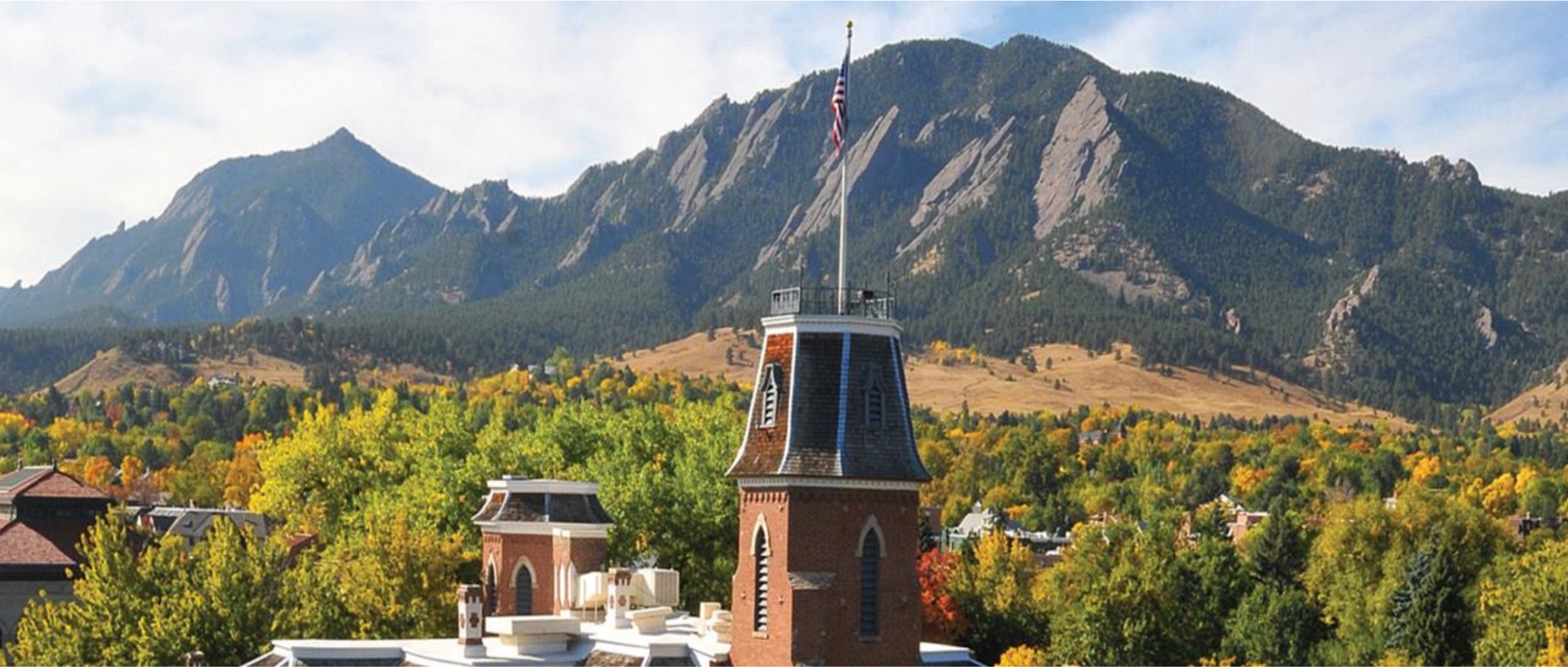


Working with Linux on HPC



Working with Linux on HPC:

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,
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Meet the User Support Team



Layla Freeborn



Brandon Reyes



Andy Monaghan



Michael
Schneider



John
Reiland



Dylan Gottlieb



Mohal
Khandelwal



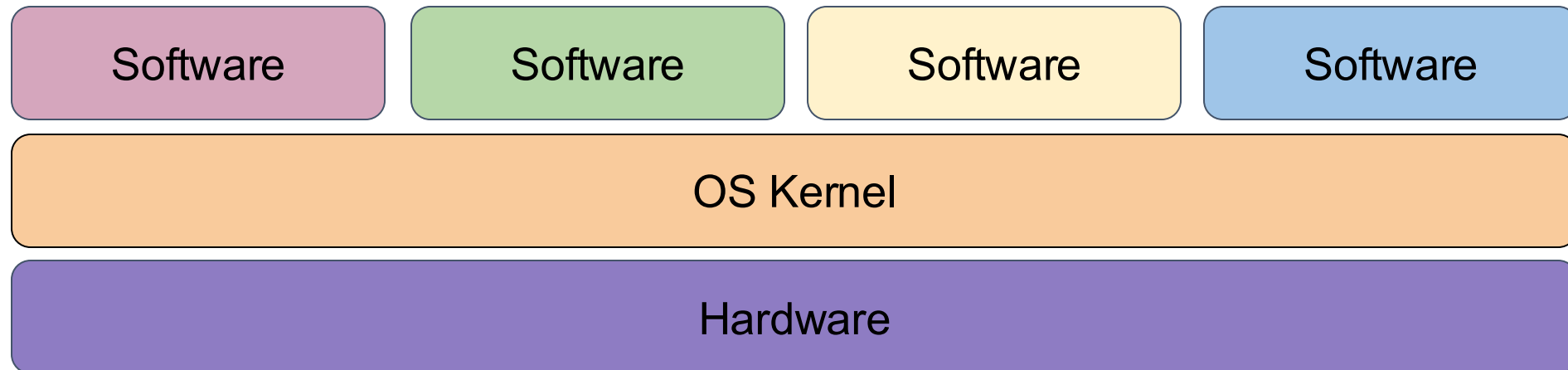
Ragan
Lee

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)



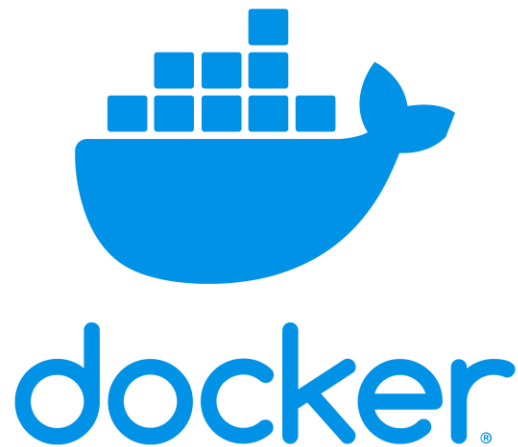
Ubuntu



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://www.putty.org>
 - Git BASH: <https://gitforwindows.org>
 - Open OnDemand: <https://ondemand.rc.colorado.edu/>
 - RMACC: <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

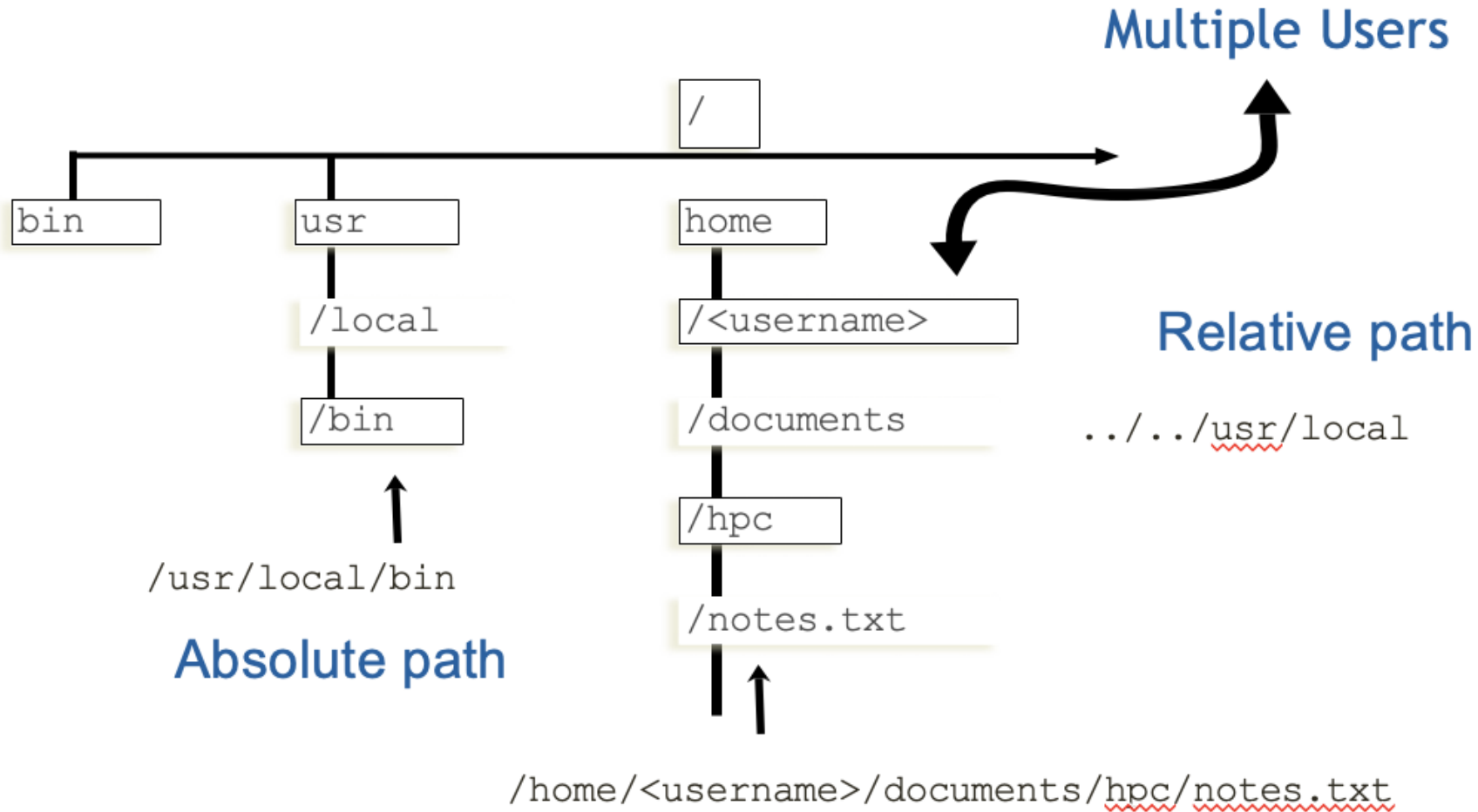
- Navigate to <https://ondemand-rmacc.rc.colorado.edu>
- Choose your organization
- Enter your password
- Authenticate by accepting the Duo push to your smartphone
- Select the “Clusters” app to bring up an Alpine terminal

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

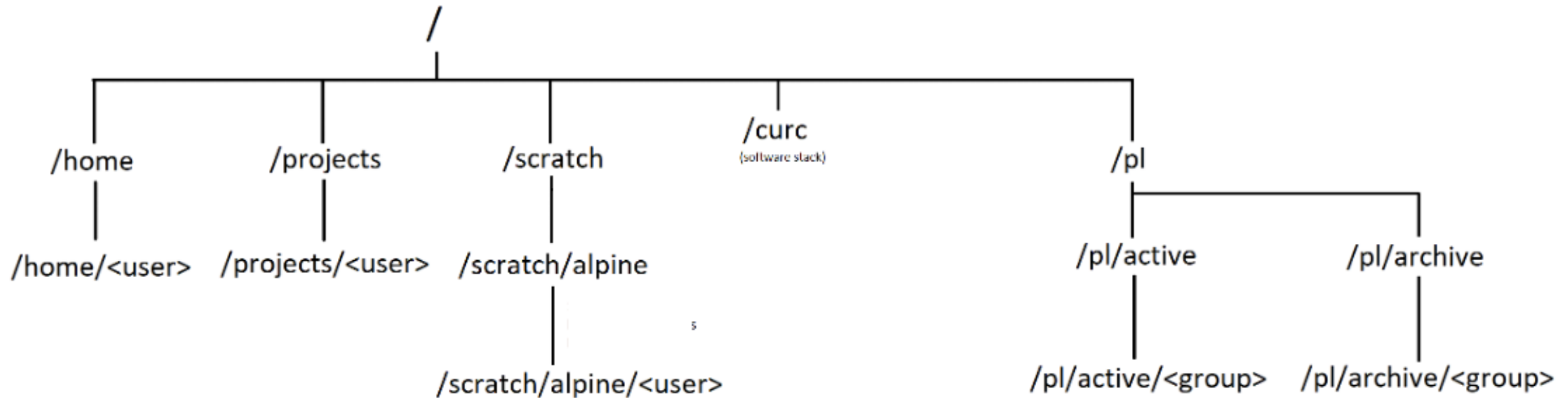
The Linux Filesystem

- 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)
- `-h` (readable file size)
- `-S` (sort by file size)
- `-a` (all files)
- `-r` (reverse sort)

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 contain `#!/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`/`tcsh` C-shell (`tcsh`: updated version of `cs`)
- `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>

