CSCI 4061: Unix Basics

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Week 1

Logistics

Reading

- Robbins and Robbins, Ch 1 and Ch 2
- OR Stevens and Rago, Ch 1 and Ch 7

Goals Today

- Warm-up C program
- Course Mechanics
- Unix Basics

Continue Mechanics

See remaining mechanics slides.

Finish Intro C Program

Access to Unix Machines

- CSE Labs
  - Via SSH
  - Via `http://vole.cse.umn.edu`
- Mac OS X: Terminal, development tools
- Windows: Install Cygwin
- Either: Install VirtualBox to host a Unix you like

Exercise: Quick Review

- Name two major functions of all operating systems
- Give some major components/abstractions that Unix provides as part of its interfaces
- What is a system call? How does it work?

Unix Standards: POSIX

POSIX defines what you an plausibly expect on unix-like systems. Includes

- C libraries for system calls, standard libraries
- Basic layout of file system and naming conventions
- Some Devices such as `/dev/null`

Distinction: C Standard vs Unix Library

- Lots of systems have a C compiler which has the C standard library: `printf()`, `fopen()`, `exp()` etc.
- Unix systems have additional, separate libraries for Unix-specific stuff like `read()`, `fork()`, `select()`, `kill()`
- Some branches of Unix have their own special, special versions of these like Linux `clone()`

Command Line: Basic File System Navigation

Command	Effect
`pwd`	print the current directory
`cd folder`	change directory / folder
`ls`	list files in directory
`cd ~`	change to home directory

```
> pwd
/home/kauffman
> ls
1103-F2017  aurs     Downloads  Hello.class  Hello.java~  PathClassLoader.txt
4061-F2017  Desktop  Dropbox    Hello.java   misc         public_html
> cd 4061-F2017
> ls
exams  lectures  Makefile~  projects       schedule.html~  schedule.org~  textbook
labs   Makefile  misc       schedule.html  schedule.org    syllabus
> pwd
/home/kauffman/4061-F2017
> cd lectures
> pwd
/home/kauffman/4061-F2017/lectures
> ls
00-course-mechanics.org   00-course-mechanics.tex   01-introduction.org   01-introduction.tex
00-course-mechanics.org~  01-introduction-code      01-introduction.org~  02-unix-basic.c
00-course-mechanics.pdf   01-introduction-code.zip  01-introduction.pdf   02-unix-basics.org
> cd ~
> pwd
/home/kauffman
> ls
1103-F2017  aurs     Downloads  Hello.class  Hello.java~  PathClassLoader.txt
4061-F2017  Desktop  Dropbox    Hello.java   misc         public_html
```

Determining File Types

Command	Effect
`file something.ext`	try to determine the type of given file

```
> file xxx
xxx: UTF-8 Unicode text, with very long lines
> file test.txt
test.txt: ASCII text
> file www
www: directory
> file 4061-F2017
4061-F2017: symbolic link to /home/kauffman/Dropbox/teaching/4061-F2017
> file 4061-F2017/
4061-F2017/: directory
> cd 4061-F2017/lectures/
> file 01-introduction-code.zip
01-introduction-code.zip: Zip archive data, at least v1.0 to extract

> file 02-unix-basics-code/no_interruptions.c
02-unix-basics-code/no_interruptions.c: C source, ASCII text

> file 02-unix-basics-code/no_interruptions.o
02-unix-basics-code/no_interruptions.o: ELF 64-bit LSB relocatable, x86-64, version 1 (SYSV),
not stripped

> file 02-unix-basics-code/a.out
02-unix-basics-code/a.out: ELF 64-bit LSB shared object, x86-64, version 1 (SYSV),
dynamically linked, interpreter /lib64/ld-linux-x86-64.so.2, for GNU/Linux 2.6.32,
BuildID[sha1]=ffb87934737b0e48b891d27573ae8a2e5687c46a, not stripped
>
```

Searching and Manipulating Text

Command	Effect
`cat file.txt`	show contents of file in terminal
`less file.txt`	"page" text file, press "q" to quit
`grep 'expression' file.txt`	show lines matching expression in file
`grep 'expression' *.txt`	search every `.txt` file for lines
`find .`	show all files recursively from current
~find . -name '*.c'~	find all C source files recursively

These may be covered in a future lab.

Editing Files

Command	Effect
`vi`	modal editing, terse, powerful text manipulator, ALWAYS
`emacs`	modes for editing, extensible, almost always available
`nano`	simple, podunky, usually available

- Learn some vi or emacs
- Comes in real handy when you need to edit but there is no graphical login

Permissions on Files

Command	Effect
`ls -l`	long listing of files
`chmod u+x file.abc`	make file executable by user
`chmod o-rwx file.abc`	remove permissions from other users
`chmod 777 file.abc`	everyone can do anything to file

```
> ls
a.out  no_interruptions.c  no_interruptions.c~ no_interruptions.o
> ls -l
total 40K
-rwxrwx--- 1 kauffman kauffman 8.5K Sep  7 09:55 a.out
-rw-r--r-- 1 kauffman kauffman  955 Sep  7 09:55 no_interruptions.c
-rw-r--r-- 1 kauffman kauffman  883 Sep  7 09:54 no_interruptions.c~
-rw-rw---- 1 kauffman kauffman 2.4K Sep  7 11:59 no_interruptions.o
> chmod u-x a.out
> ls -l
total 40K
-rw-rwx--- 1 kauffman kauffman 8.5K Sep  7 09:55 a.out
-rw-r--r-- 1 kauffman kauffman  955 Sep  7 09:55 no_interruptions.c
-rw-r--r-- 1 kauffman kauffman  883 Sep  7 09:54 no_interruptions.c~
-rw-rw---- 1 kauffman kauffman 2.4K Sep  7 11:59 no_interruptions.o
> ./a.out
bash: ./a.out: Permission denied
> chmod u+x a.out
> ./a.out
Ma-na na-na!
```

Manual Pages

Command	Effect
`man ls`	Bring up the manual page for command `ls`

```
> man ls | cat
LS(1)                    User Commands                    LS(1)

NAME
       ls - list directory contents

SYNOPSIS
       ls [OPTION]... [FILE]...

DESCRIPTION

       List information about the FILEs (the current directory by
       default).  Sort entries alphabetically if none of -cftuvSUX nor
       --sort is specified.

       Mandatory arguments to long options are mandatory for short
       options too.

       -a, --all
              do not ignore entries starting with .

       -A, --almost-all
              do not list implied . and ..
...
```

Program Search PATH

Command	Effect
`echo $PATH`	show where shell looks for progra
`PATH=$PATH:/home/kauffman/bin`	also look in my `bin` directory
`PATH=$PATH:.`	also look in current directory
`PATH=.`	ONLY look in the current directo

```
> echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/bin:/usr/lib/jvm/default/bin:
/usr/bin/site_perl:/usr/bin/vendor_perl:/usr/bin/core_perl:/home/kauffman/bin:
/home/kauffman/Dropbox/bin:/home/kauffman/code/bin:/home/kauffman/code/utils:.
```

Search directories are separated by colons in Unix

Exercise: Compilation

- What command is typically used to compile C programs again?
- What function does a *runnable* C file need to have to make a program?
- Can you compile a C file without that special function function?
- What is the default name of a compiled program on Unix?
- How do you change the name of the file the compiler will produce?

`make` and Makefiles

- Example of a build system
- Very old system, many newer ones but a good starting point
- Will be discussed in `Lab01` which will go up over the weekend
- Make sure to attend your first lab, *the one you are registered for*

How `make` and `Makefile` Works

Build up dependencies recursively

- A tree-like structure (actually a DAG)
- Run commands for the lowest level
- Then go up a level
- Then up another . . .
- Can recurse to subdirectories to use other `Makefiles` as well
- `Makefile` describes dependencies between source/program files and commands to generate/compile

`Makefile` Format

```
target1 : dependecy1 dependency2
	do command 1
	then do command 2

target2 : target1 dependency3
	do command X
	then do command Y
```

Showing and Murdering Running Processes

Command	Effect
`ps`	show running processes associated with terminal
`ps a`	show ALL running processes
`ps u`	show all processes for me
`kill 1234`	send process 1234 the TERM signal
`kill -9 1234`	send process 1234 the KILL signal
`pkill a.out`	send process named a.out the TERM signal
`pkill -9 a.out`	send process named a.out the KILL signal

```
> ps
  PID TTY          TIME CMD
 8050 pts/1    00:00:00 bash
 8061 pts/1    00:00:00 ssh
11033 pts/1    00:00:00 ps
> ps u
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
kauffman   724  0.0  0.0 201092  5520 tty2     Ssl+ Sep06   0:00 /usr/lib/gdm/gdm-x-session --run-script
kauffman   726  0.1  0.5 691872 94388 tty2     Rl+  Sep06   2:08 /usr/lib/xorg-server/Xorg vt2 -displayfd
kauffman   737  0.0  0.3 603020 49496 tty2     Sl+  Sep06   0:00 cinnamon-session --session cinnamon
kauffman   784  0.0  0.1 565264 23008 tty2     Sl+  Sep06   0:00 /usr/lib/cinnamon-settings-daemon/csd-or
...
```