CS 35L

Software Construction Laboratory

Lecture 3.1

22nd January, 2019

Logistics

- Assignment 2
  - Due on Jan 23rd
- Hardware requirement for Week 8
  - Seeed Studio BeagleBone Green Wireless Development Board
- Presentations for Assignment 10
  - Fill your details in the link below
  - Do not fill a slot without a Presentation Topic
  - https://docs.google.com/spreadsheets/d/1o6r6CKCaB2du3klPflHiquymhBvbn7oP0wkHHMz_q1E/edit?usp=sharing

Review - Previous Lab

- Regular Expressions
- sed
- grep

Week 3
Modifying and Rewriting Software

How to Install software

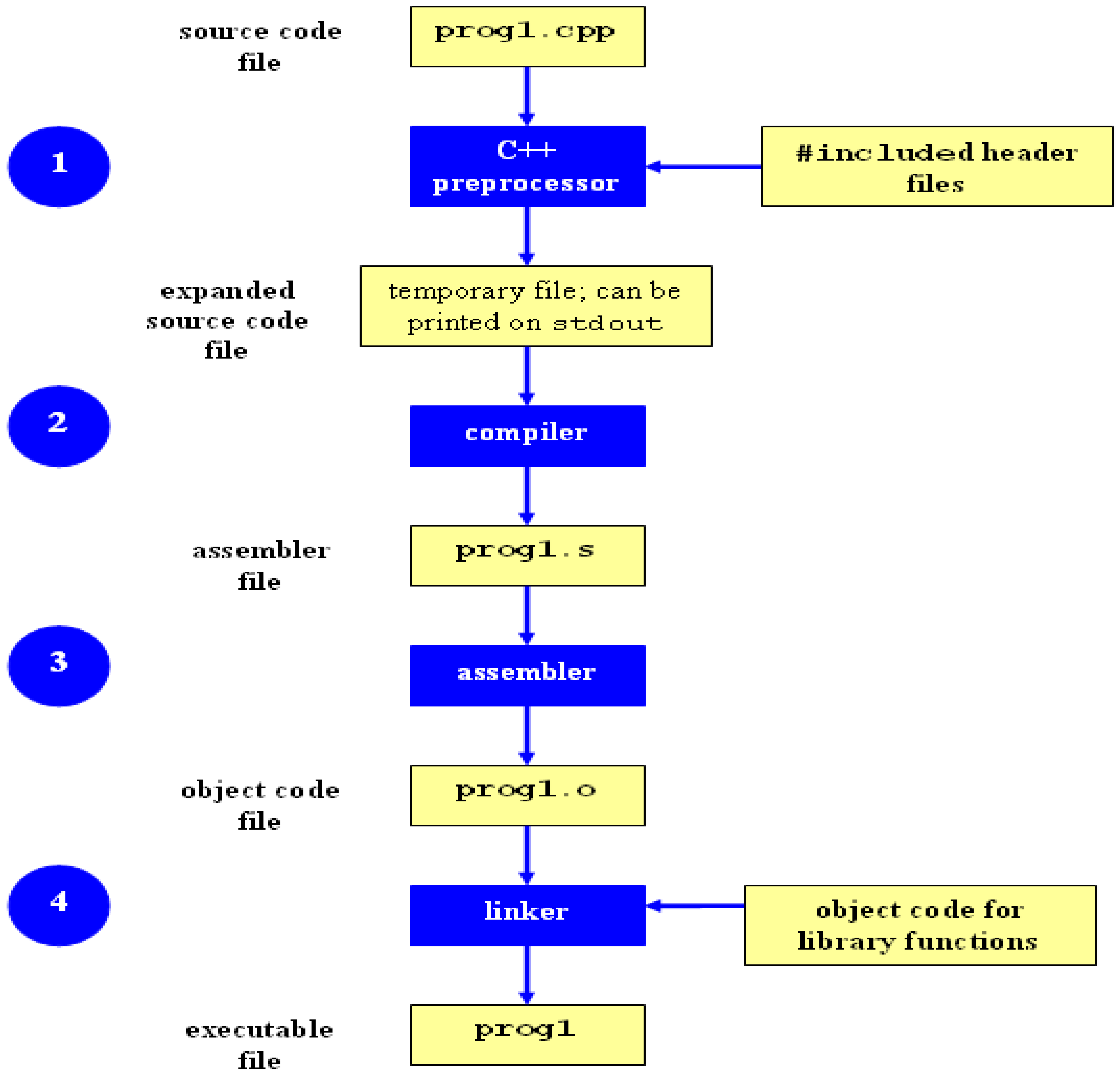
- Windows
  - Installshield
  - Microsoft/Windows Installer
- OS X
  - Drag and drop from .dmg mount -> Applications folder
- Linux
  - Rpm (Red hat Package Management)
    - RedHat Linux (.rpm)
  - apt-get (Advanced Package Tool)
    - Debian Linux, Ubuntu Linux (.deb)
  - **Good old build process**
    - **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

Compilation Process



Command Line Compilation

- shop.cpp
  - #include shoppingList.h and item.h
- shoppingList.cpp
  - #include shoppingList.h
- item.cpp
  - #include item.h
- How to compile?
  - g++ -Wall shoppingList.cpp item.cpp shop.cpp –o shop

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.cpp?
    - not efficient to recompile shoppinglist.cpp and shop.cpp
    - Solution: avoid waste by producing a separate object code file for each source file
        - g++ -Wall –c item.cpp… (for each source file)
        - g++ 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.cpp and shop.cpp
  - 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
	g++ -g -Wall -o shop item.o shoppingList.o shop.o
item.o : item.cpp item.h
	g++ -g -Wall -c item.cpp
shoppingList.o : shoppingList.cpp shoppingList.h
	g++ -g -Wall -c shoppingList.cpp
shop.o : shop.cpp item.h shoppingList.h
	g++ -g -Wall -c shop.cpp
clean :
	rm -f item.o shoppingList.o shop.o
```

Rule

🟩	Comments	
🟦	Targets	Dependency Line
🟪	Prerequisites	Dependency Line
🟫	Commands	

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)

Lab 3 - Assignment

- Coreutils 8.29 has a problem
  - $ la –A is equivalent to ls -a –A
  - if the current directory has two files named .foo and bar, the command la -A outputs four lines, one each for ., .., .foo, and bar.
  - These users want la -A to output just two lines instead, one for .foo and one for bar
- Why?
  - the -a option always overrides the -A option regardless of which option is given first
- Want the flag that comes later to take effect
- Fix the ls program

Step 1 – Getting Started

- Download coreutils-8.29 to your home directory
  - Use ‘wget’
- Untar and Unzip it
  - tar –xJvf coreutils-8.29.tar.xz
- Make a directory ~/coreutilsInstall in your home directory (this is where you’ll be installing coreutils)
  - mkdir ~/coreutilsInstall

Step 2 – Building coreutils

- Go into coreutils-8.29 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 (won’t work on Linux server without proper prefix!)
  - Why?

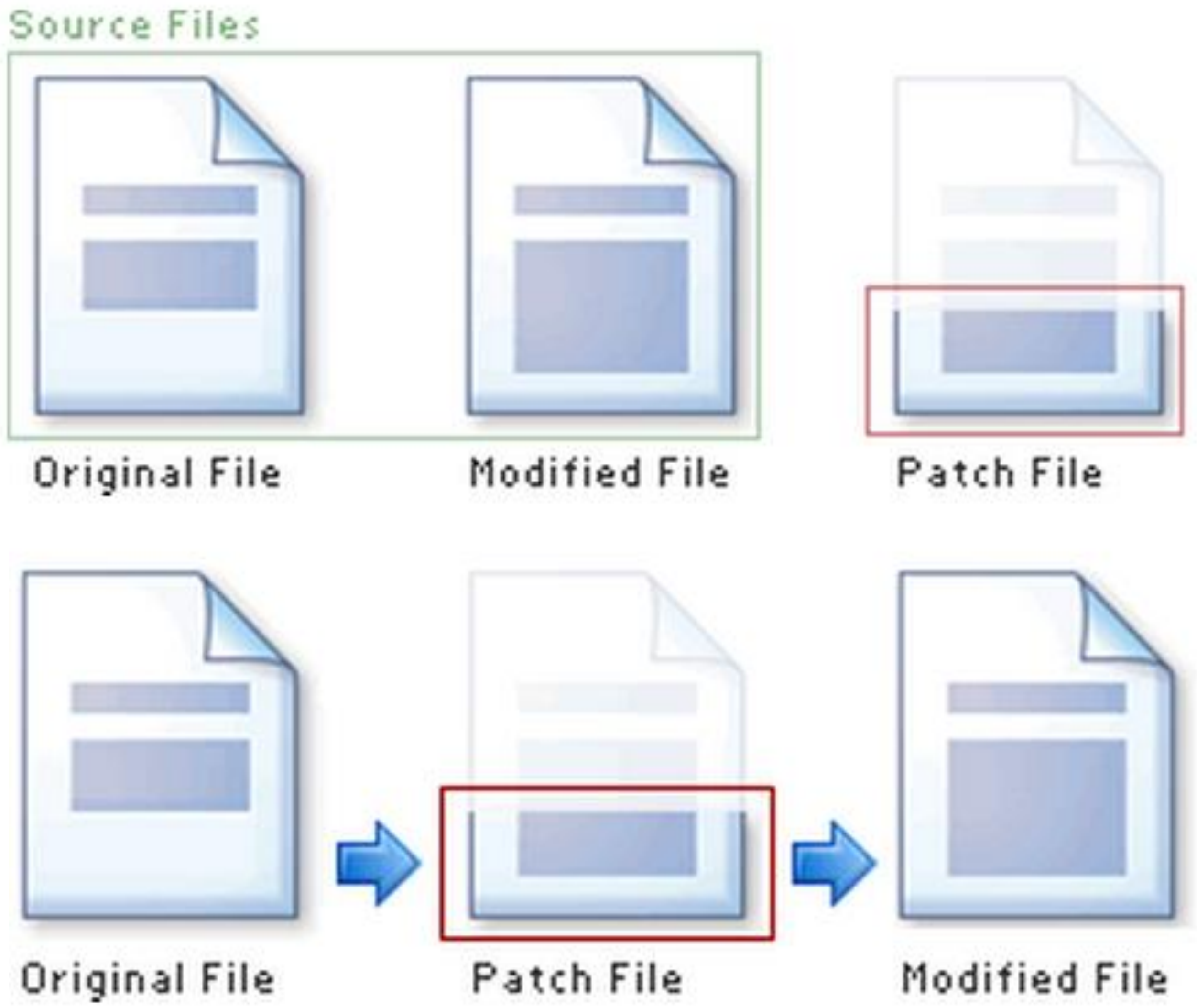
Step 3 – Reproduce Bug

- Reproduce the bug by running the version of 'ls -a -A ' in coreutils 8.29
- If you just type $ ls at CLI it won't run 'ls' in coreutils 8.29
  - Why? Shell looks for /bin/ls
  - To use coreutils 8.29: $ ./ls
    - This manually runs the executable in this directory

Step 4 – 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

Step 4 – 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

Step 4 & 5 - Patching and Building

- cd coreutils-8.29
- vim or emacs patch_file: copy and paste the patch content
- patch –pnum < patch_file
  - ‘man patch’ to find out what pnum does and how to use it
- cd into the coreutils-8.29 directory and type make to rebuild patched ls.c.
  - **Don’t install!!**

Step 6 – Testing Fix

- Test the following:
  - Modified ls works
  - Installed unmodified ls does NOT work
- Test on:
  - Empty directory
  - Directory containing a hidden file
    - With just –a, with just –A
    - With –aA
    - With –Aa
- Answer Q1 and Q2 in the Assignment

Questions?