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# 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

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

# Course Staff

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- Me:
  - Ruth Anderson, rea@cs
  - Office hours in CSE 460:
    - Mon 1:30-2:30pm, Tues 11-11:50am,
    - and by appointment

# Course Introduction

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- 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: Linux command line interface (CLI), Shell scripting, compilation tools (makefiles), version control...
  - Credit / No Credit course, determined by short weekly assignments

# Operating systems

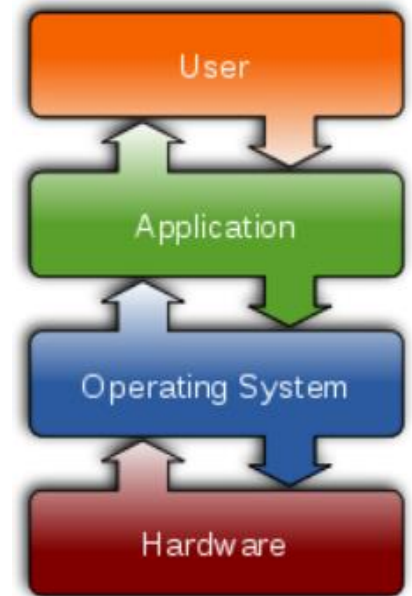
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- What is an OS? Why have one?
- What is a Kernel?

# Operating systems

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- **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.



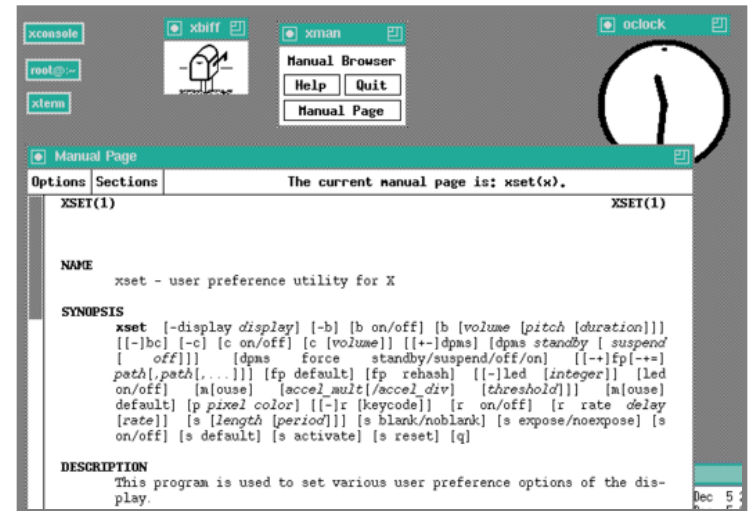
# Unix

- 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



The screenshot shows a desktop environment with several windows. The main window is titled 'Manual Page' and displays the manual for the 'xset' utility. The manual text is as follows:

```
XSET(1) XSET(1)

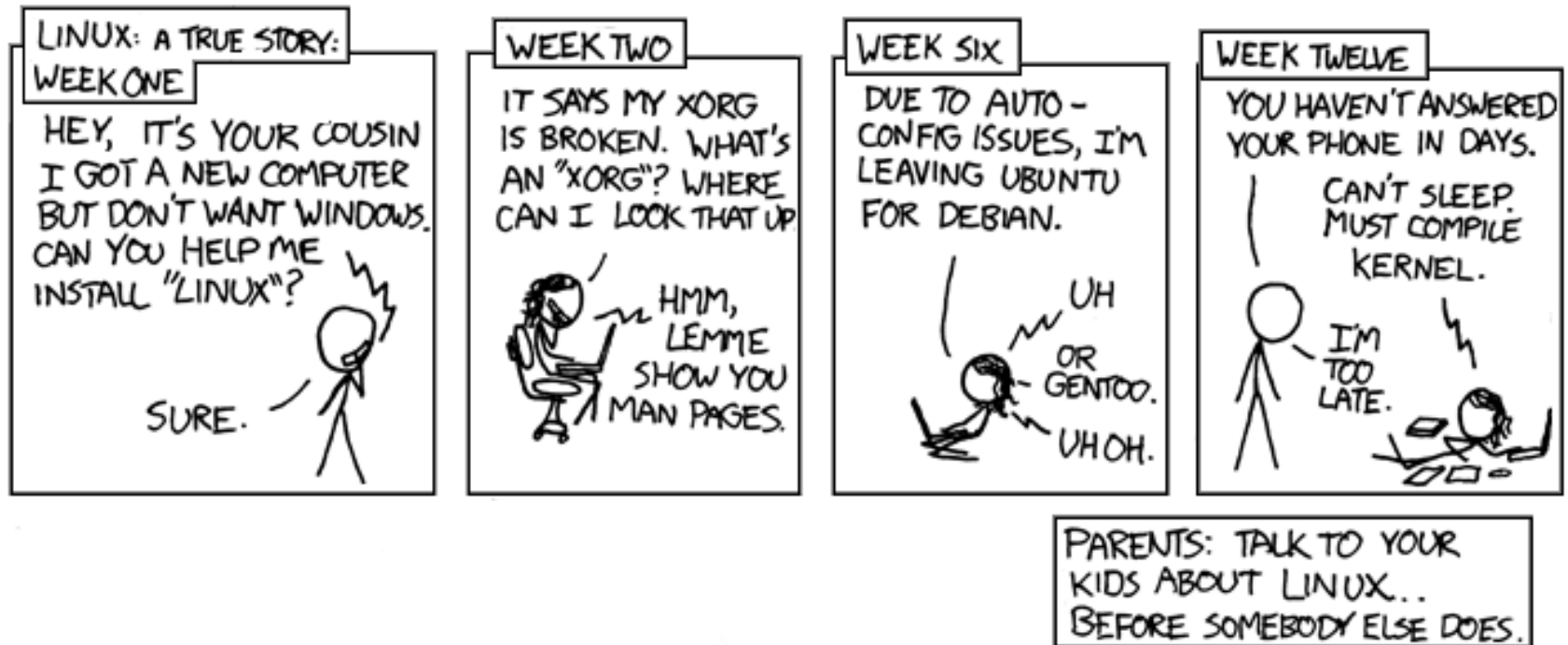
NAME
  xset - user preference utility for X

SYNOPSIS
  xset [-display display] [-b] [b on/off] [b [volume [pitch [duration]]]
  [[-]bc] [-c] [c on/off] [c [volume]] [[+]-dpms] [dpms standby [suspend
  [ off]]] [dpms force standby/suspend/off/on] [[-+]fp[+]=]
  path[,path,...]]] [fp default] [fp rehash] [[-]led [integer]] [led
  on/off] [m[ouse] [accel_mult[/accel_div] [threshold]]] [m[ouse]
  default] [p [pixel color] [[-]r [keycode]] [r on/off] [r rate delay
  [rate]] [s [length [period]]] [s blank/noblank] [s expose/noexpose] [s
  on/off] [s default] [s activate] [s reset] [q]

DESCRIPTION
  This program is used to set various user preference options of the dis-
  play.

Dec 5 1992
```

# On to Linux



Courtesy XKCD.com



# Linux

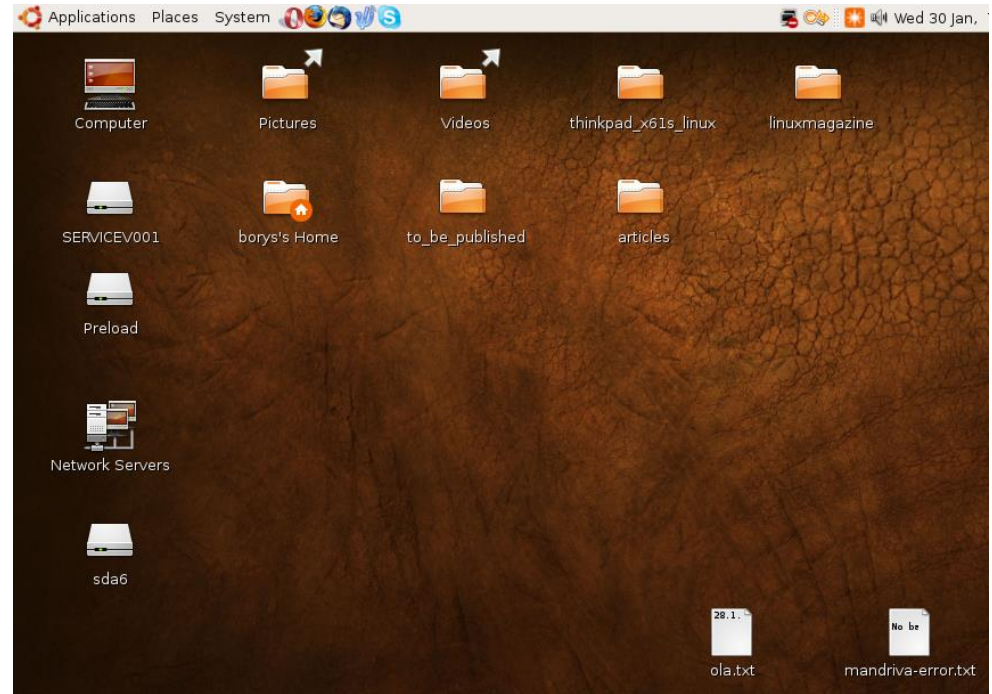
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- **Linux:** A kernel for a Unix-like operating system.
  - commonly seen/used today in servers, mobile/embedded devices, ...
- **GNU:** A "free software" implementation of many Unix-like tools
  - many GNU tools are distributed with the Linux kernel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

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

# Shell

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- **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?

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- 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	<b>p</b> rint the current <b>w</b> orking <b>d</b> irectory
cd	<b>c</b> hanges the working <b>d</b> 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 2016-03-29 17:45 file1.txt
-rw-r--r-- 1 rea    fac_cs 0 2016-03-29 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 <u>home</u> directory (on many systems, this is /home/ <i>username</i> )
~ <i>username</i>	<i>username</i> 's <u>home</u> directory
~/Desktop	your desktop

# Directory commands

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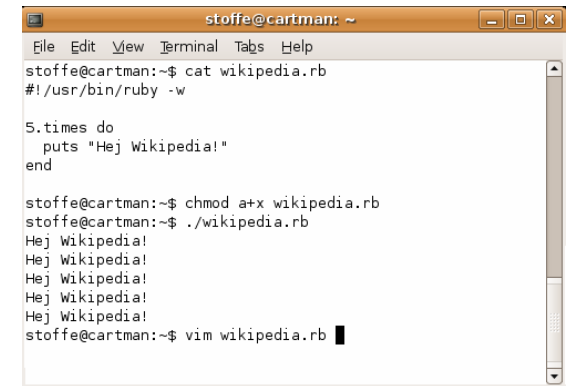
command	description
ls	list files in a directory
pwd	<b>p</b> rint the current <b>w</b> orking <b>d</b> irectory
cd	<b>c</b> hanges the working <b>d</b> irectory
mkdir	create a new directory
rmdir	delete a directory (must be empty)

- 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



```
stoffe@cartman: ~  
File Edit View Terminal Tabs Help  
stoffe@cartman:~$ cat wikipedia.rb  
#!/usr/bin/ruby -w  
  
5.times do  
  puts "Hej Wikipedia!"  
end  
  
stoffe@cartman:~$ chmod a+x wikipedia.rb  
stoffe@cartman:~$ ./wikipedia.rb  
Hej Wikipedia!  
Hej Wikipedia!  
Hej Wikipedia!  
Hej Wikipedia!  
Hej Wikipedia!  
stoffe@cartman:~$ vim wikipedia.rb
```

# Command-line arguments

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- 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

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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

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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.

# Mounting cse homedir on VM

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<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!

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<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>

# Exercise Solutions

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- 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 201412280456 Hello.java`

# Basic Emacs Commands

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- 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->



# Basic Vim Commands

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- `: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