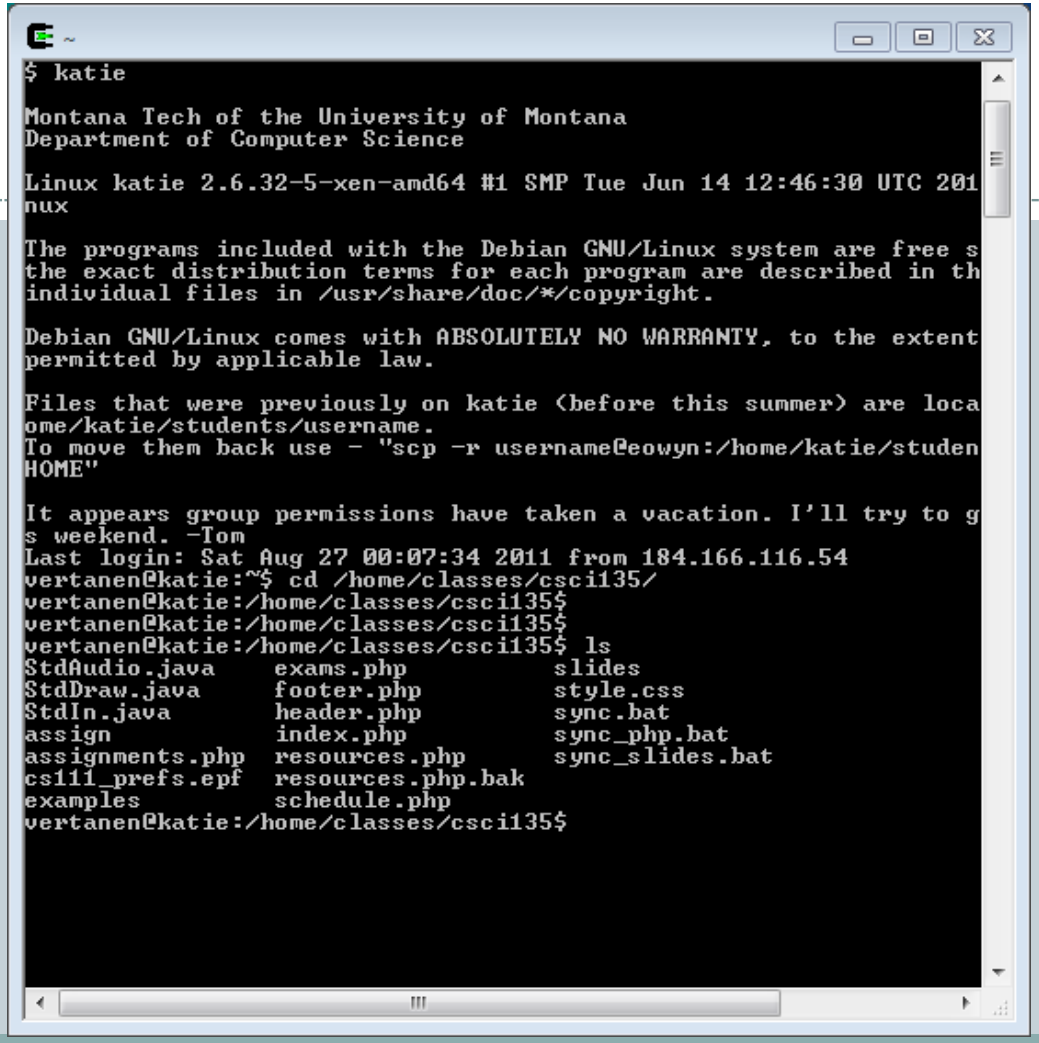
# More Linux – Piping and Redirection

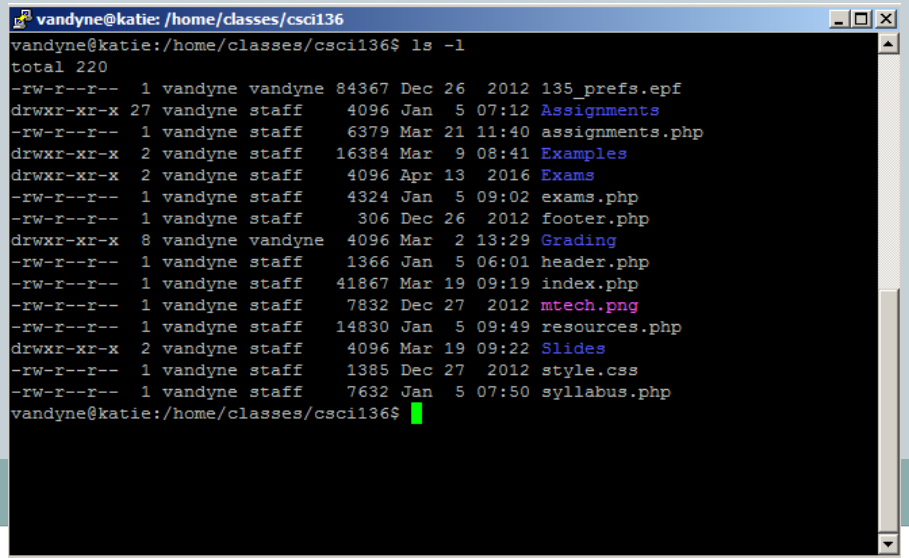


# Outline

- File and Directory Permissions
- File Content
- Finding Files
- Sorting Files
- File Compression
- Processes
- Pipes
- Input/Output Redirection
- Controlling Processes

# File and Directory Permissions

| Permission | File | Directory |
|---|---|---|
| read | User can look at the contents of the file | User can list the files in the directory |
| write | User can modify the contents of the file | User can create new files and remove existing files in the directory |
| execute | User can use the filename as a Linux command | User can change into the directory, but cannot list the files unless they have read permission. User can read files if they have read permission on them. |



# Changing File Permissions

- `chmod` *`options files`*
- Two forms:
  - *options* as a sequence of three octal digits
    - first digit is for owner permissions
    - second for group permissions
    - third is for everyone else

```
drwxr-xr-x
-rw-r--r--
-rw-r--r--
-rw-r--r--
-rw-r--r--
drwxr-xr-x
```

    - `chmod 600 private.txt`

      -rw-------

| Permission | Binary | Octal |
|---|---|---|
| --- | 000 | 0 |
| --x | 001 | 1 |
| -w- | 010 | 2 |
| -wx | 011 | 3 |
| r-- | 100 | 4 |
| r-x | 101 | 5 |
| rw- | 110 | 6 |
| rwx | 111 | 7 |

# Changing File Permissions

- `chmod options files`
- Second form:
  - *options* as a sequence of symbols
  - u – user, g – group, o, other, a – all, r – read, w – write, x – execute
  - "+" – add permission, "-" delete permission
    - `chmod ug=rw,o-rw,a-x private.txt`

      -rw-rw----

# File Contents

- `file` *`filename(s)`*
  - Analyzes a files contents

```
$ file myprog.c letter.txt webpage.html
myprog.c:       C program text
letter.txt:     English text
webpage.html:   HTML document text
```

- `head, tail` *`filename`*
  - Displays the first or last few lines in a file
  - You can specify number of lines

```
$ tail -20 messages.txt ↵
$ head -5 messages.txt ↵
```

# File Contents

- od *options filename*
  - Displays binary file contents in different formats

```
$ cat hello.txt↵
hello world
$ od -c hello.txt↵
0000000  h  e  l  l  o     w  o  r  l  d \n
0000014
$ od -x hello.txt↵
0000000 6865 6c6c 6f20 776f 726c 640a
0000014
```

# Finding Files

- find *directory* -name *targetfile* -print

```
$ find /home -name "*.txt" -print 2>/dev/null↵
```

- which *command*

```
$ which ls↵
/bin/ls
```

- locate *string*

```
$ locate ".txt"↵
```

# Finding Text in Files

- `grep options patterns files`
- Stands for General Regular Expression Print

The caret `^' and the dollar sign `$' are special characters that match the beginning and end of a line respectively. The dot '.' matches any character. So

```
$ grep ^..[l-z]$ hello.txt ↵
```

matches any line in `hello.txt` that contains a three character sequence that ends with a lowercase letter from l to z.

- `egrep options patterns files`
- Stands for Extended grep
  - Can join expressions with or '|', can use parentheses for grouping
  - Can use other regular expression operators:
    - ?, *, +, {N}, {N,}, {N,M}

# Sorting File Contents

- `sort` *`filenames`*

```
$ sort input1.txt input2.txt > output.txt ↵
```

outputs the sorted concentenation of files `input1.txt` and `input2.txt` to the file `output.txt`.

- `uniq` *`filename`*
  - Removes duplicate adjacent lines in a file, handy when combined with sort:

```
$ sort input.txt | uniq > output.txt ↵
```

# File Backup – tar – and Compression

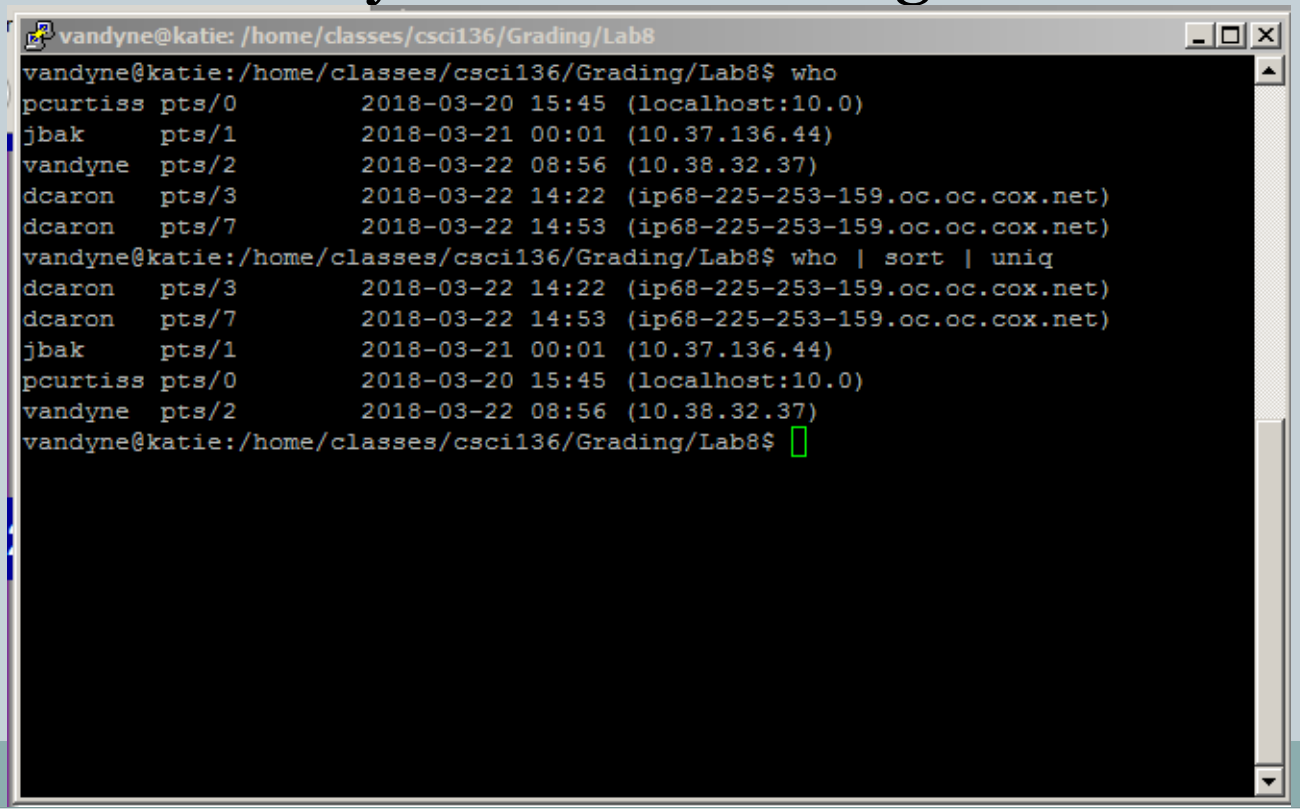
- To create a disk file `tar` archive:
  - tar -cvf *archivename filenames*
- To list the contents of an archive:
  - tar -tvf *archivename*
- To restore files from a `tar` archive:
  - tar -xvf *archivename*
- To compress files in a `tar` archive:
  - compress *filename*
- Or:
  - gzip *filename*

# Processes

- A process is a program in execution
  - Each has a unique process identifier (PID)
  - The first process started when Linux boots is init
    - All processes are children of init
  - Can be any executing program:
    - Your running Java program
    - A command you are executing
    - A daemon started by the Linux kernel
    - Etc.

# Pipes

- Pipe operator '|' creates concurrently executing processes which pass data directly to one another
- Used to combine system utilities together



# Input/Output Redirection

- Linux treats everything as a file
  - Including standard input (keyboard), standard output (screen) and standard error (also the screen)
  - We can redirect input or output from these “files” using the redirection operators < and >
    - The “arrow” points to where the input/output goes

# Redirecting Standard Output

- To redirect standard output to a file instead of a screen, use the > operator:

```
$ echo hello ↵
hello
$ echo hello > output ↵
$ cat output ↵
hello
```

- This will create a new blank file each time
  - If you want to append to a file, use >>

```
$ echo bye >> output ↵
$ cat output ↵
hello
bye
```

# Redirecting Standard Error to a File

- Standard input (0), standard output (1) and standard error (2) have those numbers associated with them
- To output any error messages to a file, use 2>

```
$ cat nonexistent 2>errors↵
$ cat errors↵
cat: nonexistent: No such file or directory
$
```

- To output results to one file and errors to another:
  - find . –print 1>files 2>errors
- This is **very** handy when you are compiling a program and you get a whole list of error messages

# Redirecting Standard Input

- Input will be read from a file rather than from keyboard input

```
$ cat < output ↵
hello
bye
```

- Remember – the "arrow" points to where the data will go
  - In this case it will come from a file and go into the command "cat"

# Controlling Processes

- You can run several processes at the same time
  - Processes can run in the foreground (the thing you currently see) or in the background (you don't see it running, but it is)
- To start a process in the background, use & at the end of the command line:

```
$ find / -print 1>output 2>errors &↵
[1] 27501
$
```

- [1] is the job number and 27501 is the process id (PID)
- Note: if your background process prints to the screen, it will show up as you're doing something else

# Controlling Processes

- To put the current process in the background:
  - Type Ctrl-Z
- To bring a background process to the foreground:
  - fg %<job number>
- To see all of the processes you have running:
  - ps

```
$ ps↵
  PID TTY          TIME CMD
17717 pts/10   00:00:00 bash
27501 pts/10   00:00:01 find
27502 pts/10   00:00:00 ps
```

# Controlling Processes

- What if you have a process you want to stop? (Maybe it's in an infinite loop, maybe… it's just a bad process?)
  - You can use:
    - kill %<job number> OR
    - kill <PID>
  - These are polite ways of asking the process to terminate
  - Processes are not always polite in return…
    - kill -9 <PID>
      - This will kill them on contact

# Summary

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