cpp
clean :
        rm -f item.o shoppingList.o shop.o shop
```

Rule

Comments
Targets
Prerequisites
Commands

Dependency Line

Lab 3

- Coreutils 7.6 has a problem
  - Different users see different date formats
  - $ ls –l /bin/bash
    - -rwxr-xr-x 1 root root 729040 **2009-03-02 06:22** /bin/bash
    - -rwxr-xr-x 1 root root 729040 **Mar 2 2009** /bin/bash
- Why?
  - Different locales
- Want the traditional Unix format for all users
- Fix the ls program

Getting Set Up (Step 1)

- Download coreutils-7.6 to your home directory
  - Use 'wget'
- Untar and Unzip it
  - tar –xzvf coreutils-7.6.tar.gz
- Make a directory ~/coreutilsInstall in your home directory (this is where you'll be installing coreutils)
  - mkdir coreutilsInstall

Building coreutils (Step 2)

- Go into coreutils-7.6 directory. This is what you just unzipped.
- Read the INSTALL file on how to configure "make", especially **--prefix** flag
- Run the configure script using the prefix flag so that when everything is done, coreutils will be installed in the directory ~/coreutilsInstall
- Compile it: make
- Install it: make install

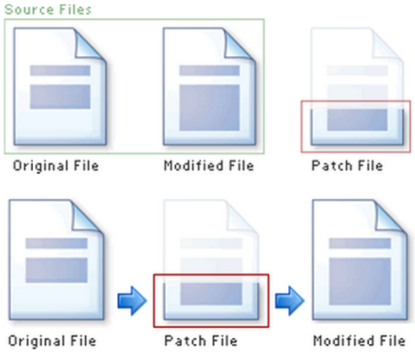
Reproduce Bug (Step 3)

- Reproduce the bug by running the version of 'ls' in coreutils 7.6
- If you just type $ ls at CLI it won't run 'ls' in coreutils 7.6
  - Why? Shell looks for /bin/ls
  - To use coreutils 7.6:
    - cd coreutilsInstall
    - ./bin/ls -l
    - This manually runs the executable in this directory

Patching

- A patch is a piece of software designed to fix problems with or update a computer program
- It's a diff file that includes the changes made to a file
- A person who has the original (buggy) file can use the patch command with the diff file to add the changes to their original file

Applying a Patch



diff Unified Format

- diff –u original_file modified_file
- --- path/to/original_file
- +++ path/to/modified_file
- @@ -l,s +l,s @@
  - @@: beginning of a hunk
  - l: beginning line number
  - s: number of lines the change hunk applies to for each file
  - A line with a:
    - - sign was deleted from the original
    - + sign was added to the original
    - stayed the same

Patching and Building (Steps 4 & 5)

- cd coreutils-7.6
- vim patch_file: copy and paste the patch content
- `patch` –p**num** < patch_file
  - '`man patch`' to find out what p**num** does and how to use it
- type make to rebuild patched ls.c.

Testing Fix (Step 6)

- Test the following:
  - Modified ls works
  - Installed unmodified ls does NOT work
- Test on:
  - 1) a file that has been recently modified
    - Make a change to an existing file or create a new file
  - 2) a file that is at least a year old
    - touch –t 201401210959.30 *test_file*