CSE 391
Lecture 1

introduction to Linux/Unix environment

slides created by Marty Stepp, modified by Jessica Miller & Ruth Anderson
http://www.cs.washington.edu/391/

Lecture summary

- Course introduction and syllabus
- Unix and Linux operating system
- Introduction to Bash shell

Course Staff

- Me:
  - Ruth Anderson, rea@cs
  - Office hours in CSE 460:
    - Mon 12:30-1:20pm & Tues 11-11:50am,
    - and by appointment

Course Introduction

- CSE391
  - Collection of tools and topics not specifically addressed in other courses that CSE majors should know
  - CSE 351 may be the first course you take that uses Linux
  - Course Topics: Linix command line interface (CLI), Shell scripting, compilation tools (makefiles), version control…
  - Credit / No Credit course, determined by short weekly assignments

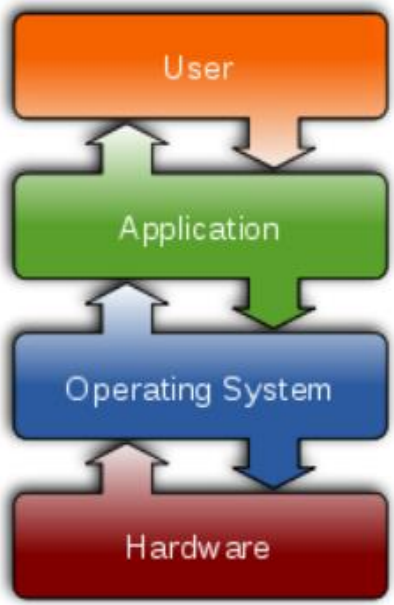
Operating systems

- What is an OS? Why have one?
- What is a Kernel?

Operating systems

- **operating system**: Manages activities and resources of a computer.
  - software that acts as an interface between hardware and user
  - provides a layer of abstraction for application developers

- features provided by an operating system:
  - ability to execute programs (and multi-tasking)
  - memory management (and virtual memory)
  - file systems, disk and network access
  - an interface to communicate with hardware
  - a user interface (often graphical)



- **kernel**: The lowest-level core of an operating system.

Unix

- brief history:
  - Multics (1964) for mainframes
  - Unix (1969)
  - K&R
  - Linus Torvalds and Linux (1992)

- key Unix ideas:
  - written in a high-level language (C)
  - virtual memory
  - hierarchical file system; "everything" is a file
  - lots of small programs that work together to solve larger problems
  - security, users, access, and groups
  - human-readable documentation included

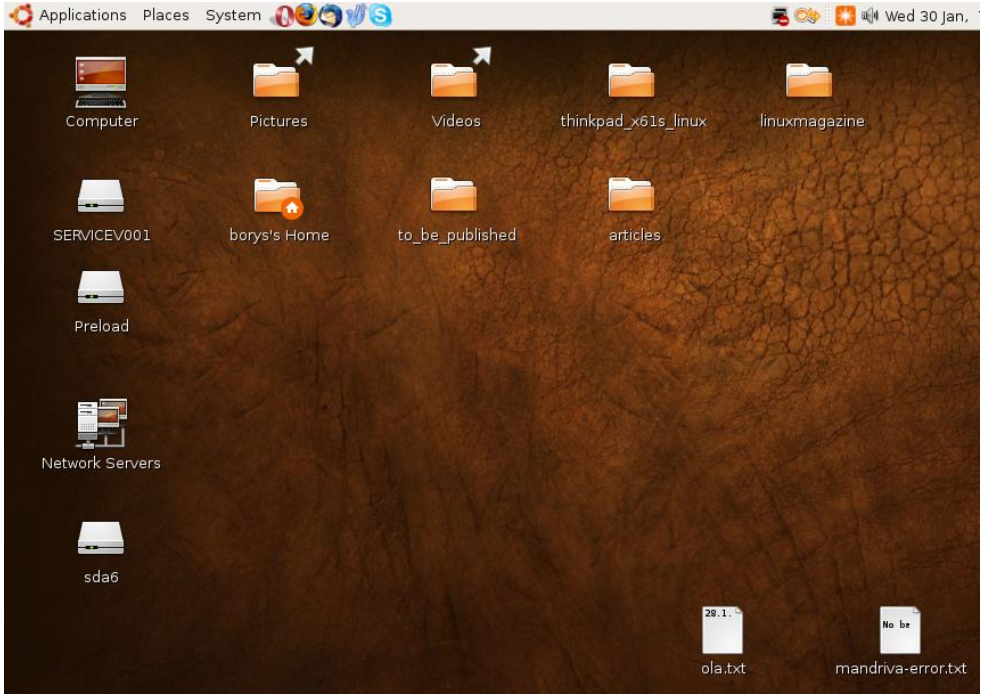
Linux

- **Linux**: A kernel for a Unix-like operating system.
  - commonly seen/used today in servers, mobile/embedded devices, ...
- **GNU**: A "free software" implementation of many Unix-like tools
  - many GNU tools are distributed with the Linux kernel
- **distribution**: A pre-packaged set of Linux software.
  - examples: Ubuntu, Fedora, CentOS

- key features of Linux:
  - **open source software**: source can be downloaded
  - free to use
  - constantly being improved/updated by the community

Linux Desktop

- X-windows
- window managers
- desktop environments
  - Gnome
  - KDE



- How can I try out Linux?
  - CSE Virtual machine
  - CSE basement labs
  - `attu` shared server

Things you can do in Linux

- Load the course web site in a browser
- Install and play games
- Play MP3s
- Edit photos
- IM, Skype

Shell

- **shell**: An interactive program that uses user input to manage the execution of other programs.
  - A command processor, typically runs in a text window.
  - User types commands, the shell runs the commands
  - Several different shell programs exist:
    - `bash` : the default shell program on most Linux/Unix systems
    - We will use bash
    - Other shells: Bourne, csh, tsch

- Why should I learn to use a shell when GUIs exist?

Why use a shell?

- Why should I learn to use a shell when GUIs exist?
  - faster
  - work remotely
  - programmable
  - customizable
  - repeatable

Shell commands

command	description
`exit`	logs out of the shell
`ls`	lists files in a directory
`pwd`	**p**rint the current **w**orking **d**irectory
`cd`	**c**hanges the working **d**irectory
`man`	brings up the manual for a command

```
$ pwd
/homes/iws/rea
$ cd CSE391
$ ls
file1.txt file2.txt
$ ls -l
-rw-r--r-- 1 rea    fac_cs 0 2017-03-29 17:45 file1.txt
-rw-r--r-- 1 rea    fac_cs 0 2017-03-29 17:45 file2.txt
$ cd ..
$ man ls
$ exit
```

Relative directories

directory	description
`.`	the directory you are in ("working directory")
`..`	the parent of the working directory (`../..` is grandparent, etc.)
`~`	your **home** directory (on many systems, this is `/home/`***username***)
`~`***username***	***username***'s **home** directory
`~/Desktop`	your desktop

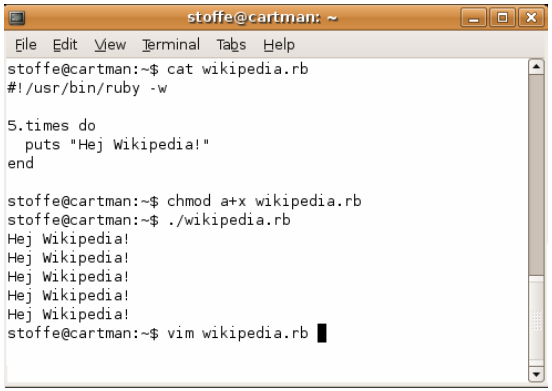
Directory commands

command	description
`ls`	list files in a directory
`pwd`	**p**rint the current **w**orking **d**irectory
`cd`	**c**hanges the working **d**irectory
`mkdir`	create a new directory
`rmdir`	delete a directory (must be empty)

- some commands (`cd`, `exit`) are part of the shell ("builtins")
- others (`ls`, `mkdir`) are separate programs the shell runs

Shell commands

- many accept **arguments** or **parameters**
  - example: cp (copy) accepts a source and destination file path



- a program uses 3 streams of information:
  - stdin, stdout, stderr (standard in, out, error)

- **input**: comes from user's keyboard
- **output**: goes to console
- **errors** can also be printed (by default, sent to console like output)

- parameters vs. input
  - *parameters*: before Enter is pressed; sent in by shell
  - *input*: after Enter is pressed; sent in by user

Command-line arguments

- most options are a `-` followed by a letter such as `-c`
  - some are longer words preceded by two `-` signs, such as `--count`
- options can be combined: `ls -l -a -r` can be `ls -lar`
- many programs accept a `--help` or `-help` option to give more information about that command (in addition to `man` pages)
  - or if you run the program with no arguments, it may print help info
- for many commands that accept a file name argument, if you omit the parameter, it will read from standard input (your keyboard)

Shell/system commands

command	description
`man or info`	get help on a command
`clear`	clears out the output from the console
`exit`	exits and logs out of the shell

command	description
`date`	output the system date
`cal`	output a text calendar
`uname`	print information about the current system

- "man pages" are a very important way to learn new commands

```
man ls
man man
```

File commands

command	description
`cp`	copy a file
`mv`	move or rename a file
`rm`	delete a file
`touch`	create a new empty file, or update its last-modified time stamp

- caution: the above commands do not prompt for confirmation
  - easy to overwrite/delete a file; this setting can be overridden (how?)

- *Exercise* : Given several albums of `.mp3` files all in one folder, move them into separate folders by artist.
- *Exercise* : Modify a `.java file` to make it seem as though you finished writing it on Dec 28 at 4:56am.

Exercise Solutions

- caution: the cp, rm, mv commands do not prompt for confirmation
  - easy to overwrite/delete a file; this setting can be overridden (how?)
    - Use "-i" with the command, "interactive" to prompt before overwrite
- *Exercise* : Given several albums of `.mp3` files all in one folder, move them into separate folders by artist.
  - `mkdir U2`
  - `mkdir PSY`
  - `mkdir JustinBieber`
  - `mv GangnamStyle.mp3 PSY/`
  - `mv Pride.mp3 U2/`
- *Exercise* : Modify a `.java file` to make it seem as though you finished writing it on Dec 28 at 4:56am.
  - `touch -t "201812280456" Hello.java`

Basic Emacs Commands

- C- = control key M- = meta/alt key
- read a file into Emacs: C-x C-f
- save a file back to disk: C-x C-s
- exit Emacs permanently: C-x C-c
- search forward: C-s search backward: C-r
- scroll to next screen: C-v scroll to previous screen: M-v
- Undo: C-x u

entity to move over	backward	forward
character	C-b	C-f
word	M-b	M-f
line	C-p	C-n
go to line beginning/end	C-a	C-e
go to buffer beginning/end	M-<	M->

https://courses.cs.washington.edu/courses/cse391/18sp/handouts/emacs.pdf

Basic Vim Commands

- :w Write the current file
- :wq Write the current file and exit.
- :q! Quit without writing
- To change into insert mode: i or a
  - Use escape to exit
- search forward /, repeat the search backwards: N
- Basic movement:
  - h l k j character left, right; line up, down (also arrow keys)
  - b w word/token left, right
  - ge e end of word/token left, right
  - 0 $ jump to first/last character on the line
- x delete
- u undo

https://wiki.gentoo.org/wiki/Vim/Guide and http://tnerual.eriogerg.free.fr/vimqrc.pdf

Mounting cse homedir on VM

https://www.cs.washington.edu/lab/software/homeVMs/linuxVM#install

- Create a directory in your home directory, called csehomedir:
  - cd
  - mkdir csehomedir
- Now to use that directory as a “link” to your CSE files on your VM:
  - sshfs username@attu: ~/csehomedir **OR**
  - sshfs username@attu.cs.washington.edu:/homes/iws/username ~/csehomedir/
- It is a good idea to back up your files from your VM regularly.
  - Actually keep your files on your CSE home directory
  - Regularly move files from your VM to another location
  - If you need to get a fresh VM image, you can save the files from your old VM using this procedure: **"My VM Seems Broken. How Do I Recover?"**
- https://www.cs.washington.edu/lab/software/homeVMs/linuxVM#faq

My VM is Broken!

https://www.cs.washington.edu/lab/software/homeVMs/linuxVM#install

- If your VM is misbehaving, first try a reboot of the VM and also of your machine. If that doesn't work, often it is easiest just to get a fresh VM image and start over (maybe you saved the .zip file you downloaded previously?)
- BEFORE you delete your current copy of the VM, you can save the files from your current copy of the VM using this procedure:
  - See **"My VM Seems Broken. How Do I Recover?"** here:

https://www.cs.washington.edu/lab/software/homeVMs/linuxVM#faq