Introduction to the Linux shell and Slurm (Part 1)

By Kevin Fotso

Objectives

TO GET A BASIC UNDERSTANDING OF THE LINUX SHELL

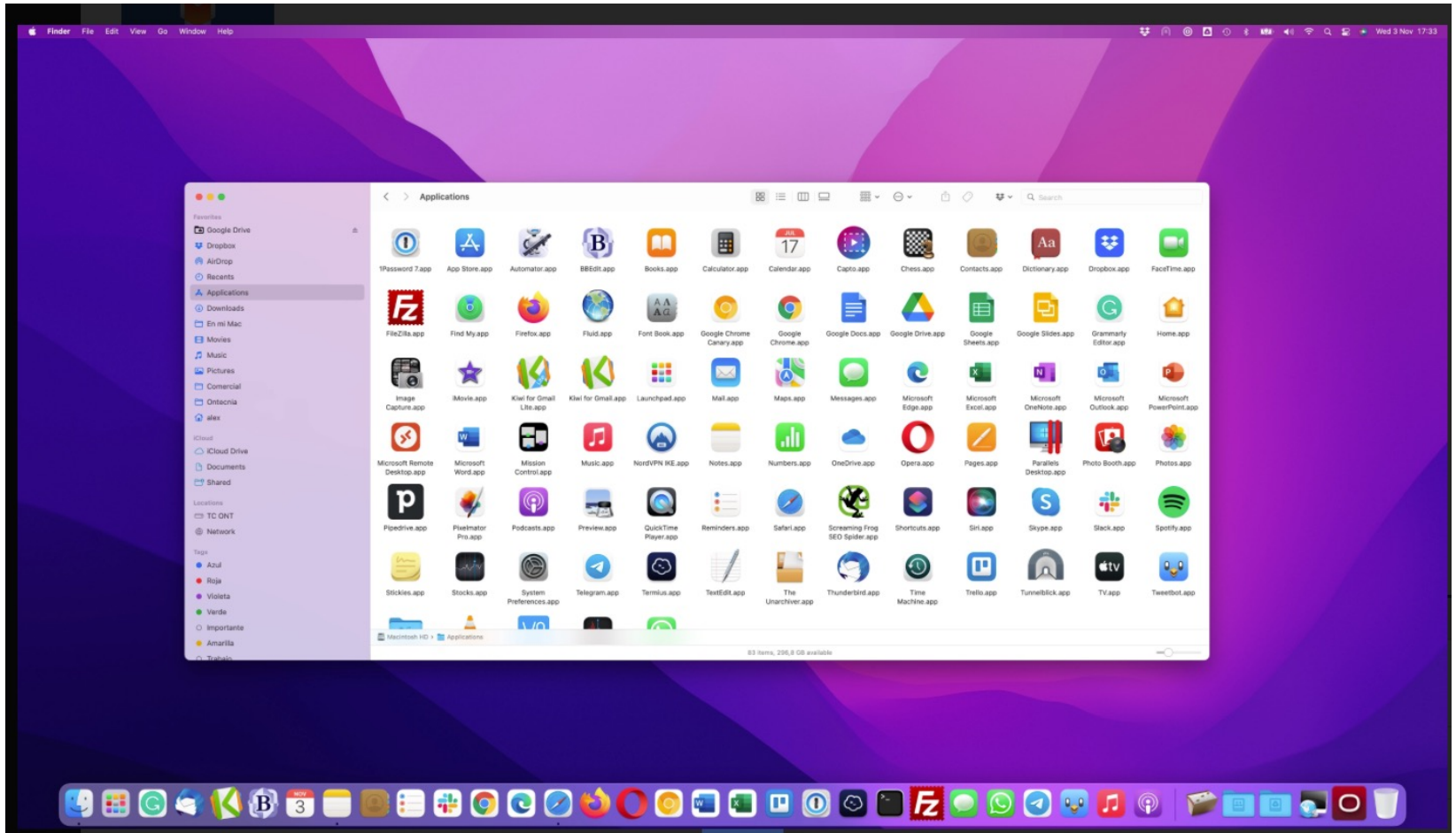
TO GET SOME FAMILIARITY WITH SLURM

What is a shell?

The shell is a program that takes input commands (from the mouse or keyboard) and translates them to the OS to perform.

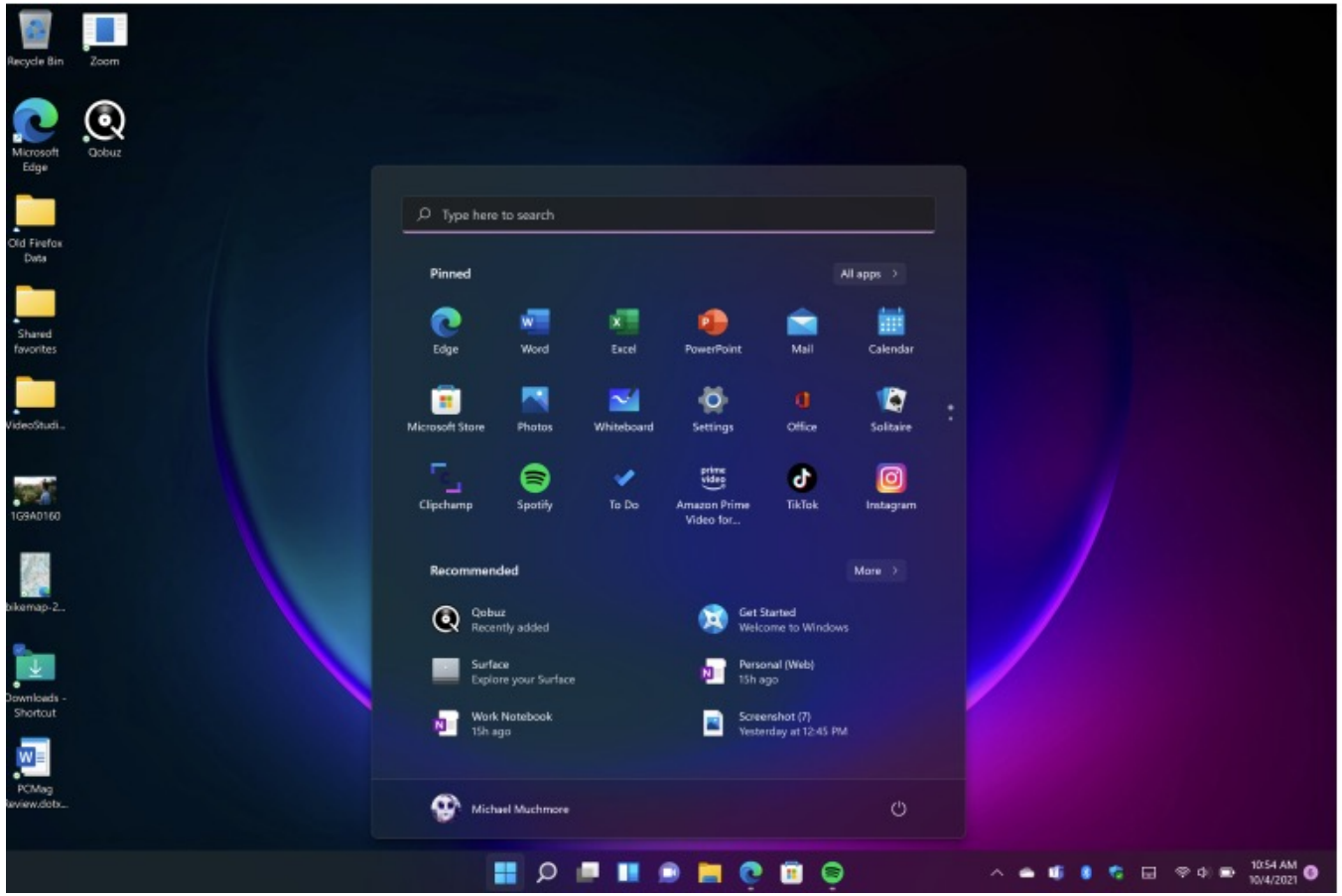
There are graphical shells and linux shells.

Graphical shells (1)



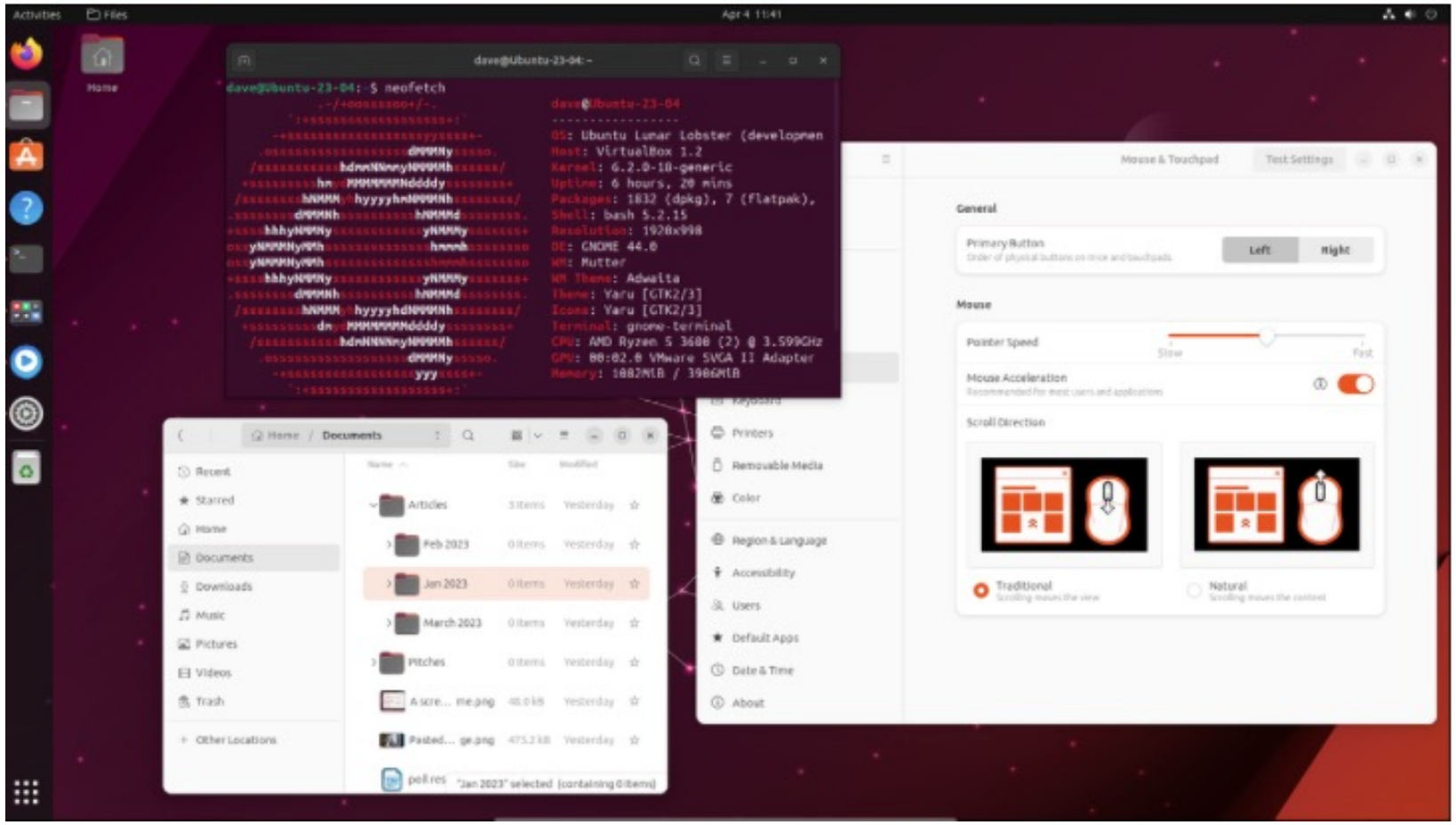
Macbook OS

Graphical shells (2)



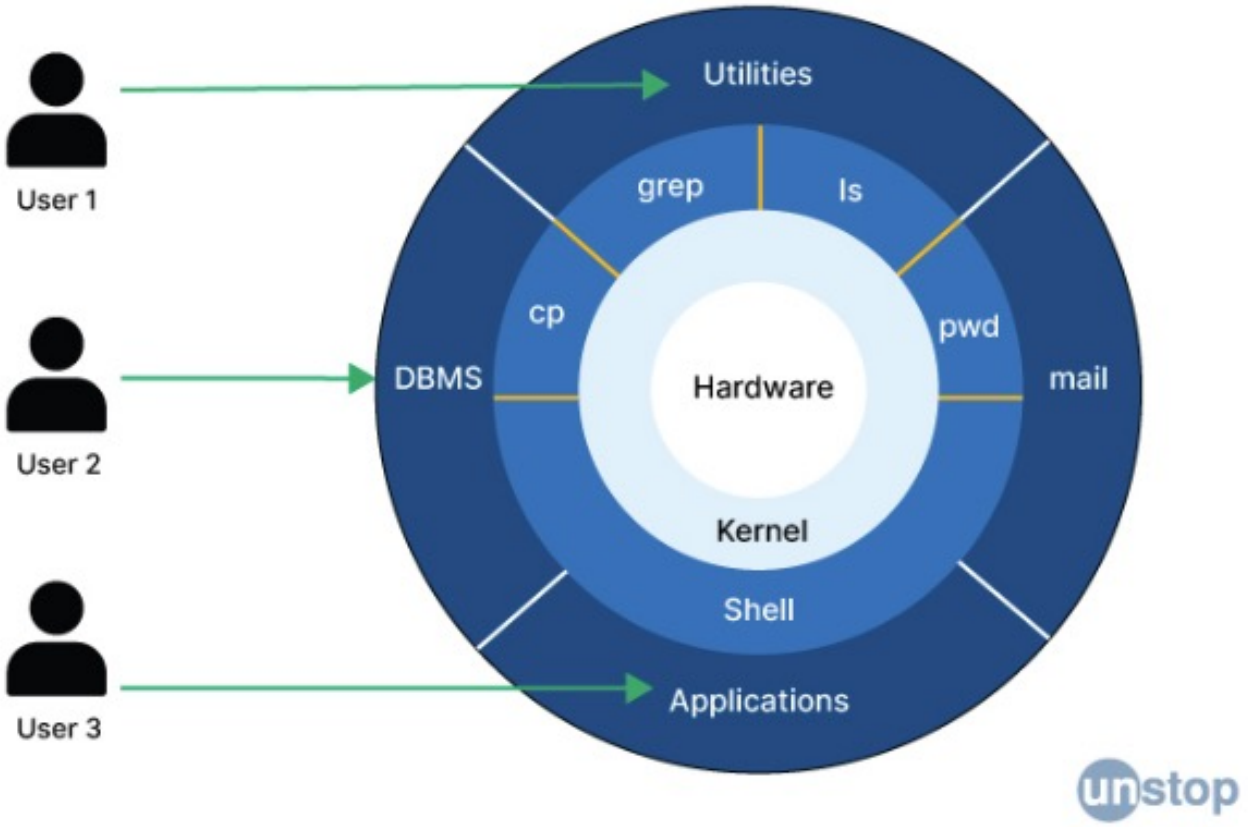
Windows

Graphical shells (3)



Ubuntu (Linux)

Linux shell



- The kernel manages resource access to the hardware .
- The OS is made of the Kernel + the userful programs that interact with it to get access to resouces
- The shell is where the user interacts with the OS

BASH shell

- Stands for Bourne Again Shell.

- Created in 1989 by Brian Fox

Overview of the shell prompt (1)

```
Welcome to University of Colorado Boulder Research Computing!

Full documentation is available in our user guide at
https://www.rc.colorado.edu/support/user-guide. If you have a question
that's not answered there, contact us at rc-help@colorado.edu.

A number of directories have been created for you already:

* `/home/$USER`, your home directory
* `/projects/$USER`, your project directory

Run the command `module avail` to see a list of available software.

To prevent this README from being displayed at login, edit your
`.bash_profile` or `.login` files.
Welcome to CU-Boulder Research Computing.

  * Website http://colorado.edu/rc
  * Questions? rc-help@colorado.edu
  * Subscribe to system announcements: https://curc.statuspage.io/
  * Please type rc-help for the Acceptable Use Policy and a short help page.

You are using login node: login-ci1

Users who had jobs in the queue prior to the planned maintenance should check
to confirm these jobs are still queued.  Some jobs, particularly those schedule
since midnight today (Wed June 7), may have been canceled during the
maintenance period.
[kfotso@xsede.org@login-ci1 ~]$
```

Overview the shell prompt (2)

```
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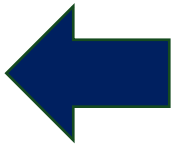


CURC messaging

Overview the shell prompt (3)

Overview the shell prompt (4)

```
[kfotso@xsede.org@login-ci1 ~]$
```

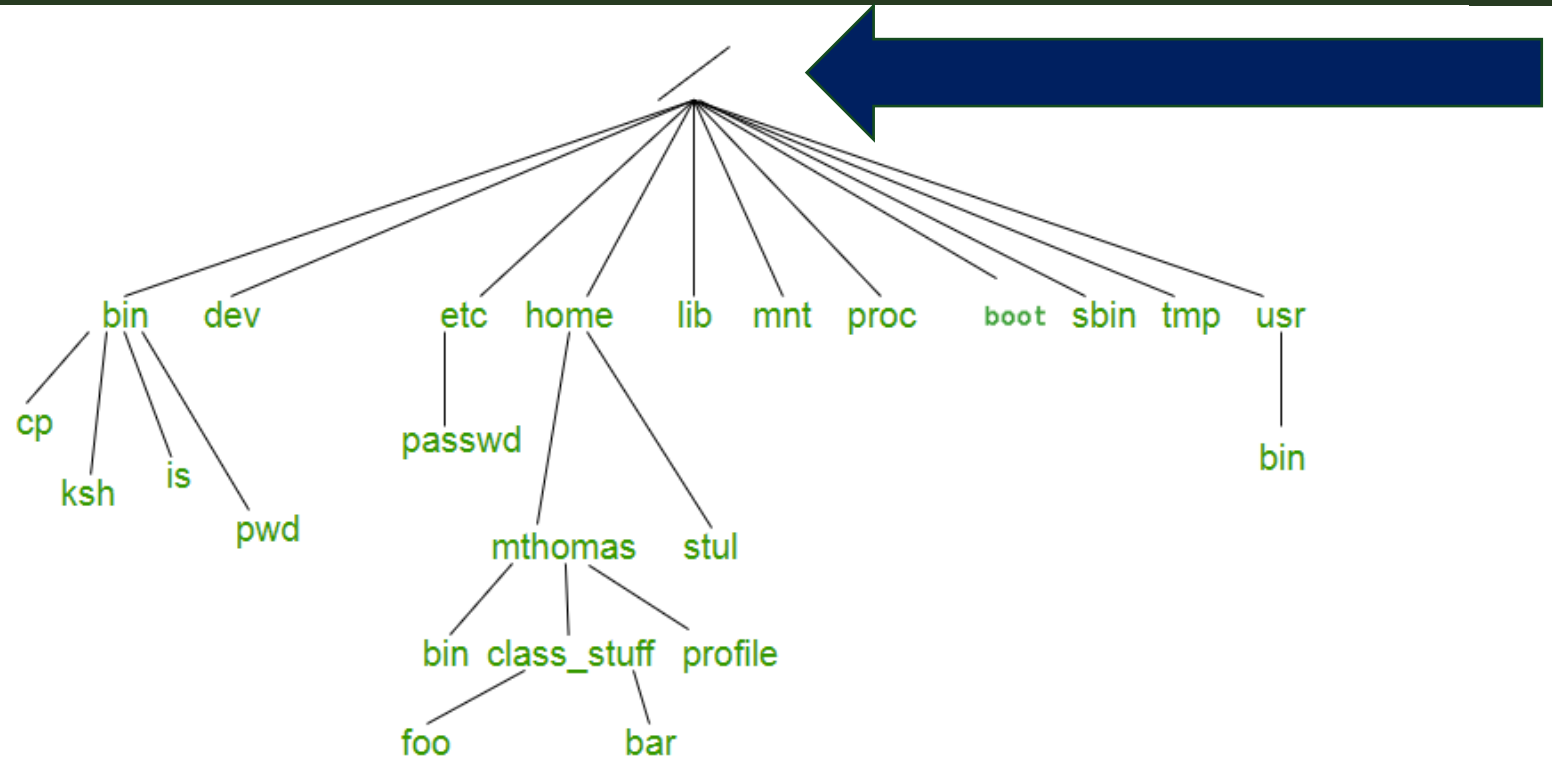
~ shows your current working directory.
~ (tilda) stands for your home directory in the filesystem tree

Overview the shell prompt (5)

```
[kfotso@xsede.org@login-ci1 ~]$
```

$ shows that you are a standard user and not administrator (root)
# would have meant that you are a standard admininstrator

Understanding the linux filesystem tree



Root level

Basic bash shell commands(1)

```
[kfotso@xsede.org@login-ci1 ~]$ pwd
/home/kfotso@xsede.org
[kfotso@xsede.org@login-ci1 ~]$
```

- pwd stands for "print working directory"
- Very useful to locate your position in the filesystem tree

Basic bash shell commands(2)

```
[kfotso@xsede.org@login-ci1 ~]$ ls
'$TMPDIR'                          job.log         output{1..36}       slurm-1169215.out
 All_PP_nomeds_chr1_01_results.log log.file        README.mdwn         slurm-1288904.out
 check_nodes.txt                   make.log        slurm-1047744.out   slurm-1330575.out
 config.log                        nodelist.txt    slurm-1152814.out   slurm-1330585.out
 file                              output1         slurm-1165091.out   slurm-1330591.out
[kfotso@xsede.org@login-ci1 ~]$
```

- ls stands for “list directory contents”
- Can run “man ls” to learn more about a bash shell related command.

Basic bash shell commands(3)

```
[kfotso@xsede.org@login-ci1 ~]$ tree
.
├── $TMPDIR
├── All_PP_nomeds_chr1_01_results.log
├── check_nodes.txt
├── config.log
├── file
├── job.log
├── log.file
├── make.log
├── nodelist.txt
├── output1
├── output{1..36}
├── README.mdwn
├── SLURM_SUBMIT_DIR
├── spack-build-env.txt
├── spack-build-out.txt
├── test
└── TMPDIR

5 directories, 12 files
[kfotso@xsede.org@login-ci1 ~]$
```

- "." the dot mean your current working directory
- tree - list content of directories in a tree-like format
- It also lists number of directories and files

Understanding absolute vs relative paths (1)

- The file path is defined as a human-readable representation of a file or a folder's location on a computer system
- An absolute path informs a user location on the filesystem from root "/"
- A relative path informs a user location of the filesystem from the current directory "."

Understanding absolute vs relative paths (2)

```
[kfotso@xsede.org@login-ci1 software]$ pwd
/projects/kfotso@xsede.org/software
[kfotso@xsede.org@login-ci1 software]$
```

- Example of an **absolute path** from "/" using pwd

Understanding absolute vs relative paths (4)

```
[kfotso@xsede.org@login-ci1 software]$ tree
.
└── anaconda
    └── envs
        └── ccc-env
            └── bin
                └── 2to3 -> 2to3-3.9
```

- Overview of the files from "."

```
[kfotso@xsede.org@login-ci1 software]$ ls ./anaconda/envs/ccc-env/bin/
2to3          ipython     lzmore              python3             tput
2to3-3.9      ipython3    matplotlib          python3.9           tset
captoinfo     lzcat       ncursesw6-config    python3.9-config    unlzma
```

- Listing the relative path from "."

Understanding absolute vs relative paths (5)

```
[kfotso@xsede.org@login-ci1 software]$ ls /projects/kfotso@xsede.org/software/anacond
a/envs/ccc-env/bin/
2to3        lzegrep          pygmentize       unxz
2to3-3.9    lzfgrep          python           wheel
captoinfo   lzgrep           python3          wish
clear       lzless           python3.9        wish8.6
```

- Same listing of files could have been done as absolute path from “/”

Basic bash shell commands(4)

```
[kfotso@xsede.org@login-ci1 ~]$ ls
'$TMPDIR'                          job.log         output{1..36}          test
 All_PP_nomeds_chr1_01_results.log log.file        README.mdwn            TMPDIR
 check_nodes.txt                   make.log        SLURM_SUBMIT_DIR
 config.log                        nodelist.txt    spack-build-env.txt
 file                              output1         spack-build-out.txt
```

```
[kfotso@xsede.org@login-ci1 ~]$ ls -a
 .                                 .horovod        .python_history
 ..                                .ipython        .RData
'$TMPDIR'                          .java           README.mdwn
 All_PP_nomeds_chr1_01_results.log job.log         .Rhistory
 .bash_history                     .jupyter        .shrc
```

- "-a" stands for "all" so it lists hidden files as well

Basic bash shell commands(5)

```
[kfotso@xsede.org@login-ci1 ~]$ ls -l
total 1432
drwxr-xr-x. 2 kfotso@xsede.org kfotsopgrp@xsede.org      0 May  1 01:57 '$TMPDIR'
-rw-r--r--. 1 kfotso@xsede.org kfotsopgrp@xsede.org   1052 Apr 27 13:31  All_PP_nomed
s_chr1_01_results.log
-rw-r--r--. 1 kfotso@xsede.org kfotsopgrp@xsede.org 249155 Apr 13 18:19  check_nodes.
txt
```

File permission

Number of links

Owner name

Group name

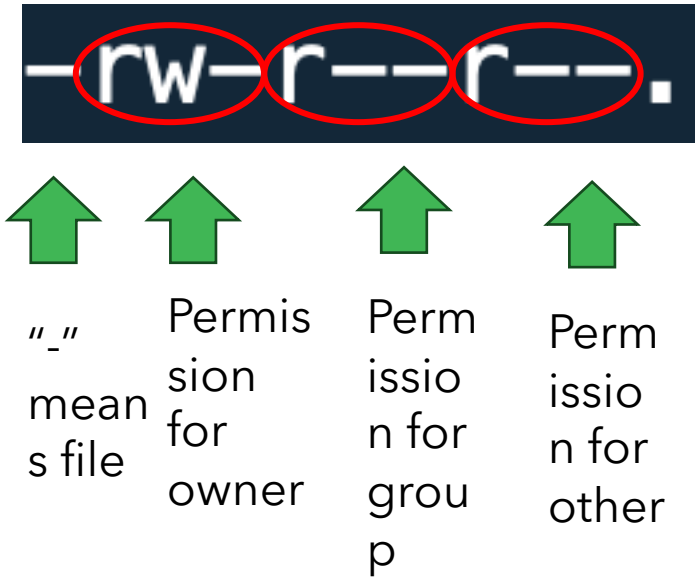
File size

Time of last modification

File or directory

- "-l" stands for "long listing".

File permission



Storage (1)

```
[kfotso@xsede.org@login-ci1 ~]$ curc-quota
---------------------------------------------------------------------
                                Used          Avail    Quota Limit
---------------------------------------------------------------------
/home/kfotso@xsede.org           434M           1.6G           2.0G
/projects/kfotso@xsede.org       100G           151G           250G
/scratch/alpine1               26368G           4352G         30720G
```

- curc-quota shows disk usage

Storage (2)

```
[kfotso@xsede.org@login-ci1 ~]$ du -sh /scratch/alpine/kfotso@xsede.org/data
1.0K    /scratch/alpine/kfotso@xsede.org/data
```

- du stands for disk usage

Storage (3)

```
[kfotso@xsede.org@login-ci1 ~]$ df -h
Filesystem                                              Size  Used Avail Use% Mounted
 on
devtmpfs                                                3.8G     0  3.8G   0% /dev
tmpfs                                                   3.8G  4.0K  3.8G   1% /dev/sh
m
tmpfs                                                   3.8G  393M  3.5G  11% /run
tmpfs                                                   3.8G     0  3.8G   0% /sys/fs
/cgroup
/dev/mapper/vg_root-lv_root                             145G  4.6G  141G   4% /
/dev/sdb1                                               7.8G   84K  7.4G   1% /tmp
/dev/sda2                                              1014M  343M  672M  34% /boot
/dev/sda1                                               200M  5.8M  195M   3% /boot/e
fi
/dev/mapper/vg_root-lv_var                              8.0G  1.9G  6.2G  23% /var
sgate1-data.rc.int.colorado.edu:/gpfs/summit/scratch    463G   11G  453G   3% /scratc
h/summit
c3nsd1.rc.int.colorado.edu:/gpfs/alpine1/scratch        1.9P  1.2P  661T  65% /scratc
h/alpine
isilon1-data.rc.int.colorado.edu:/ifs/curc/sw           433T  260T  159T  63% /curc/s
w
isilon1-data.rc.int.colorado.edu:/ifs/curc/slurm        433T  260T  159T  63% /curc/s
lurm
isilon1-data.rc.int.colorado.edu:/ifs/curc/home         433T  260T  159T  63% /home
```

- df shows the filesystem disk space usage

Basic bash shell commands(6)

```
[kfotso@xsede.org@login-ci1 ~]$ cd /scratch/alpine/$USER
[kfotso@xsede.org@login-ci1 kfotso@xsede.org]$
```

- ”cd” means change my working directory

Basic bash shell commands(7)

```
[kfotso@xsede.org@login-ci1 kfotso@xsede.org]$ pwd
/projects/kfotso@xsede.org
[kfotso@xsede.org@login-ci1 kfotso@xsede.org]$ cp /projects/ssills24@xsede.org/new_reduce_multi.slurm .
```

Source

Destination

- Copy file to my current working directory

Basic bash shell commands(8)

```
[kfotso@xsede.org@login-ci1 software]$ cp -r mkdir /projects/kfotso@xsede.org/
[kfotso@xsede.org@login-ci1 software]$
```

- Copy folder to my project directory.
- “-r” means recursive

Basic bash shell commands(9)

```
[kfotso@xsede.org@login-ci1 software]$ cp -r mkdir /projects/kfotso@xsede.org/mkdir-from-Sam
[kfotso@xsede.org@login-ci1 software]$
```

- Copy folder to my project directory as “mkdir-from-Sam”

Basic bash shell commands(10)

```
[kfotso@xsede.org@login-ci1 software]$ mv mkdir mkdir-renamed
[kfotso@xsede.org@login-ci1 software]$
```

- Renaming a folder or file. “mv” means move.

Basic bash shell commands(11)

```
[kfotso@xsede.org@login-ci1 software]$ cat demonstration
This is the content from the demonstration file
[kfotso@xsede.org@login-ci1 software]$
```

- "cat" stands for concatenate
- Outputs content of a file
- You can play with the nano command as well

Basic bash shell commands(12)

```
#!/bin/bash -l

# Run this file using 'sbatch reduce.sbatch.summit'
#
#SBATCH --account=amc-general
#SBATCH --partition=amilan

#  Give this job a name
#SBATCH --job-name=reduce-sim

#  Join standard output and error to a single file
#SBATCH --output=reduce.qlog

#  Request time needed for job to run (default: 12 hours)
#SBATCH --time=00:40:00
#SBATCH --qos=normal

#  Send an email when the job begins and when it ends running
#SBATCH --mail-type=BEGIN,FAIL,END

# Whom to send the email to
                              [ Read 74 lines ]
^G Get Help    ^O Write Out   ^W Where Is    ^K Cut Text    ^J Justify     ^C Cur Pos     M-U Undo
^X Exit        ^R Read File   ^\ Replace     ^U Uncut Text  ^T To Linter   ^_ Go To Line  M-E Redo
```

- nano new_reduce_multi.slurm
- To edit a file

Basic bash shell commands(13)

```
[kfotso@xsede.org@login-ci1 kfotso@xsede.org]$ hostname
login-ci1
[kfotso@xsede.org@login-ci1 kfotso@xsede.org]$
```

- Hostname is a program that can print the current hostname