# CSE 391
# Lecture 1

introduction to Linux/Unix environment

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

# Lecture summary

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

# Course Introduction

- Instructor:
  - Zorah Fung, zorahf@cs
  - CSE2 311
  - OH: Tues, 2:30-3:30pm

# Course Introduction

- TA:
  - Josh Ervin, joshue@uw

# Course Introduction

- Website: http://cs.washington.edu/391

- Collection of tools and topics not specifically addressed in other courses that CSE majors (and interested others) should know
  - CSE 351 may be the first course you take that uses Linux

- Credit / No Credit course, determined by weekly assignments
  - Graded primarily on effort/completion

- "Textbook" – *Linux Pocket Guide*
  - Optional but recommended; very useful guide

# Course Topics

- Linux command line interface (CLI)
- Shell commands
- Users and groups
- Permissions
- Shell scripting
- Regular expressions
- Project management tools (e.g. makefiles)
- Version control (e.g. git)

# Homework/Grading

- ~Nine weekly assignments
  - Released after lecture
  - Due following Tuesday, 1:00pm (no late work accepted)
- Based on material covered in that week's lecture
  - A few "self-discovery" extensions
  - All required information in lecture, slides, book, and/or man pages
- Graded out of 2 points each
  - Primarily determined by effort/completion (see syllabus)
  - Total of 14 points required to receive credit for the course
- To be completed on Linux/Unix systems (next slide)
- Collaboration allowed/encouraged, but **ALL SUBMITTED WORK MUST BE YOUR OWN**

# Accessing Linux/Unix

*Roughly in suggested order…*

- `ssh` to attu (CSE majors), linuxNN (EE majors), or ovid (all UW students)
- Download/run CSE VM
- Visit CS or EE basement labs
- Set up Linux on your own machine

- See "Working at Home" on course website for more info

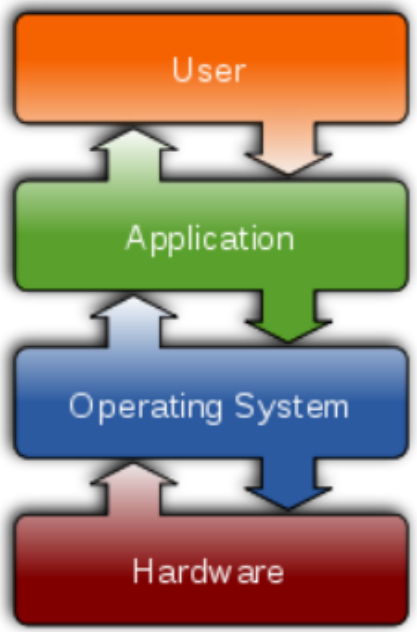
# Operating systems

- 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

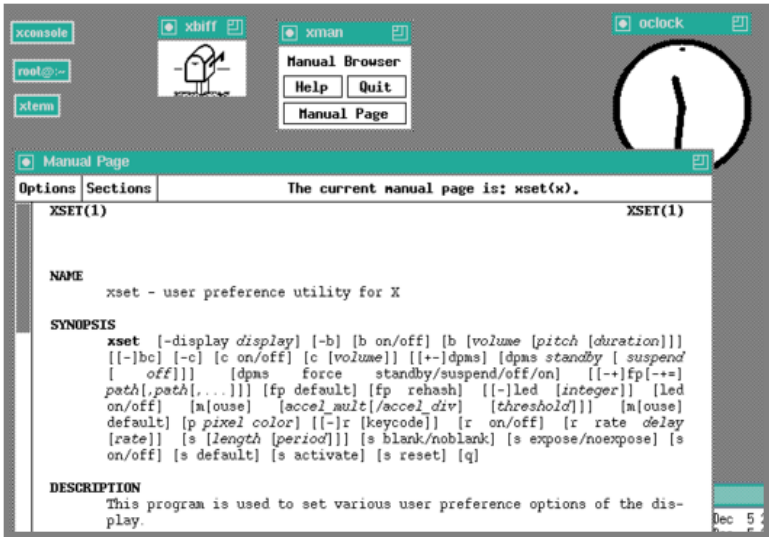
- features provided by an operating system:
  - ability to execute programs (and multi-tasking)
  - memory management (and virtual memory)
  - file systems, disk and network access
  - an interface to communicate with hardware
  - a user interface (often graphical)




- **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)



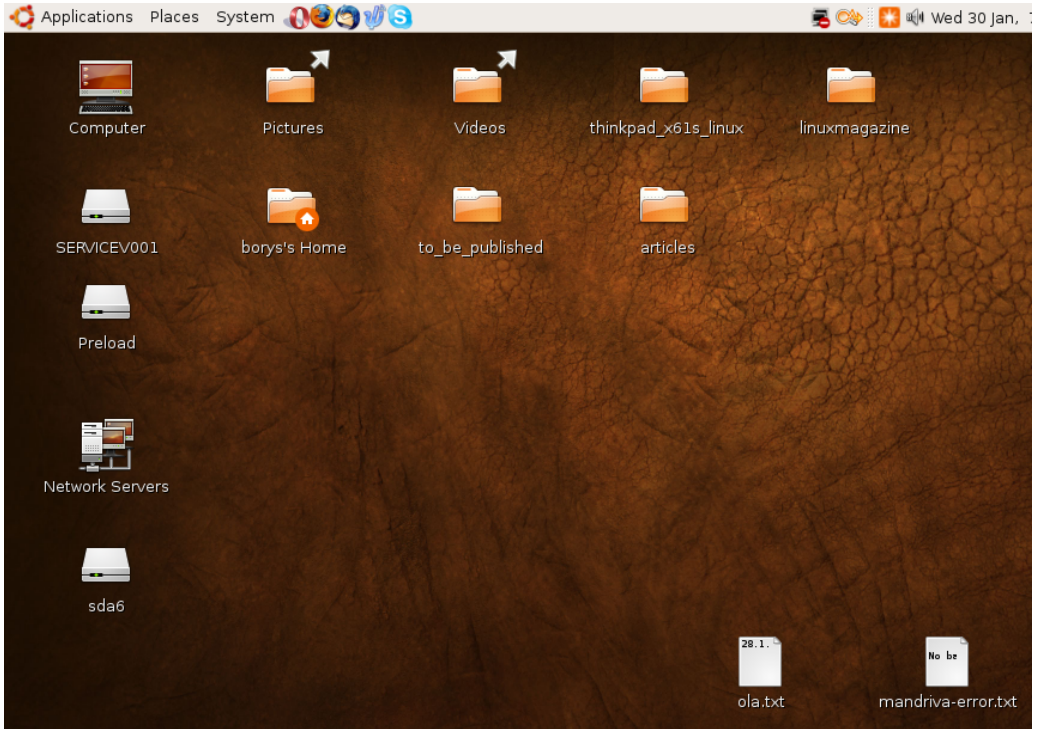

- key Unix ideas:
  - written in a high-level language (C)
  - virtual memory
  - hierarchical file system; "everything" is a file
  - lots of small programs that work together to solve larger problems
  - security, users, access, and groups
  - human-readable documentation included

# 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

# Example shell commands

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

```
$ 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
```

# 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 |
| `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
```

# Relative directories

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

# Unix file system

| directory | description |
|---|---|
| `/` | root directory that contains all others<br>(drives do not have letters in Unix) |
| `/bin` | programs |
| `/dev` | hardware devices |
| `/etc` | system configuration files<br>▪ `/etc/passwd` stores user info<br>▪ `/etc/shadow` stores passwords |
| `/home` | users' home directories |
| `/media`,<br>`/mnt`, … | drives and removable disks that have been "mounted" for use on this computer |
| `/proc` | currently running processes (programs) |
| `/tmp`, `/var` | temporary files |
| `/usr` | user-installed programs |

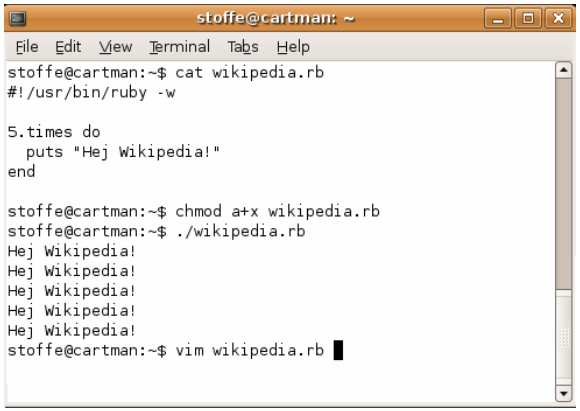
# Directory commands

| 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

# Command-line arguments

- 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)

# 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<br>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`

# Text editors

| command | description |
|---|---|
| `pico or nano` | simple editors |
| `emacs` | More advanced text editor |
| `vi or vim` | More advanced text editor |

- you cannot run graphical programs when connected to `attu` (yet)
  - so if you want to edit documents, you need to use a text-only editor

- **most advanced Unix/Linux users learn `emacs` or `vi`**
  - I would recommend you try to pick up the basics of one of these.
  - Your choice!

# 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.p