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# CSE 391

## Lecture 2

Exploring Shell Commands, Streams, and Redirection

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<http://www.cs.washington.edu/391/>

# Lecture summary

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- Unix file system structure
- Commands for file manipulation, examination, searching
- Java compilation: using parameters, input, and streams
- Redirection and Pipes

# Unix file system

directory	description
/	root directory that contains all others (drives do not have letters in Unix)
/bin	programs
/dev	hardware devices
/etc	system configuration files <ul style="list-style-type: none"><li>▪ /etc/passwd stores user info</li><li>▪ /etc/shadow stores passwords</li></ul>
/home	users' home directories
/media, /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

# Links

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command	description
<code>ln</code>	create a link to a file
<code>unlink</code>	remove a link to a file

- **hard link:** Two names for the same file.

```
$ ln orig other_name
```

- the above command links `other_name` as a duplicate name for `orig`
  - if one is modified, the other is too; follows file moves

- **soft (symbolic) link:** A reference to another existing file.

```
$ ln -s orig_filename nickname
```

- the above command creates a reference `nickname` to the file `orig_filename`
  - `nickname` can be used as though it were `orig_filename`
  - but if `nickname` is deleted, `orig_filename` will be unaffected

# File examination

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command	description
cat	output a file's contents on the console
more or less	output a file's contents, one page at a time
head, tail	output the first or last few lines of a file
wc	count words, characters, and lines in a file
du	report disk space used by a file(s)
diff	compare two files and report differences

- Let's explore what we can do here...

# Searching and sorting

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command	description
grep	search a file for a given string (useful options: <code>-v</code> and <code>-i</code> )
sort	convert an input into a sorted output by lines
uniq	strip duplicate (adjacent) lines
find	search for files within a given directory
locate	search for files on the entire system
which	shows the complete path of a command

- `grep` is actually a very powerful search tool; more later...
- *Exercise* : Given a text file `names.txt`, display the students arranged by the reverse alphabetical order of their names.

Answers posted in `lecture_commands.txt` after lecture

# Keyboard shortcuts

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**^KEY** means hold Ctrl and press **KEY**

key	description
Up arrow	repeat previous commands
Home/End or ^A/^E	move to start/end of current line
"	quotes surround multi-word arguments and arguments containing special characters
*	"wildcard" , matches any files; can be used as a prefix, suffix, or partial name
Tab	auto-completes a partially typed file/command name
^C or ^\ (Ctrl-C)	terminates the currently running process
^D (Ctrl-D)	end of input; used when a program is reading input from your keyboard and you are finished typing
^Z (Ctrl-Z)	suspends (pauses) the currently running process
^S (Ctrl-S)	don't use this; hides all output until ^Q is pressed

# Shell History

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- The shell remembers all the commands you've entered
- Can access them with the `history` command
- Can execute the most recent matching command with `!`
  - Ex: `!less` will search backwards until it finds a command that starts with `less`, and re-execute the entire command line
- Can execute also execute a command by number with `!`

```
165 19:36 ls
166 19:37 cat test.txt
167 19:38 pwd
168 19:40 history
```

Ex: `!166` will execute: `"cat test.txt"`



# Programming

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command	description
<code>javac <i>ClassName</i>.java</code>	compile a Java program
<code>java <i>ClassName</i></code>	run a Java program
<code>python, perl, ruby, gcc, sml, ...</code>	compile or run programs in various other languages

- *Exercise* : Write/compile/run a program that prints "Hello, world!"

```
$ javac Hello.java
```

```
$ java Hello
```

```
Hello, world!
```

```
$
```

# Programming

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- Creating parameter input to programs
  - `String[] args` holds any provided parameters
  - *Exercise:* modify hello world to use parameters
- Parameters not the same as the input stream!
  - *Exercise:* modify hello world to also use a Scanner to grab input

Let's revisit the standard streams...

# Streams in the Shell

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- Stdin, stdout, stderr
  - These default to the console
  - Some commands that expect an input stream will thus read from the console if you don't tell it otherwise.
- *Example:* `grep hi`
  - What happens? Why?

We can change the default streams to something other than the console via redirection.

# Output redirection

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*command* > *filename*

- run *command* and write its output to *filename* instead of to console;
  - think of it like an arrow going from the command to the file...
  - if the file already exists, it will be overwritten (be careful)
  - >> appends rather than overwriting, if the file already exists
  - *command* > /dev/null suppresses the output of the command
- Example: `ls -l > myfiles.txt`
- Example: `java Foo >> Foo_output.txt`
- Example: `cat > somefile.txt`  
(writes console input to the file until you press ^D)

# Input redirection

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*command* < *filename*

- run *command* and read its input from *filename* instead of console
  - whenever the program prompts the user to enter input (such as reading from a Scanner in Java), it will instead read the input from a file
  - some commands don't use this; they accept a file name as an argument
- Example: `java Guess < input.txt`
- *Exercise*: run hello world with the input stream as a file instead of the console
- *Exercise*: Also change the output stream to write the results to file
- again note that this affects *user input*, not *parameters*
- useful with commands that can process standard input or files:
  - e.g. `grep`, `more`, `head`, `tail`, `wc`, `sort`, `uniq`, `write`

# Combining commands

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*command1* | *command2*

- run *command1* and send its console output as input to *command2*
- very similar to the following sequence:  

```
command1 > filename  
command2 < filename  
rm filename
```
- Examples: 

```
diff students.txt names.txt | less  
sort names.txt | uniq
```
- *Exercise* : `names.txt` contains CSE student first names, one per line. We are interested in students whose names contain a capital "B", such as "Bart".
  - Find out of how names containing "B" are in the file.
  - Then figure out how many characters long the name of the last student whose name contains "B" is when looking at the names alphabetically.

# Misusing pipes and cat

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- Why doesn't this work to compile all Java programs?

```
ls *.java | javac
```

- Misuse of cat

- bad: `cat input_filename | command`

- good: `command < input_filename`

- bad: `cat filename | more`

- good: `more filename`

- bad: `command | cat`

- good: `command`

# Commands in sequence

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## ***command1 ; command2***

- run ***command1*** and then ***command2*** afterward (they are not linked)

## ***command1 && command2***

- run ***command1***, and if it succeeds, runs ***command2*** afterward
- will not run ***command2*** if any error occurs during the running of 1

- Example: Make directory songs and move my files into it.

```
mkdir songs && mv *.mp3 songs
```