CS 261
Fall 2021

Mike Lam, Professor

Command Line Introduction

Linux and the command line

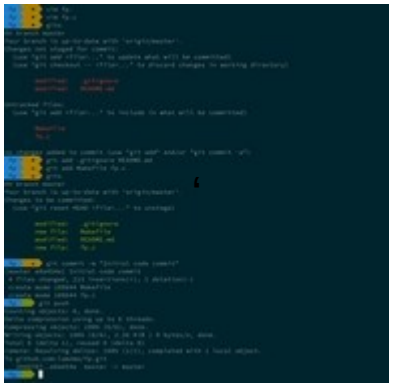
- Linux is a popular operating system in computer science
  - We'll study operating systems in more detail later this semester
  - For now, think of it as the low-level software that manages the hardware
- You interact with your operating system through an **interface**
  - In Windows and macOS, the primary interface is **graphical**
  - In Linux, the primary interface is **textual**

Graphical interfaces

"Windows 10 Creators Update" by okubax
is licensed under CC BY 2.0

"about-this-mac" by Wang Liang
is licensed under CC BY-NC 2.0

Textual interface



Why use the command line?

- More speed
  - Typing is often quicker than clicking
  - Easy to create shortcuts for common tasks
- More power
  - Write custom software / scripts
  - Chain together programs (e.g., w/ pipes)
- More flexibility
  - Command-line arguments to customize behavior
  - Work remotely even if your connection is slow

Computer conversations

- Shell programs facilitate a command/response conversation with a computer system
  - Example: sh, bash, zsh, PowerShell
- Terminal programs provide a visual interface
  - Examples: Terminal, iTerm2, gnome-terminal
- SSH clients provide remote access
  - Examples: ssh, PuTTY, MobaXterm
- Text editors allow you to edit files
  - Examples: nano, emacs, vim

Context is important

- In a shell, the conversation context is the working directory
  - This is your current location in the file system (also called '.')
  - Use '`pwd`' to see the full path
  - Use '`ls`' to list the files in the working directory
  - Other useful commands:

```
cd <dir>            "change directory" to the given directory name
cd ..               change to the parent of the current directory
cd                  change to your home directory
less <file>         view a long file one screen at a time
cp <src> <dest>     copy a file from "src" to "dest"
mv <src> <dest>     move/rename a file from "src" to "dest"
rm <file>           remove a file
mkdir <dir>         create a new directory
rmdir <dir>         remove a directory (it must be empty first!)
man <command>       read help text about the given command
tar -xvf <file>     extract a "tarball" (similar to a zip file)
nano <file>         open a file in the Nano text editor
```

Command-line text editing

- Recommended: learn emacs or vim
  - Run "`emacs`" and press Ctrl-'h' followed by 't'
  - Run "`vimtutor`"
- Alternative: just use nano
  - Run "`nano <filename>`" to open or create a file
  - Useful key combinations:

Ctrl-O	Save ("Write Out")
Ctrl-X	Exit
Ctrl-W	Search
Ctrl-K	Cut line
Ctrl-U	Paste ("uncut") line
Ctrl-C	See current line number
Ctrl-_	Go to a specific line number

JMU CS student server

- “stu” is a server running Linux that is available to all JMU CS students
  - Fully-qualified name: `stu.cs.jmu.edu`
  - Pre-configured for CS 261
  - Use for all project distribution and submission
  - You should already have an account
    - Username is your eID
    - Password is the same as your eID password
    - For technical support, email `cs-sysadmin@jmu.edu`
      - **(also CC me!)**

Accessing stu

- Windows
  - Run PowerShell (or download PuTTY or MobaXterm)
- macOS
  - Run Terminal (or download iTerm2)
- Debian-based Linux (e.g., Ubuntu, Mint)
  - Run gnome-terminal
- Run this command:
  - `ssh lam2mo@stu.cs.jmu.edu` *(use your eID!)*

More info here: `wiki.cs.jmu.edu/student/stu/basics`

Working on CS 261 projects

- **1st choice**: edit, test, and submit on stu
  - SSH to stu
    - Edit w/ command-line text editor (e.g., nano or vim)
    - Build, test, and submit on stu via the command line
- **2nd choice**: edit locally, test and submit on stu
  - "Mount" stu home folder to your local computer
    - Edit w/ the text editor of your choice (e.g., VS Code)
  - SSH to stu
    - Build, test, and submit on stu via the command line

More info here: `wiki.cs.jmu.edu/student/utilities/sshfs`

Working on CS 261 projects

- **3rd choice**: edit and test locally, submit on stu
  - Install Linux virtual machine
    - Tutorial: `w3.cs.jmu.edu/cs101/virtual/`
  - Work locally
    - Copy project files to your local machine
    - Edit w/ the text editor of your choice
    - Build and test locally (may need to install additional software)
    - Copy files back to stu
  - SSH to stu
    - Submit on stu via the command line
  - **Caution: avoid unless offline access is necessary!**

“Hello, World” in C

```
#include <stdio.h>

int main()
{
    printf("Hello, world!\n");
    return 0;
}
```

hello.c

Compiling C programs

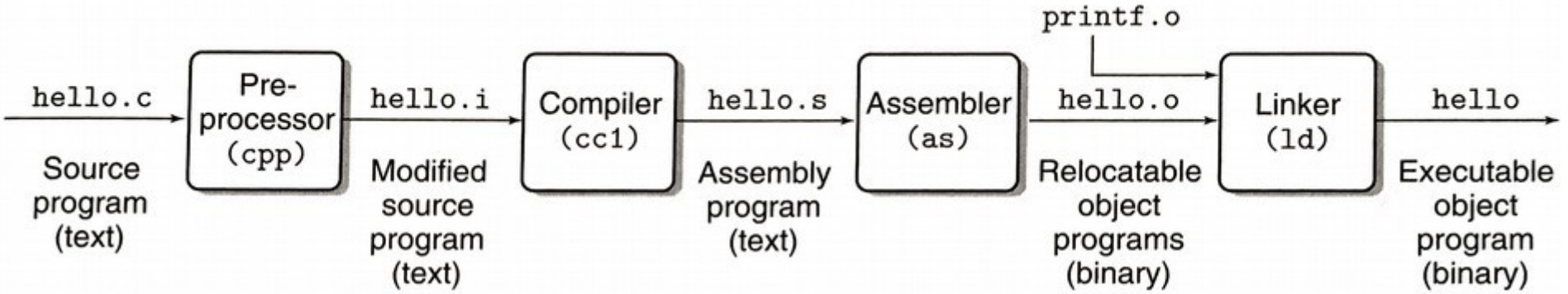


Figure 1.3 The compilation system.

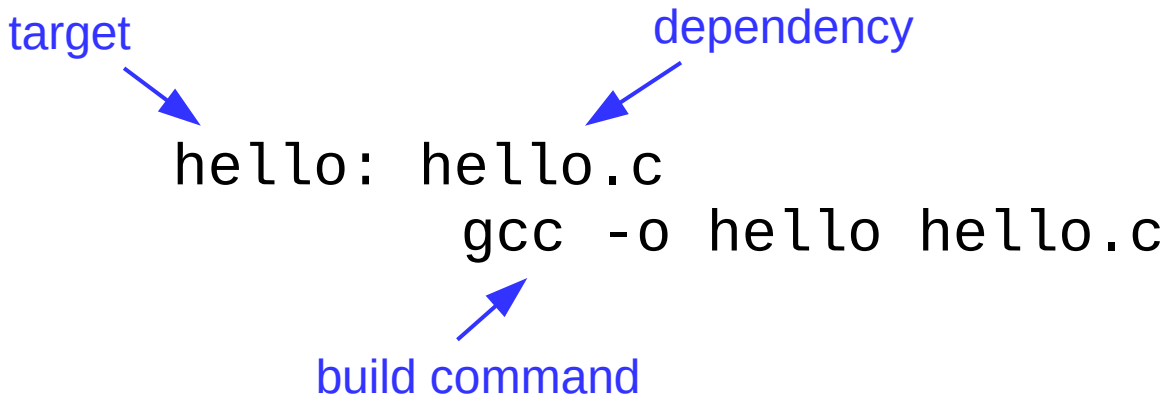
```
linux> gcc -o hello hello.c
```

Here, the GCC compiler driver reads the source file `hello.c` and translates it into an executable object file `hello`. The translation is performed in the sequence of four phases shown in Figure 1.3. The programs that perform the four phases (*preprocessor*, *compiler*, *assembler*, and *linker*) are known collectively as the *compilation system*.

To run the program (after compiling): `./hello`

Using a build system

- The compilation process is usually streamlined using a build system (we'll use Make)
  - Provide a text file (must be called “Makefile”) that contains individual commands to compile and link the project
  - Run the entire build with one command: “`make`”
- Example Makefile:



Getting started

- Complete today's compilation lab
  - This should help you become more comfortable with the command line and how C programs are built
- Read the project guide
  - Link: `w3.cs.jmu.edu/lam2mo/cs261/project_guide.html`
  - This contains lots of important information!
  - Experimentation is highly encouraged
- Skim the Project 0 description
  - This project is an intro to C programming
  - **Don't panic!** There's no need to finish it immediately
  - Work on it incrementally over the next couple of weeks as you learn more about C and how it is different from Java