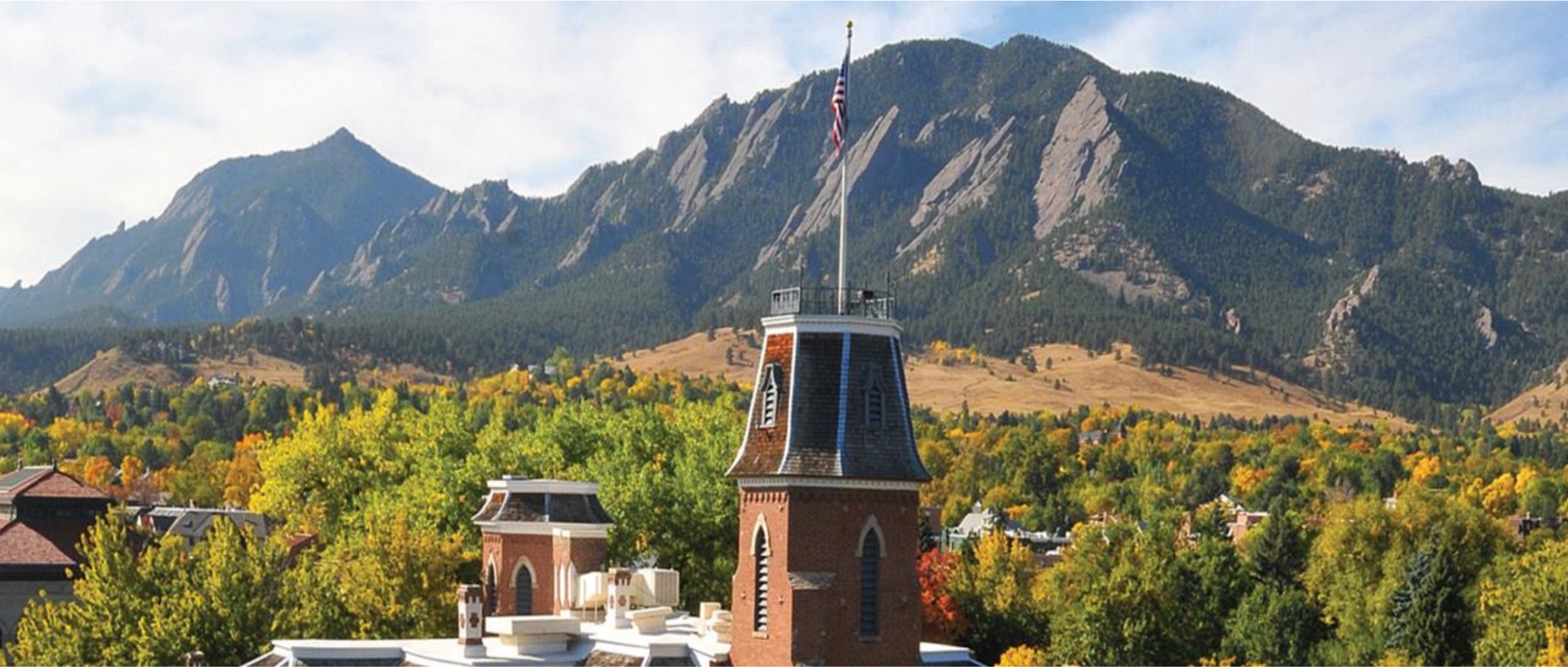


Working with Linux



Working with Linux

Workshop Type: Short Course

Instructor: Brandon Reyes

Contact: rc-help@colorado.edu

Website:

- <https://www.colorado.edu/rc>
- <https://curc.readthedocs.io/en/latest/>



Slides and other files available for download and viewing:

https://github.com/ResearchComputing/working_with_linux_on_hpc_shortcourse

Contributors: Michael Schneider, Layla Freeborn, Andrew Monaghan, Brandon Reyes, John Reiland, Mohal Khandelwal

Meet the User Support Team



Layla Freeborn



Brandon Reyes



Andy Monaghan



Michael
Schneider



John
Reiland



Dylan Gottlieb



Mohal
Khandelwal



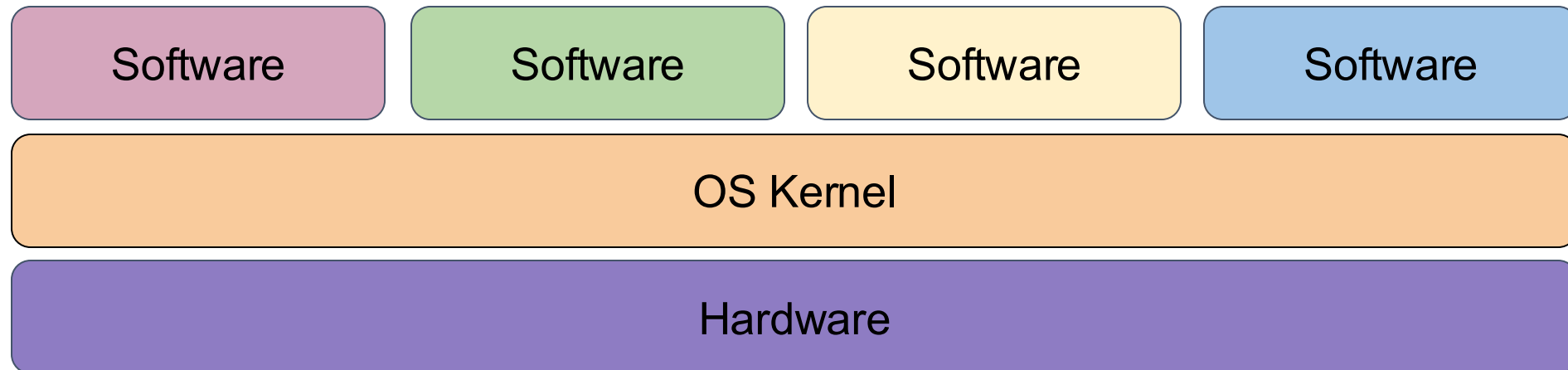
Ragan
Lee

Learning Goals

- Why Linux?
- Working with Files
- Working with Scripts

What is Linux?

- Created by Linus Torvalds (1991)
- “Unix”-based operating system (like Mac OS)
- Supports a variety of hardware and software systems



images courtesy of wikicommons

Linux Distro

- Variety of distributions, or distros, available
- Embedded systems (Raspberry PI)
- “Windows” replacement (Ubuntu)
- Commercial/Industry Supported (RedHat)



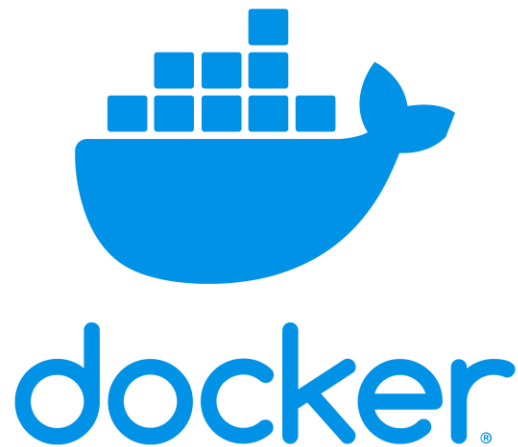
Ubuntu



images courtesy of wikicommons

Why Use Linux?

- Most common Operating System for HPC systems
- Extremely flexible, fast, and powerful
- Built-in support for many software development workflows



images courtesy of wikicommons

Opening a Terminal

- Mac: Go to **Applications** → **Utilities** → **Terminal**
- Windows: Download a terminal emulator (or use Powershell)
 - PuTTY: <https://putty.software/>
 - Git BASH: <https://gitforwindows.org>
- Use our service called Open OnDemand (more on this later):
 - CU Boulder: <https://ondemand.rc.colorado.edu/>
 - Everyone else: <https://ondemand-rmacc.rc.colorado.edu/>

Logging into CURC via terminal

- `ssh <rc_username>@login.rc.colorado.edu`
- Enter your password
- Authenticate by accepting the Duo push to your smartphone

<https://curc.readthedocs.io/en/latest/access/logging-in.html>

Alt: Logging into CURC via browser

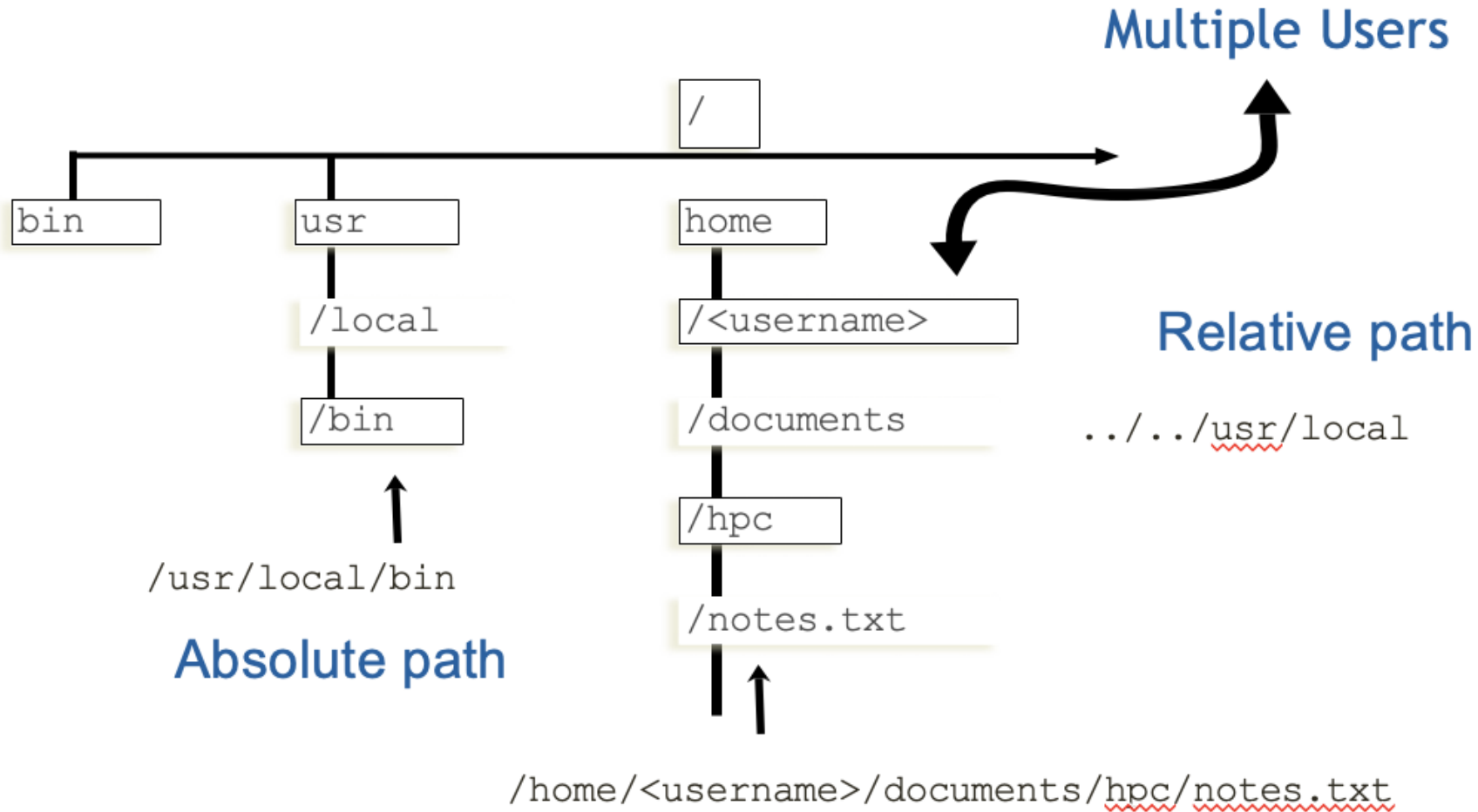
- Navigate to <https://ondemand-rmacc.rc.colorado.edu>
- Choose your organization
- Enter your password
- Authenticate by accepting the Duo push to your smartphone
- Select the “Clusters” app to bring up an Alpine terminal

https://curc.readthedocs.io/en/latest/open_ondemand/index.html

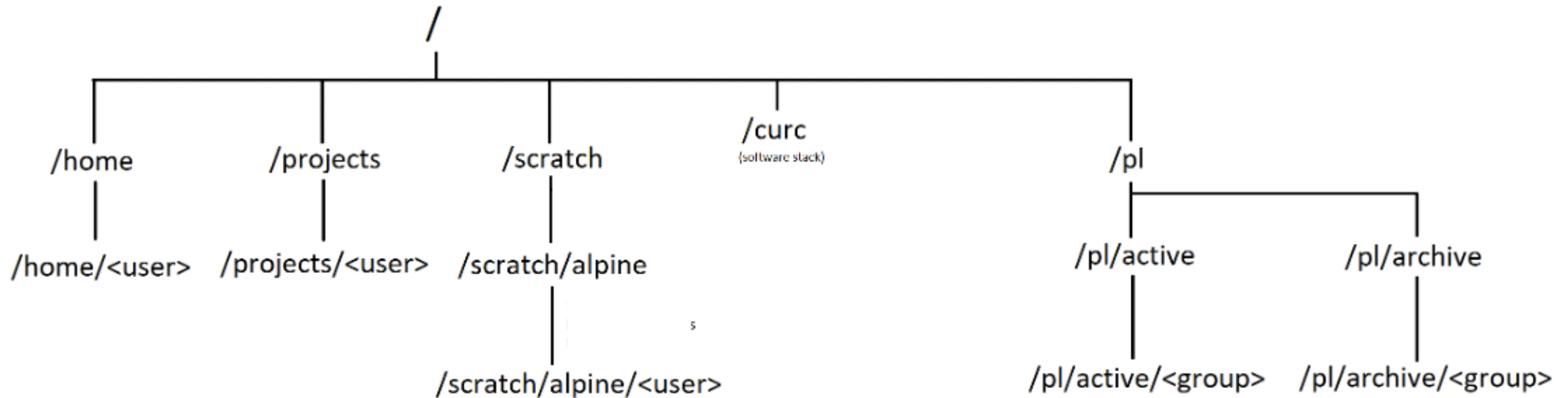
The Linux Filesystem

- System of arranging files and directories (folders)
- Levels in full paths separated by forward slashes:
e.g. `/home/user/scripts/analyze_data.sh`
- Case-sensitive; spaces in names discouraged
- Some shorthand:
 - `.` (the current directory)
 - `..` (the directory one level above)
 - `~` (home directory)
 - `-` (previous directory, when used with `cd`)

Filesystem Layout



Your personal directories on CURC



Anatomy of a Linux command

- command [flags] [target(s)]

```
ls -l myworkdir/
```

- Case is important!
- Use “man” command to view a command’s manual

```
man ls
```

Change Directories

```
cd <path/to/take>
```

```
cd /projects/$USER
```

Make Directories

`mkdir <path/directory_name>`

`mkdir rc_temp`

List Files and Directories

`ls [option] [file/directory]`

`-l` (long format)

`-a` (all files)

`-h` (readable file size)

`-r` (reverse sort)

`-S` (sort by file size)

Copy Files

```
cp <source> <destination>
```

```
cp README.md ../
```

```
cp README.md ../Docs.md
```

Remove Files

```
rm <path/to/file>
```

```
rm Docs.md
```

```
rm -r <directory>
```

Be careful when using a recursive (-r) delete. It can delete everything!

Text Editors

- **nano** – Beginner friendly
- **vi/vim** – Powerful, but steep learning curve
- **emacs** – Extendable, tons of additional features
- **VS Code** – via OnDemand
- Use local text editor and copy files manually to Alpine

Create a Text File

`nano notes.txt`

Head Command – First X Lines of File

```
head <path/to/file>
```

```
head notes.txt
```

```
head -n 3 notes.txt
```

Tail Command – Last X Lines of File

```
tail <path/to/file>
```

```
tail notes.txt
```

```
tail -n 3 notes.txt
```

Intro to Shells and Shell Scripts

A **shell** is the environment in which commands are interpreted in Linux.

GNU/Linux provides numerous shells; the most common is the Bourne Again shell (bash).

Other common shells available on Linux systems include:

- sh, csh, tcsh, ksh, zsh

Shell scripts are files containing collections of commands for Linux systems that can be executed as programs. They are powerful tools!

Shell script basics

- Executed interactively (terminal) or programmatically (scripts)
- In shell scripts, the first line must specify the shell e.g. `#!/bin/bash`
- The program loader recognizes the `#!` and will interpret the rest of the line (`/bin/bash`) as the interpreter program.
- If a line starts with `#`, it is a comment and is not run.

```
#!/bin/bash
```

Shell to run

```
# the files in /tmp.
```

Comments

```
cd /tmp
```

Change directories

```
ls
```

List everything in /tmp

Alternatives for Scripting

- `cs``h`/`tc``sh` C-shell (`tc``sh`: updated version of `cs``h`)
- `ksh` Korn shell; related to `sh`/`bash`
- `perl` exceptional text manipulation and parsing
- `python` excellent for scientific and numerical work
- `ruby` general scripting
- `make` building executables from source code

Modes (aka permissions)

- View file/directory permissions `ls -l`

- 3 classes of users:
 - User (u) aka “owner”
 - Group (g)
 - Other (o)
- 3 types of permissions:
 - Read (r)
 - Write (w)
 - Execute (x)

Diagram illustrating the permissions string `-rwxr-xr--` with annotations:

- The first character `-` is annotated as `directory`.
- The next three characters `rwx` are grouped by a bracket and annotated as `user`.
- The next three characters `r-x` are grouped by a bracket and annotated as `group`.
- The final two characters `--` are grouped by a bracket and annotated as `other`.

Modes (continued)

`chmod` changes modes:

To add write and execute permission for your group:

```
chmod g+wx filename
```

To remove execute permission for others:

```
chmod o-x filename
```

Run test.sh

```
chmod u+x test.sh
```

```
./test.sh
```

Local vs Global Variables

- A variable can contain a number, a character, a string of characters.
- Environment variables are global – effective in subsequent shells
- Shell variables are local- only effective in the current shell itself

Environment variables

- Environment variables store important information needed by Linux users and programs
- Type `env` to see your currently set up environment variables
- Useful environment variables:

| | |
|------------------------------|--|
| <code>PATH</code> | directories to search for commands |
| <code>HOME</code> | home directory |
| <code>PWD</code> | current working directory |
| <code>USER</code> | username |
| <code>LD_LIBRARY_PATH</code> | directories to search for dynamically-loaded libraries |

Run `variables_scope.sh`

```
chmod u+x variables_scope.sh
```

```
./variables_scope.sh
```

Thank you!

- **Documentation**: curc.readthedocs.io/
- **Trainings with Center for Research Data and Digital Scholarship (CRDDS)**:
<https://www.colorado.edu/crdds/>
- **Helpdesk**: rc-help@colorado.edu
- **Consult Hours** (Tuesday 12:00-1:00 in-person, Thursday 1:00-2:00 virtually)

Survey and feedback

<https://tinyurl.com/curc-survey18>

