Introduction to Unix/Linux (*nix)

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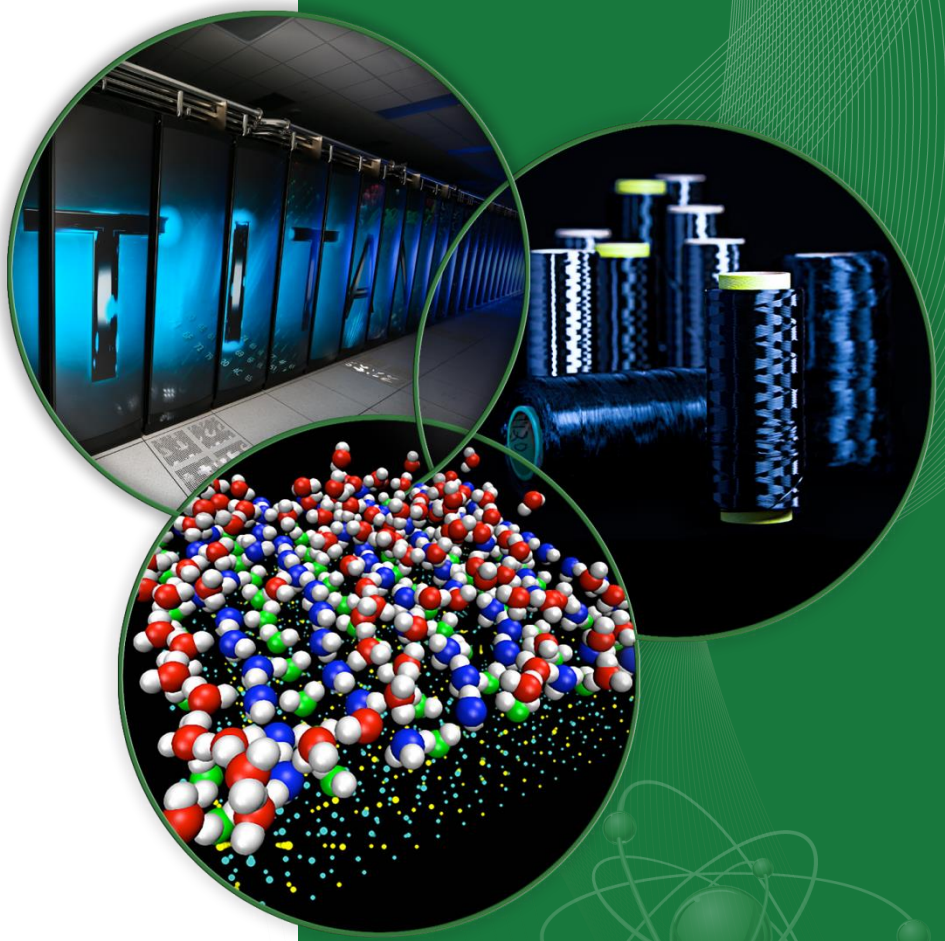

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This Presentation

- This presentation will focus on using basic Unix and Linux commands in an HPC environment
  - Assumes you're using a 'remote' system, ie: that you are logged in via terminal, PuTTY, Powershell, etc.
- Cover the basics
  - The terminal window, command line
  - The filesystem structure & how to navigate it
  - Common commands to create, delete, edit, move, copy, etc., directories and files.
- Follow along here:
  - https://github.com/olcf/foundational_hpc_skills/blob/master/intro_to_unix/README.md
- Google is your friend!

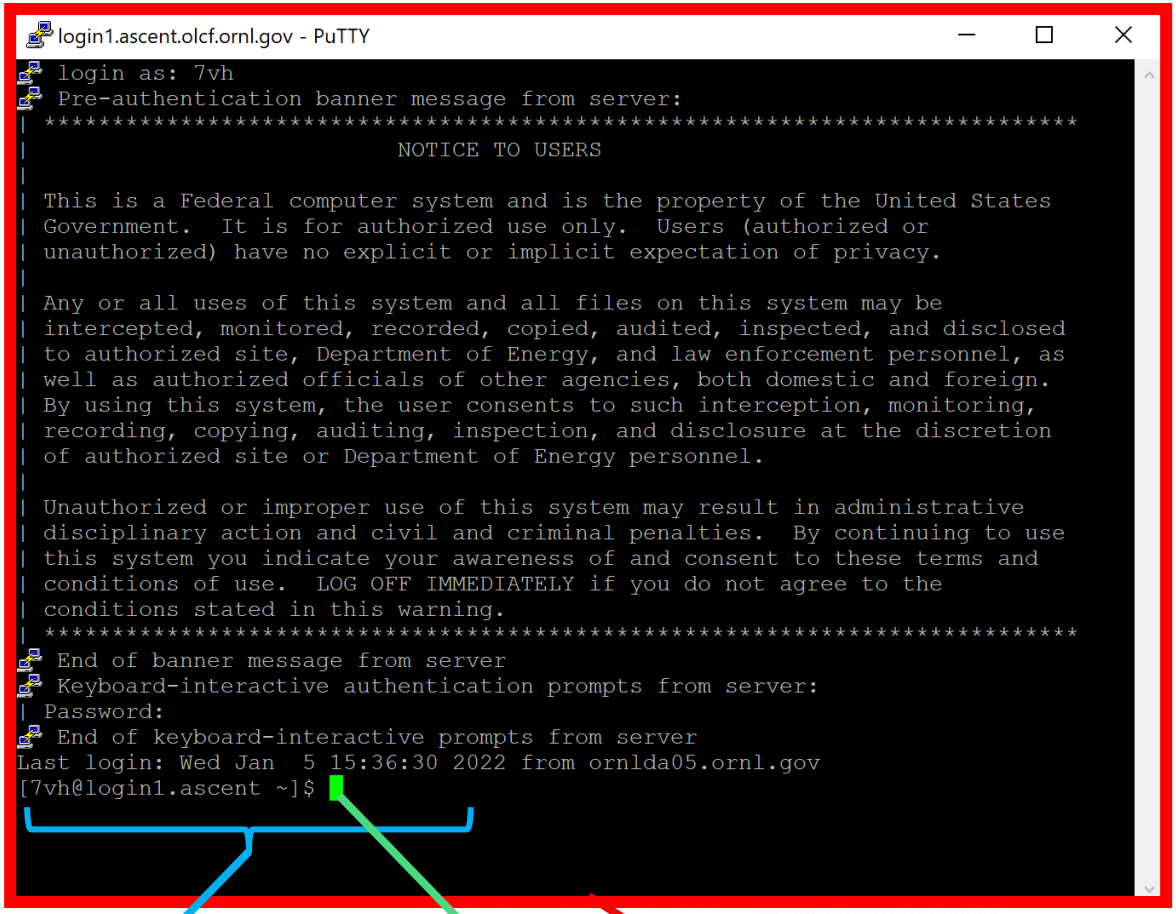
First things first

- **Login** to the remote machine using the username and password you used on Day 1. The IP address will be different; check your email!
- **Recall, the syntax is:** user##@ip.address.goes.here
- **Type** the following and hit **enter:**

```
git clone https://github.com/olcf/foundational_hpc_skills.git
```

The Command Line

- Commands are typed as text on the command line and executed by pressing “enter”
- Many examples show the “$” symbol from the command line before the actual command; you don’t need to type this symbol
- The command line often contains login and username info.
- Try typing `$ whoami` and pressing enter



Basic Commands

- Commands are usually abbreviations of words (or a series of words)
  - cp for “Copy”, rm for “Remove”
- Commands tend to follow the following syntax:

```
[command] [option flags] [file/directory/object to act upon]
```

- Almost all commands take various options to control what they do.
- Some help is available via an online manual
  - The `man` command
  - Example: Want info about `ls`? Type the following:

```
man ls
```

Wildcards

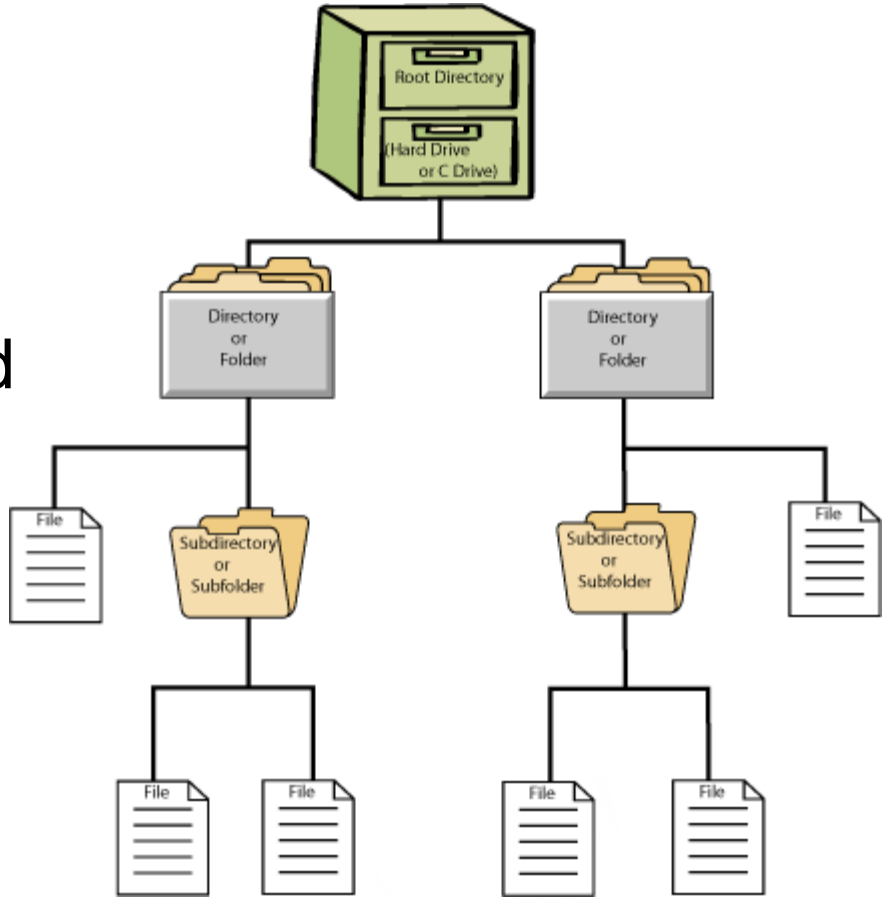
- When dealing with multiple files, it's nice to type a single command for all files at once vs. typing many separate commands for each file
- Wildcards help with this: They are generic characters that "fill in" for other characters
  - `*` means match zero or more character
  - `?` Matches 1 character
  - Example follows (the `ls` command lists files in a directory, we'll worry about specific later)

Wildcards (example)

```
$ ls
file1   file1a  file1b  file2   file2a  file2b  file3
file3a  file3b

$ ls file1?
file1a  file1b

$ ls file2*
file2   file2a  file2b

$ ls file?a
file1a  file2a  file3a
```

The Filesystem

- Think of the filesystem as a tree. Instead of branches, there are “directories. Instead of leaves, there are “files”
- It starts at /, which is called the “root” directory
- The slash (/) is the directory separator; thus when we move into subdirectories it’s used to separate things (i.e. /home/user1/src)

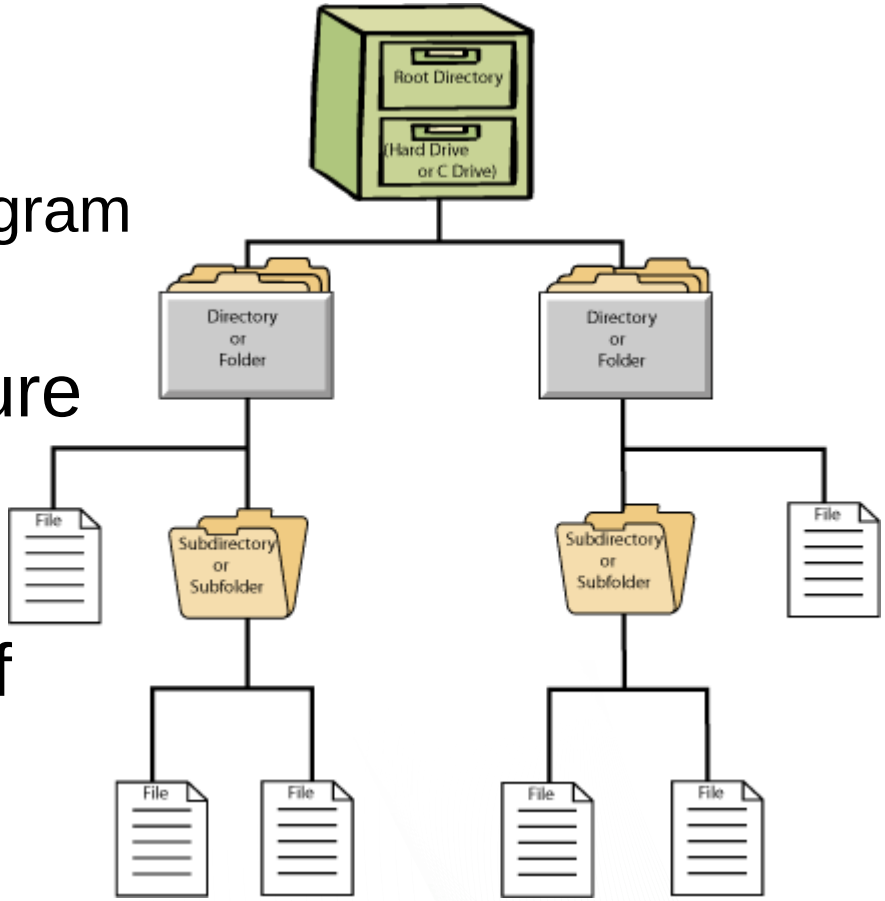


If you are ever “lost”, use the `pwd` command. It prints your location.

```
$ pwd
/ccsopen/home/your_username
```

The Filesystem

- **File** – A collection of data
  - Plain text, Input/output, a program (executable), an image, etc.
- **Directory** – A logical structure to help organize files (think "folder")
- **Filesystem** – A collection of files and directories
- As a user, you land in your "home" directory when you log in, and can create directories and files there, or move elsewhere to do that.



Special Directories

- Every directory contains two special directory entries: ”.” and “..”
- . is a reference to the current directory
- .. is a reference to the parent directory (so we can do things like `cd ..`)
- ~ can be a reference to home directories
  - ~/ is yours
  - ~user1/ is user1’s
- You’ll see how these are useful later

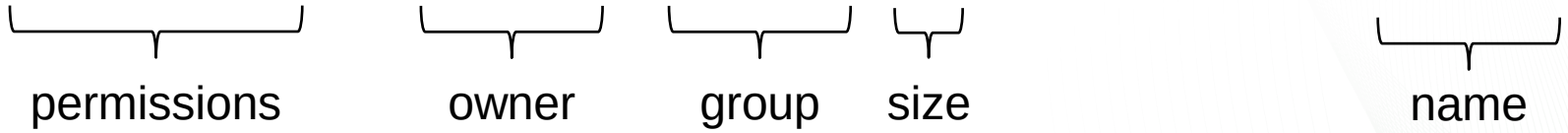
Basic File/Directory Commands

Command	Description
`pwd`	**P**rint **w**orking (i.e. current) **d**irectory
`man`	Display the **Man**ual for a command
`whoami`	Display the current user's username
`mkdir`	Create a directory (**M**a**K**e **DIR**ectory)
`rmdir`	Delete a directory (**R**e**M**ove **DIR**ectory)
`cd`	**C**hange (into a) **d**irectory
`ls`	**Ls**t files
`cp`	**Cp**y a file
`mv`	**Mv**e a file (also used to rename a file)
`rm`	**Rm**ove (delete) a file
`cat`	Display the contents (con**cat**enate) a (hopefully text) file
`less`	Display the contents of a text file in a viewing mode
`find`	**Find** files by filename
`grep`	Search for text within files
`diff`	Identify **diff**erences in the contents of files

Listing Contents – 'ls'

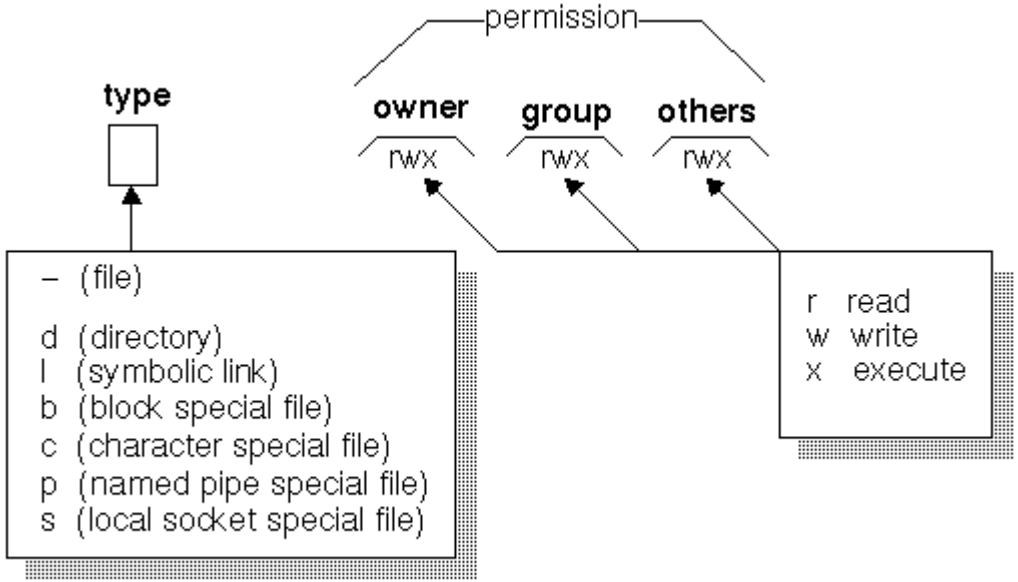
- Lists directory contents
- Helpful option: -l (shows many file attributes)

```
$ ls
filea   fileb

$ ls -l
total 0
-rw-r--r--  1 user1  group1 50 Jun 20 14:15 filea
-rw-r--r--  1 user1  group1  0 Jun 20 14:15 fileb
```



Permissions

- In the permissions string, the characters r, w, and x mean read, write, and execute permission is granted
- A - means the permission is not granted
- The permission groups always show read, write, execute in that order



Listing contents – 'ls' (Other Useful Options)

Option	Meaning
`-1`	Show one file per line (helpful in scripting)
`-F`	Show file types (directories, links, etc)
`-a`	Show all files (including hidden files)
`-r`	Reverse the order of the listing
`-t`	Sort files by timestamp
`-d`	List the (attributes of) the directory itself rather than listing its contents
…And many, many (many) more	

- You can combine options: `ls -altr` is the same as `ls -a -l -t -r` (but more concise & w/less typing)

Directories

Use `pwd, cd, mkdir, rmdir` commands to navigate the filesystem and manipulate directories

```
$ pwd
/home/user1

$ mkdir dir1

$ ls
dir1

$ cd dir1

$ pwd
/home/user1/dir1

$ cd ..

$ rmdir dir1
```

Typing just `cd` will always take you back to home no matter where you are.

Directories must be empty in order to delete them with `rmdir`

Files

- Files are the basic entity for storing data
- Might contain a program, data, configuration info, an image, etc.
- Files have several attributes
  - Permissions: who can do what to/with a file
  - Owner: whose file is this
  - Group: to which group does this file belong

Manipulating Files

- The `rm` command is used to delete a file.
- The `mv` command is used to move and rename files
- There are multiple ways to create and view text files. In the challenge, we will look at various ways to use `cat` and `less` commands to do this.
- Utilities such as `less` and `cat` are intended only for text files. The system will not stop you from running them on a non-text file
  - If you do, you'll get a screenful of unintelligible characters
  - You might get a recognizable prompt (you might not)
  - There's no shame in closing that session's window & re-connecting

Manipulating files

The `cp` command is used to copy a file, and the `mv` command is used to move and rename files.

```
$ ls
dir1    filea   fileb

$ cat filea
This is a file that
contains three lines
of text.

$ cp filea filea1

$ ls
dir1    filea   filea1  fileb

$ mv filea1 filec

$ ls
dir1    filea   fileb   filec
```

Manipulating Files

The `rm` command is used to delete a file. `cat` prints contents of a file to the screen. `less` displays the contents of a file in a viewing mode. (Press “q” to exit).

```
$  cat filec
This is a file that
contains three lines
of text.

$ less filec

$ mv filec dir1

$ ls dir1
filec

$ rm dir1/filec

$ ls
dir1    filea   fileb
```

Many uses of cat

Command	Explanation
cat file1.txt	Display contents of file
cat file1.txt file2.txt	Concatenate two text files and display the result in the terminal
cat file1.txt file2.txt > newcombinedfile.txt	Concatenate two text files and write them to a new file
cat >newfile.txt	Create a file called newfile.txt. Type the desired input and press CTRL+D to finish. The text will be in file newfile.txt.
cat -n file1.txt file2.txt > newnumberedfile.txt	Some implementations of cat, with option -n, can also number lines
cat file1.txt > file2.txt	Copy the contents of file1.txt into file2.txt
cat file1.txt >> file2.txt	Append the contents of file1.txt to file2.txt
cat file1.txt file2.txt | less	Run the program "less" with the concatenation of file1 and file2 as its input

Searching for files

- The `find` command lets you search for files on a huge variety of criteria
- It can also run commands on those files; this makes it one of the most powerful commands available
- General Syntax: `find [path/paths] [expression]`

```
$ find . -name "*data*" -print

$ find . -newer some_file

$ find /home/user1 ! -user user1

$ find . -group users -exec chgrp staff {} \;
```

Searching Within Files - grep

- Sometimes you want to search for patterns/strings in a file. As with other commands, `grep` takes many options. The grep command searches for “regular expressions”…strings that contain characters with special meaning
- Simple case: find lines with the string ‘user’ in file1

```
grep “user” file1
```

- More complex: show lines ending with ‘user’ in file1

```
grep “user$” file1
```

- …or perhaps lines beginning with ‘user’

```
grep “^user” file1
```

- Search all files in a dir1 for the string ‘user’

```
grep –r “user” dir1/
```

Searching Within Files - grep

- Normally, `grep` will treat anything beginning with a hyphen as an option…even if it's in quotes
- The workaround is the `--` option, which tells grep that you're done giving it options (and therefore any other hyphen is meant as an actual hyphen)

```
grep -- "-2" file1
```

- Grep does NOT recognize wildcards in the quoted string to search for. Use "." instead:

```
grep "user." file1
```

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