

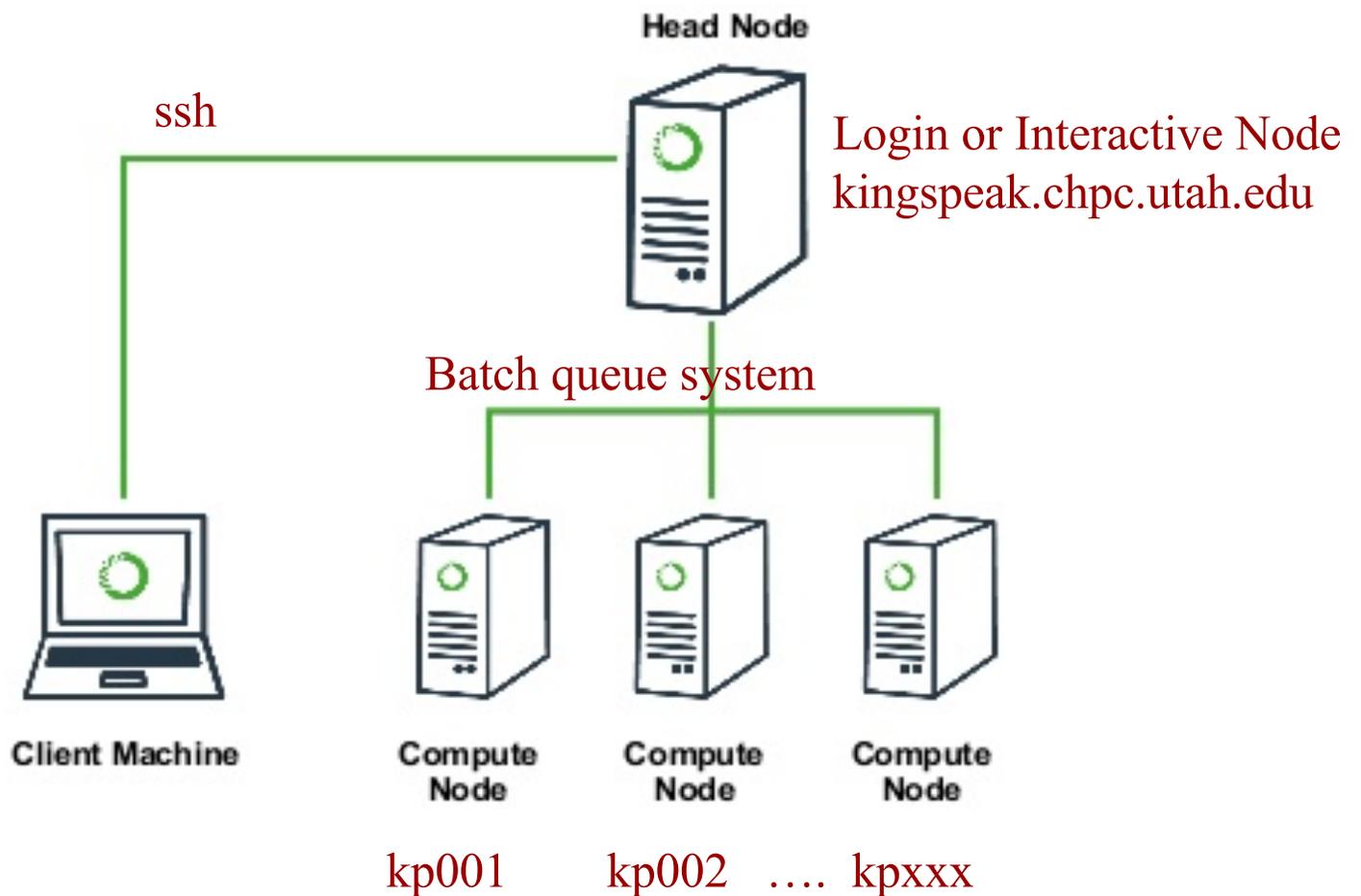
# Introduction to Linux – Part 1

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# Cluster Architecture Diagram



# FastX

- <https://www.chpc.utah.edu/documentation/software/fastx2.php>
- Remote graphical sessions in much more efficient and effective way than simple X forwarding
- Persistence - can be disconnected from without closing the session, allowing users to resume their sessions from other devices.
- Licensed by CHPC
- Desktop clients exist for windows, mac, and linux
- Web based client option
- Server installed on all CHPC interactive nodes and the frisco nodes.

# Windows – alternatives to FastX

- Need ssh client
  - PuTTY
    - <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>
  - XShell
    - [http://www.netsarang.com/download/down\\_xsh.html](http://www.netsarang.com/download/down_xsh.html)
- For X applications also need X-forwarding tool
  - Xming (use Mesa version as needed for some apps)
    - <http://www.straightrunning.com/XmingNotes/>
  - Make sure X forwarding enabled in your ssh client

# Linux or Mac Desktop

- Just need to open up a terminal or console
- When running applications with graphical interfaces, use `ssh -Y` or `ssh -X`

# Getting Started - Login

- Download and install FastX if you like (required on windows unless you already have PuTTY or Xshell installed)
- If you have a CHPC account:
  - `ssh unid@linuxclass.chpc.utah.edu`
- If not get a username and password:
  - `ssh userXX@linuxclass.chpc.utah.edu`

# Shell Basics

- ❑ A Shell is a program that is the interface between you and the operating system (OS – e.g, linux)
- ❑ Command line interface – CLI – versus a GUI – or a graphical user interface
- ❑ Type commands on command line, send command by pressing enter, then the computer reads and executes the command and returns the results (NOTE – not all commands have output!)
- ❑ When commands are done they return to the PROMPT (more on prompts later)
- ❑ Commands can take flags that modify their behaviour
  - flags are formed with – (dash) and letter
- ❑ Commands can also sometimes require an argument – this defines the item upon which the command acts

# Additional Shell Basics

- ❑ Linux is case sensitive!
- ❑ We will focus on two basic shells - slightly different command syntax
  - `csh/tcsh` (C, TENEX C shell)
  - `sh/bash` (Bourne, Bourne again)
- ❑ While many shell commands are the same between shell types – there are syntax and behaviour differences
- ❑ Your account comes with a script that is executed upon login that sets a basic environment for your shell
- ❑ To check which shell you are using: `echo $SHELL`
  - ❑ Note `$SHELL` is an environment variable – more on these later
- ❑ To change shell for the session - enter name of shell you want at the prompt and hit enter

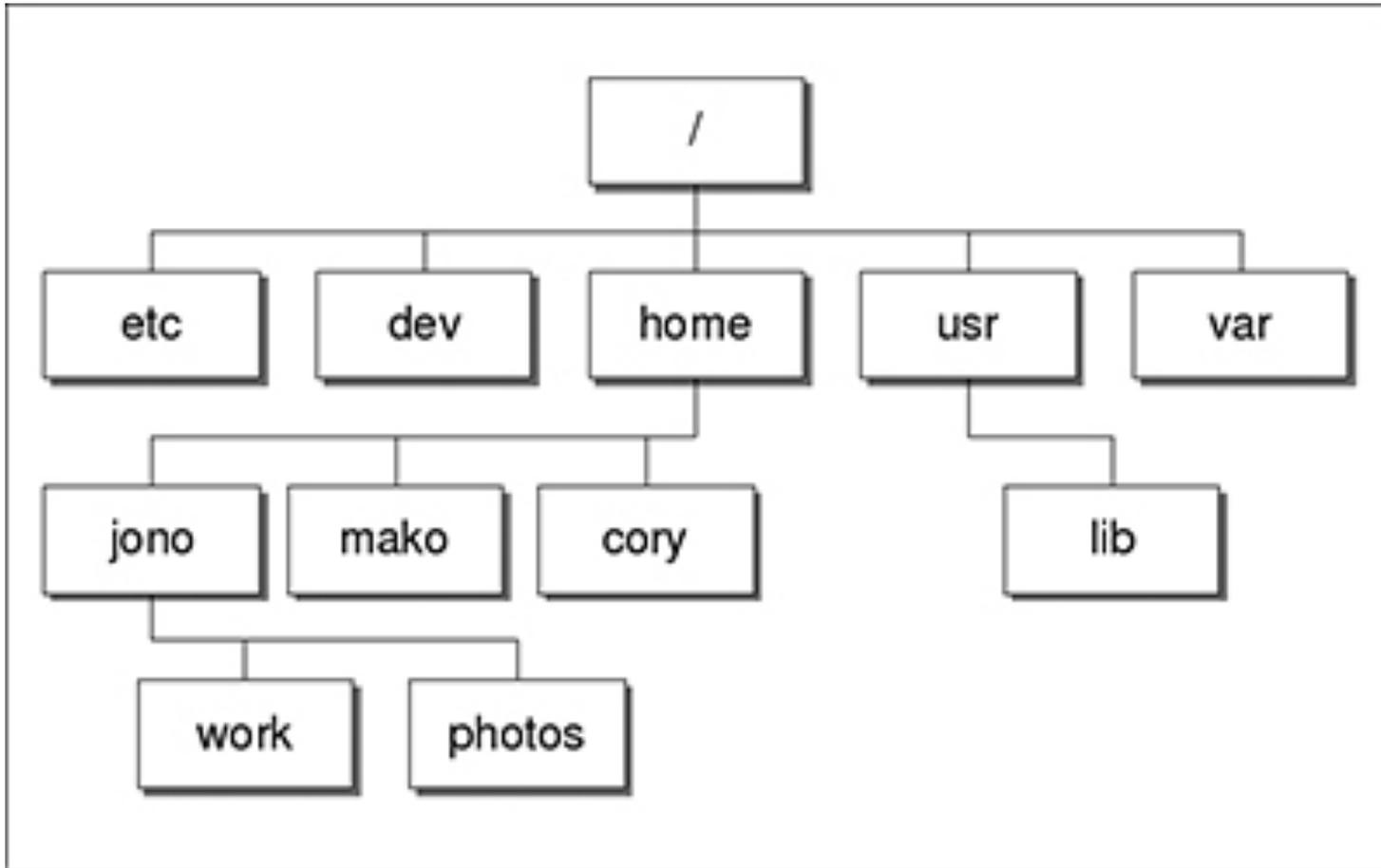
# Other Useful Items

- Up/down arrows go through past commands
- **history** – provides list of all recent commands; can ! followed by number from history list will put that command at the prompt
- Tab completion – of commands, paths, filenames – very useful
- Can edit previous commands – up and down arrow to get to command; then right/left arrow, then delete any characters and type in new at cursor; cntrl-a gets to front of command line, cntrl-e to end of command line

# Directory Structure

- / --- refers to the “root” directory – the top level directory that contains all other directories
- There is a tree directory structure – levels are separated by /
- The home directory is used to refer to a user’s base directory – this is where you will be upon login
  - If you have a CHPC account this is in  
/uufs/chpc.utah.edu/common/home/<yourunid>
  - If you use a temporary account it is /home/<yourusername>
- /path/from/root → absolute path – has leading /
- path/without/leading/slash → relative path from current location
- . → current directory
- .. → parent directory (up one level)

# Directory Structure



At CHPC --- instead of /home we have /uufs/chpc.utah.edu/common/home under which we have all user directories

# Login & Prompts

- When you first login you will see a prompt (the prompt is set by the login script)
  - [u0424091@kingspeak1:~]\$
  - [userxx@linuxclass:~]\$
- When you first login, you will be in your home directory
- To see your username: **whoami**
- To see your current directory: **pwd**
- Shortcuts
  - **~** → your home directory
  - **\$HOME** → your home directory
  - **~username** → someone else's home directory

# Exercise

- Download and install FastX if you do not yet have it on your desktop.
- Login --
- What is your shell?
- What is your username?
- What is the path of your current directory?

# Basic Directory Commands

- **ls** – list contents of a directory
  - Flags to change output To see all flags
    - `ls --help`
    - `man ls`
- **mkdir** – make directory (`mkdir test`)
- **cd** – move to directory (`cd test`)
  - **cd** without an argument moves you back to your home directory
  - `cd ..` -- moves you up one level
- **rmdir** – remove directory (`rmdir test`) – more on this later

# More on ls flags

- ❑ -l : long
- ❑ -a : All (including hidden files, also called dot files)
- ❑ -r : Reverse ordering while sorting
- ❑ -t : Timestamp

# Files & Filenames

- Within directories you can have other directories and also files
- Filenames are often name.extension
- Files that start with a “.” are hidden or dot files
- Extensions are useful for telling you what type of file it is – IF you follow the conventions (txt, pdf, jpg, etc)
  - The extensions also are used by the OS
  - The `file` command will tell you the file type
- Being careful with filenames can make your life easier – some guidelines:
  - Do not use white spaces or other special characters in names as you will have to handle these differently

# Login Scripts & Environment Variables

- In your home directory are a number of dot files - `.bashrc` and `.custom.sh`, `.tcshrc` and `.custom.csh`  
Depending on your shell choice, the appropriate pair of these are executed during login.
- These set the environment (as environment variables) needed for you to work on CHPC resources
- Commands to check your environment: `env` or `printenv`

# File commands

- ❑ **cat** – display contents of file
- ❑ **more** – display contents of file with page breaks (next page with space key) – can also look at **less**
- ❑ **head** – display top of file (default is 10 lines, change with -n)
- ❑ **tail** – display end of file (default is 10 lines, change with -n)
- ❑ **grep** – search for pattern in file (`grep "pattern" test1`)
- ❑ **vi** – edit file (more on this later)
- ❑ **cp** – copies file to a new name (`cp file1 file2`)
- ❑ **mv** – renames file to a new file (`mv old new`)
- ❑ **touch** – creates an empty file if file does not exist OR changes time stamp if it does (`touch file`)
- ❑ **rm** – deletes file (`rm file1`)
  - ❑ Note shells DO NOT have a trash bin; rm is final!

# Wildcards

- more files can be specified via wildcards
- \* - matches any number of letters including none
- ? - matches any single character
- [] - encloses set of characters that can match the single given position
- - used within [] denotes range of characters

## Examples:

```
*.csh , *.*sh , figure?.jpg , *.txt ,  
figure[0-9].*
```

# Exercise

- ❑ Make sure you are in your home directory and then make a directory called `IntroLinux1` and change into this directory
- ❑ Look at the contents of one of MY directories:  
`/uufs/chpc.utah.edu/common/home/u0424091/IntroLinux1`
- ❑ Copy over the contents of this directory into the directory you are in
- ❑ List contents of this directory – see difference of a normal `ls`, `ls -l`, `ls -ltr`, and `ls -ltra`
- ❑ See what output you get when you do a `ls` of: `figure?.jpg` , `figure[0-9].*`
- ❑ Make a new directory called `Work` inside of `IntroLinux1` and copy all files with the `txt` extension from the `IntroLinux1` directory to your new directory
- ❑ Open man page for some command (e.g. `ls`) and see what these flags do

# Exercise

- If you are not already, move into your `IntroLinux1` directory
- **View** `script.slurm` **using** `cat`, `more`, `head` **and** `tail`
- **Vary number of lines viewed with** `head` **and** `tail`
- **Search for the string** `SBATCH` **in this file with** `grep`
- **Use the file command to tell you what the file type of** `ShellReference.pdf`; **copy this file to another filename, with a different extension and check the file type again**

# Command output redirection

- **>** redirect output to a file (instead of to screen)
  - will create file if it does not exist; if it does it will overwrite the previous contents)
  - `cat file1.dat > file4.dat`
- **>>** - append to a file
  - `cat file1.dat >> file3.dat`
- **|** - pipe – redirect command output to another command
  - `head -10 file.txt | tail -2`

# Exercise

- In the `Work` directory, combine the contents of `geom1.txt` and `geom2.txt` into one file named `geom3.txt`
- Using `grep` and the file `states.dat` create a file `Mstates.dat` with only the states that start with the letter `M`
- Create the same file content using `head` and `tail`

# File Permissions

- Shown with `ls -l`
- User (u), group (g), other (o), all (a)
- Permissions are read (r), write (w), execute or search for a directory (x)
- **chmod** – to change permissions of file or directory
- Format `chmod g+x file`
- Executable files (programs and scripts) must have executable permissions

# Processes

- A Process is a running Linux program
  - Each process has a PID (Process ID)
- **ps** reports a snapshot of current processes
  - `ps, ps x` Display ALL of your processes
  - `ps ax` Display ALL processes
  - `ps aux` Display ALL processes (more detailed)
  - `ps auxw` Display ALL processes (more detailed & unlimited width)
  - `ps -eFwww` Also displays ALL processes
- **Kill PID** kills the process with the specified PID

# Some other useful commands

- `pushd directory_name, popd directory_name, dirs`
  - “pushes” and “pops” `directory_name` on to / off of stack
- `wc` – e.g. `wc -l file.txt`
  - Prints line (-l), word (-w), character (-m) or byte (-c) count of file
- `cut` – e.g. `cut -f 2 -d : file.txt`
  - Prints selected parts of lines from file to standard output (screen)
- `du` – e.g. `du -hs`
  - Reports file space usage; -s give summary of total usage, -h gives it in “human readable” format of K, M, G
- `df` – e.g. `df -h`
  - Reports file system disk space usage
- `ln` – e.g. `ln -s ~/bin/prog.exe prog1.exe`
  - create a link between files (-s symbolic)

***On your own – Use and explore options of these commands***

# Have Questions?

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- Wim: [wim.cardoen@utah.edu](mailto:wim.cardoen@utah.edu)
- CHPC has an issue tracking system:  
[issues@chpc.utah.edu](mailto:issues@chpc.utah.edu)
- Slides and files `~u0424091/IntroLinux1`
- Some useful websites  
<http://swcarpentry.github.io/shell-novice/>  
<http://linuxcommand.org/>