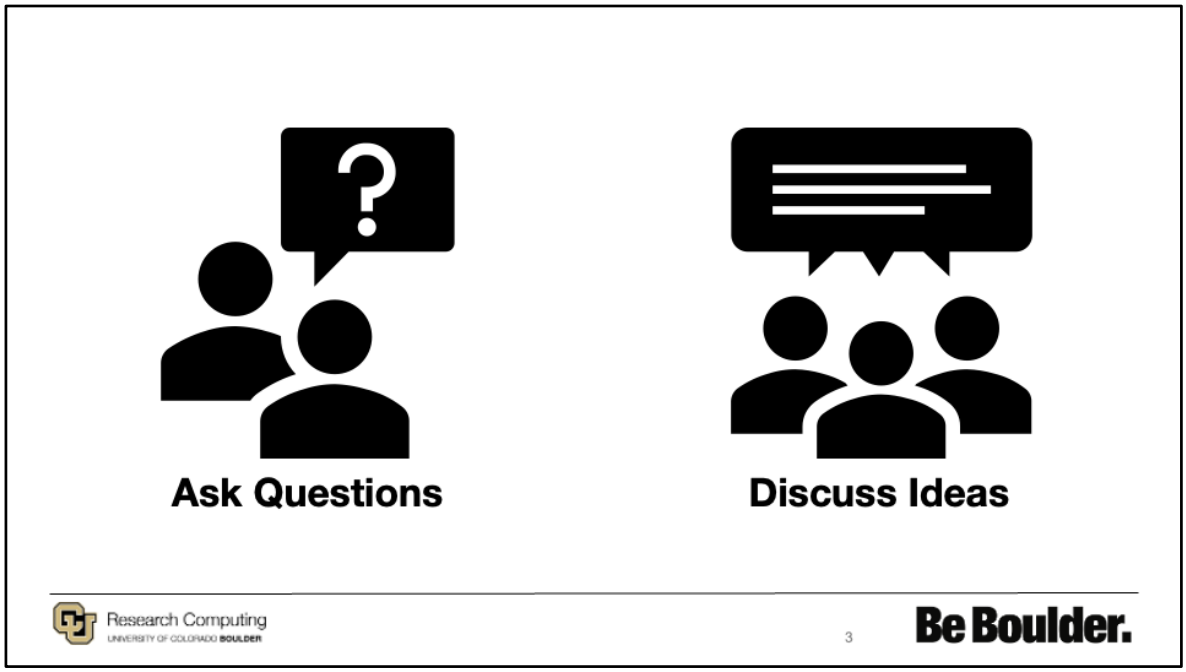
Module 1: Getting Familiar with RC

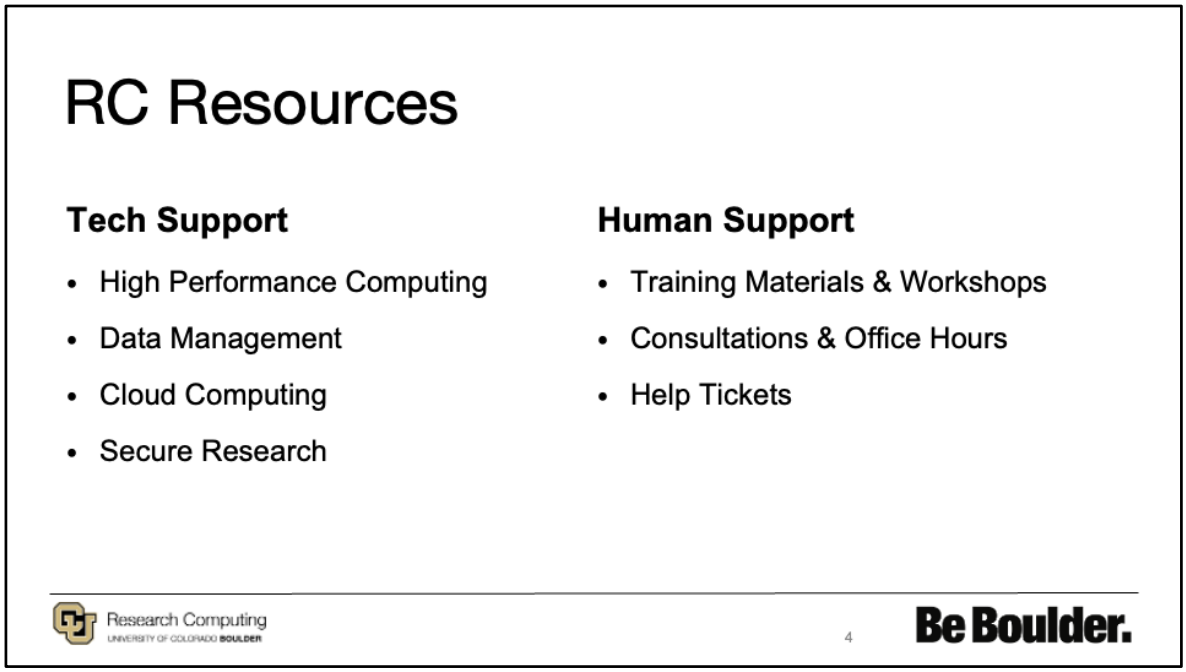
Learning Goals

1. Understand CURC Resources & the Alpine cluster
2. Getting an account & logging in
3. Navigate the RC system



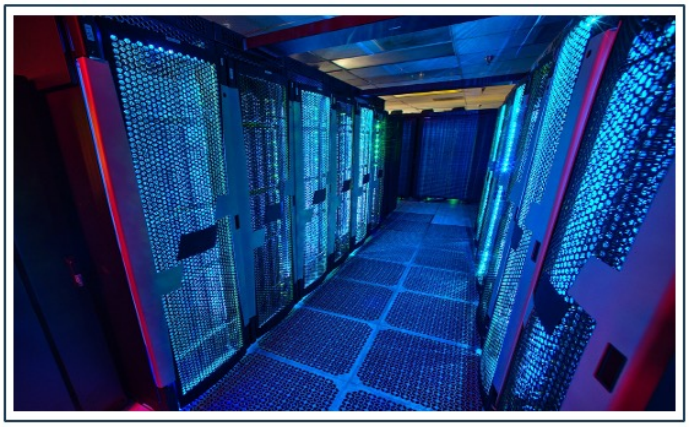
This workshop is meant to be empowering and information-rich – to help you get the most out of your HPC workflow.

Feel free to ask questions during the presentations and to discuss ideas/thoughts during breaks and the hands-on portion of the workshop.



The Secure Research manages the CMMC environment (Preserve), but we can help users connect with the SR team if they have confidential data (e.g. HIPA, Financial, FERPA, Government data, etc.)

High Performance Computing (HPC)



Traditional vs HPC

Fewer Computing Resources,
Fast Sprinter*

More Computing Resources,
Steady Marathon Runner*

***Potentially**

Research Computing
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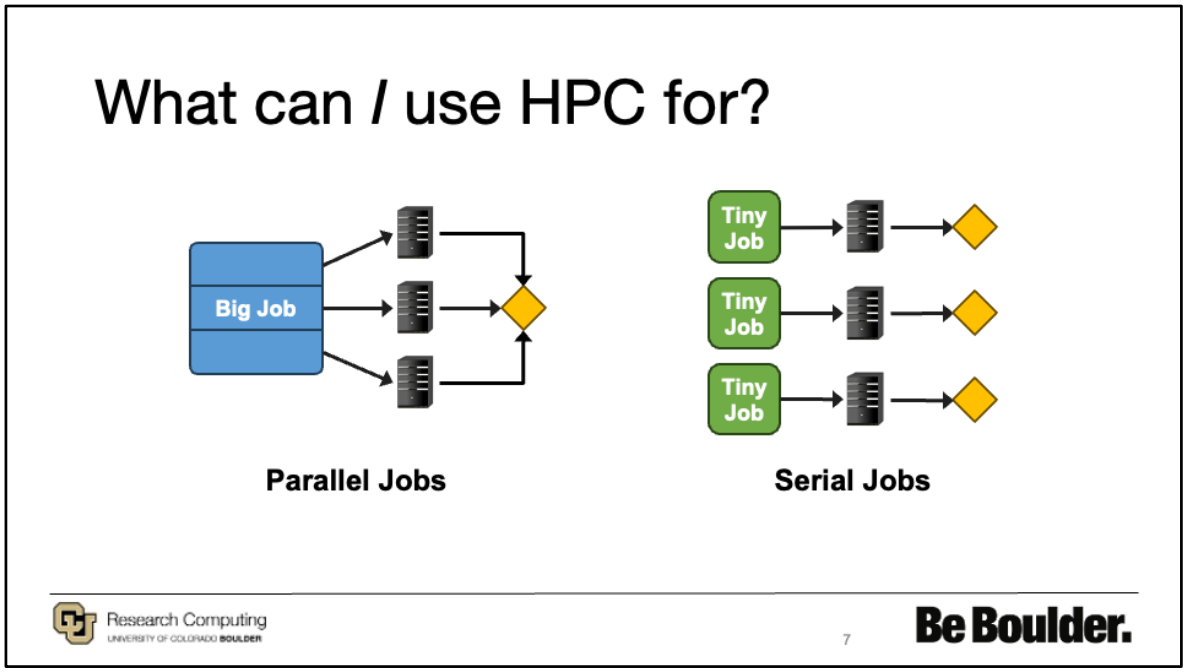
Be Boulder.

Traditional PC:
- 1 CPU with a few cores and maybe a GPU (not always)
- RAM & Storage measured in GB's
- Less Hardware, but potentially much faster hardware (clockspeed)

HPC
- Many CPU's and GPUs – Thousands of cores
- RAM & Storage measured in Terabytes and Petabytes
- Hardware built for stability and high up-time, best for distributed jobs

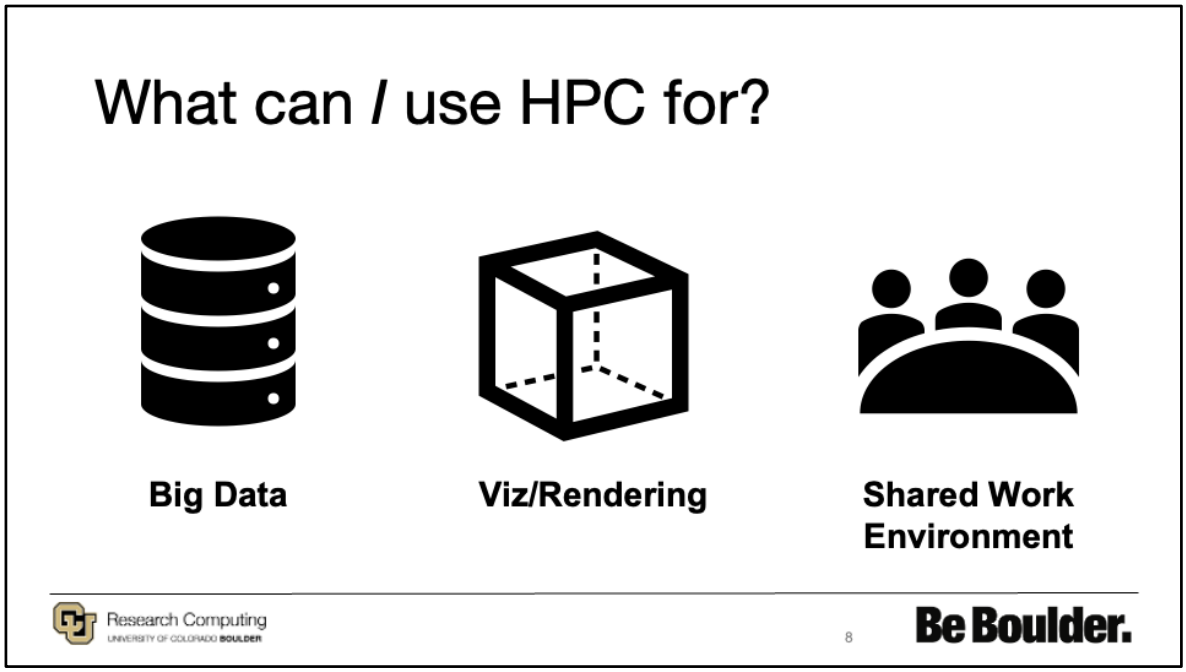


Parallel Jobs - Divide and Conquer

- A job that can be divided into smaller pieces, which can be independently run.

Serial Jobs

- A collection of small jobs which can be done simultaneously



Big Data:
- Require lots of RAM (memory) or data storage
- Need more CPU's, distributed system

Visualization Rendering

Unique Hardware
- GPU's, Linux, Shared team environment

HPC Cluster: Alpine

- 3rd-generation HPC cluster
  - Janus (2012)
  - RMACC Summit (2017)
- Heterogeneous cluster with hardware currently provided by CU Boulder, CSU, and Anschutz
- Access available to CU Boulder, CSU, AMC and RMACC users

Update Icon

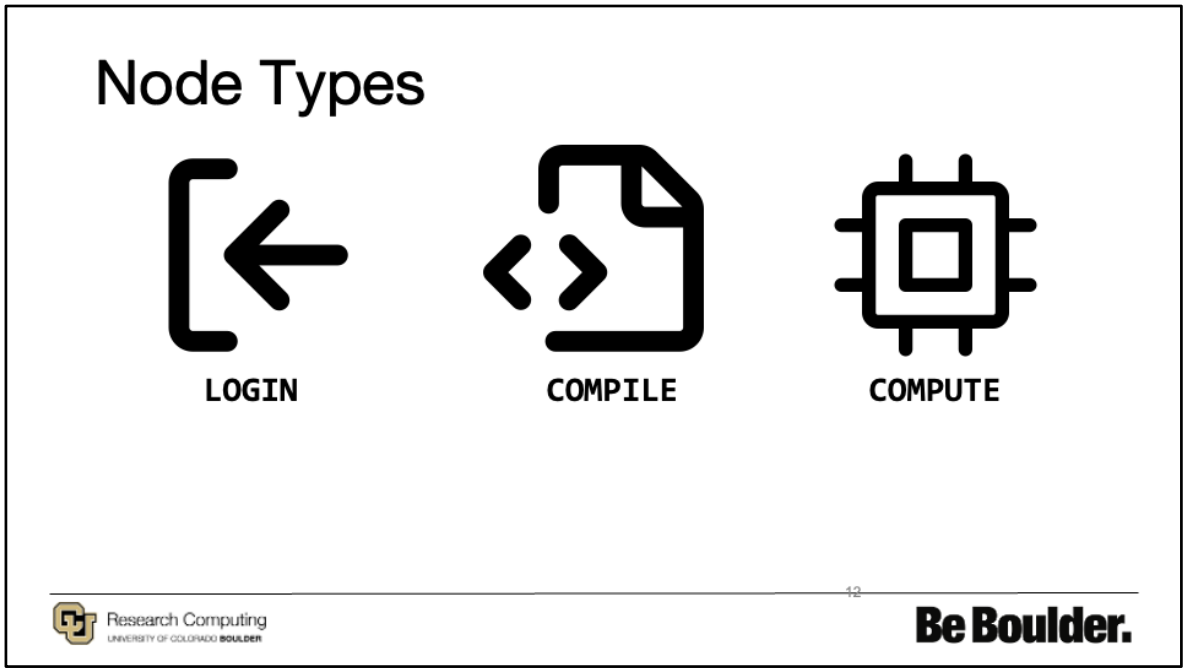
Alpine Partitions

Partition	Description	# of nodes	RAM/core (GB)	cores/node	GPUs/node
amilan	General Compute Node: AMD Milan	347	3.74	64	0
ami100	GPU Node: 3x AMD MI100	8	3.74	64	3
aa100	GPU Node: 3x Nvidia A100	12	3.74	64	3
amem	High-memory node	22	21.5	64 (10), 48 (12)	0

HPC Cluster: Alpine

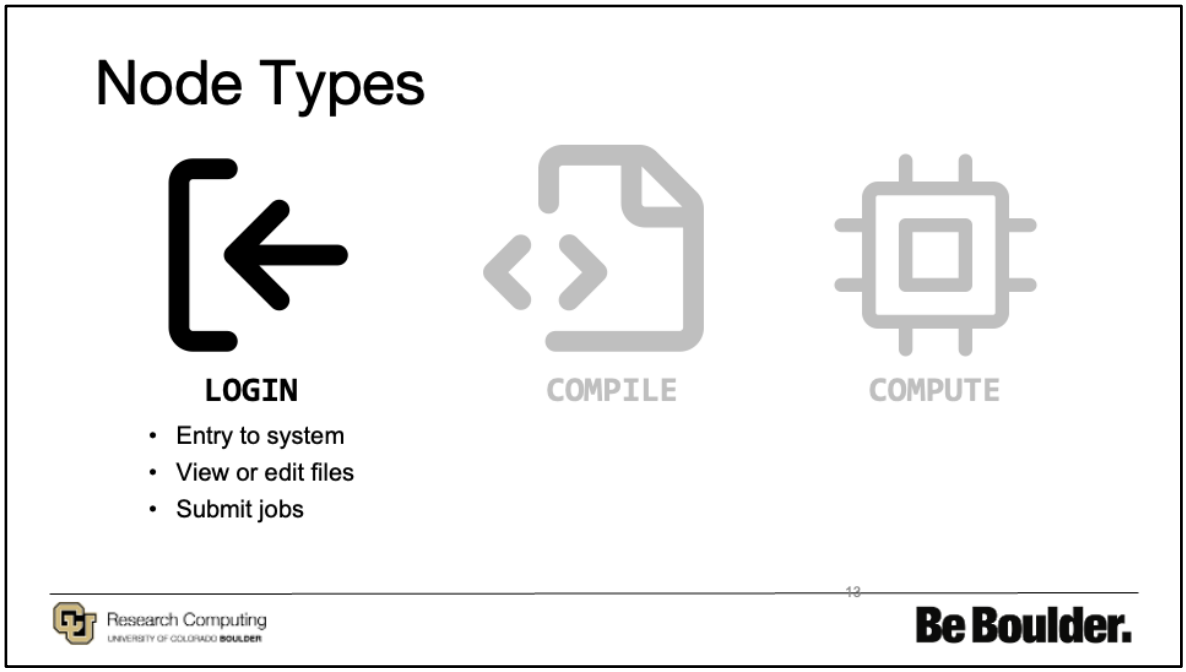
- Interconnect
  - **CPU nodes**: HDR-100 InfiniBand* (200Gb inter-node fabric)
  - **GPU nodes**: 2x25 Gb Ethernet +RoCE
  - **Scratch Storage**: 25Gb Ethernet +RoCE
- Operating System
  - RHEL 8 - **R**ed**H**at **E**nterprise **L**inux Version 8

* Not all CPU Nodes have Infiniband



Add diagram showing login node as entry point.

Login -> Testing, Compiling, Compute/GPU



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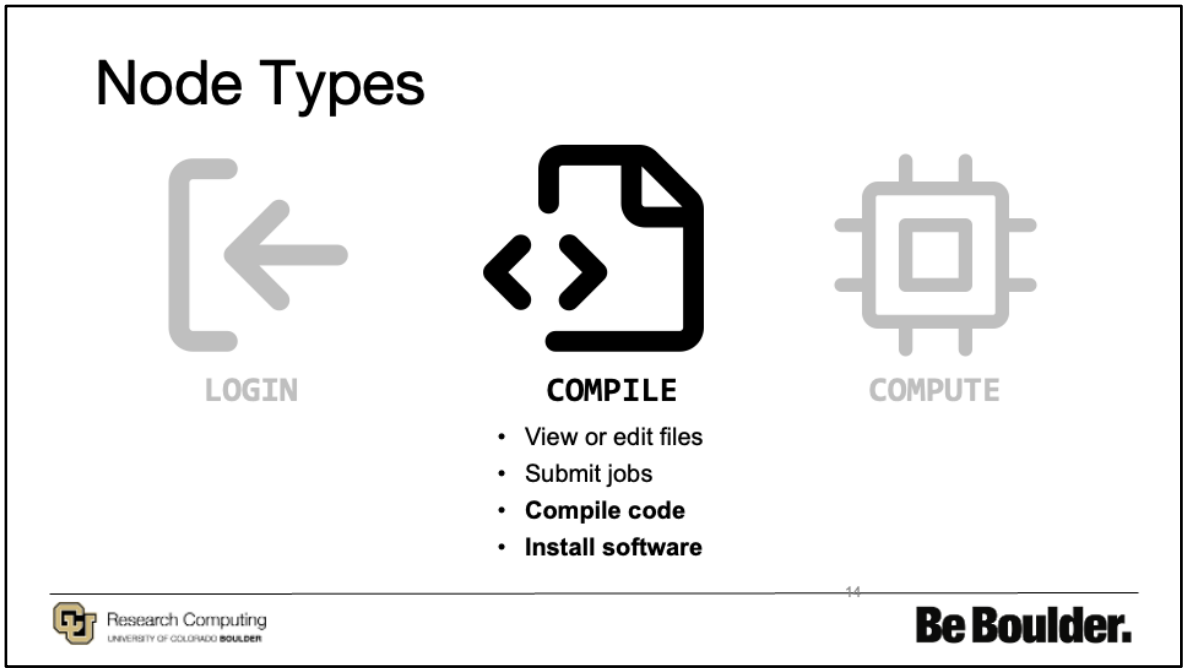

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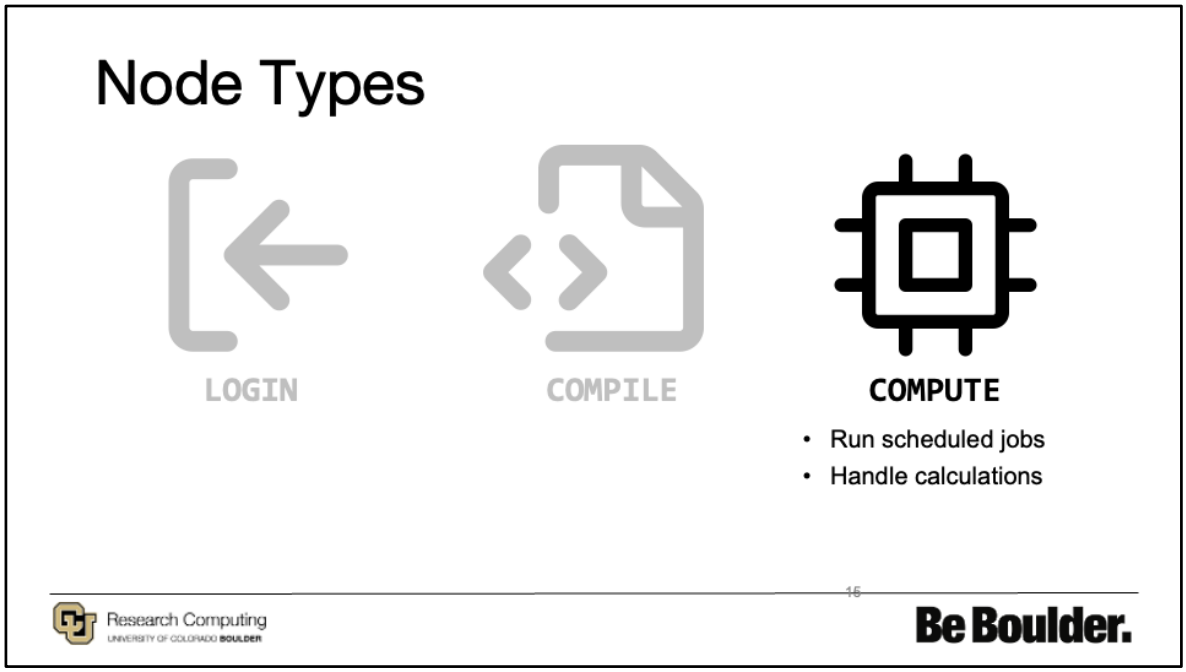

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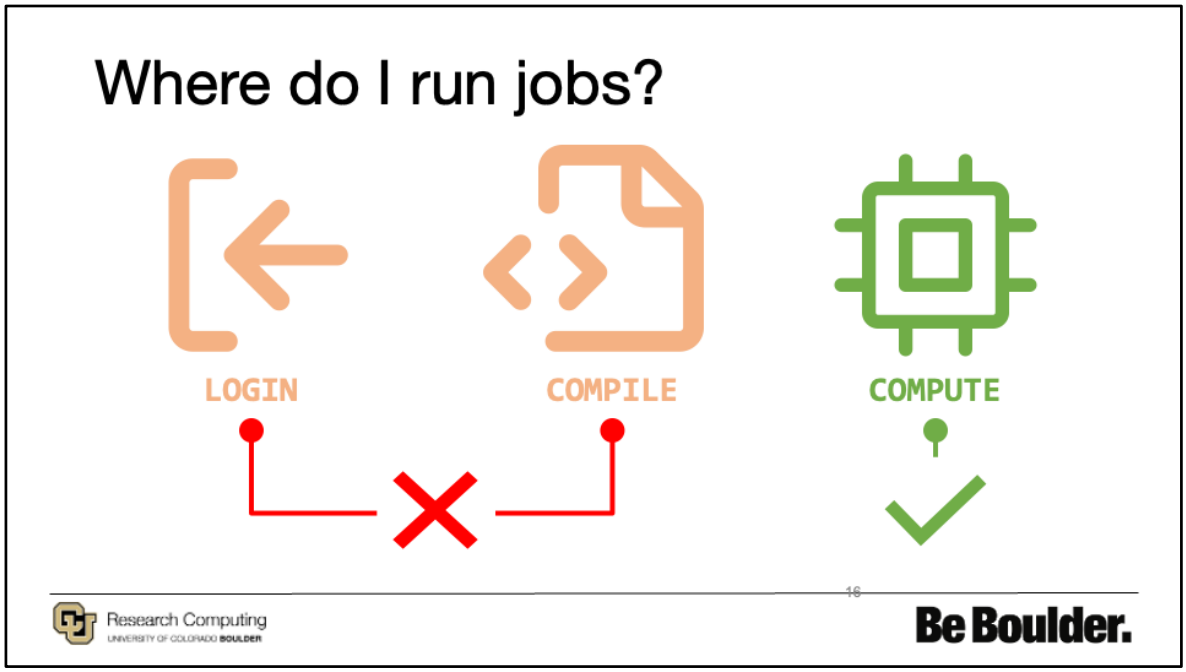

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Login -> Testing, Compiling, Compute/GPU

Node Types

DATA (DTN)

- Support data transfers
- Can be selected when using scp, sftp, or ssh transfers

Storage at CURC

Core

Included with RC account

- /home
- /projects
- /scratch

PetaLibrary

Paid Service for large data

- Storage
- Archival Backup
- Sharing

Core Filesystem Structure

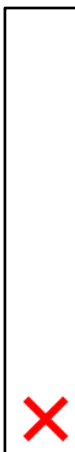
/home (2GB)	/projects (250GB)	/scratch/alpine (10TB)
• Scripts and Code • Important files (small)		
Not for: • File Sharing • Large Files		
Configuration Files, Notes		

Core Filesystem Structure

/home (2GB)	/projects (250GB)	/scratch/alpine (10TB)
• Scripts and Code • Important files (small)	• Code/files/libraries • Software you are installing • Sharing files	
Not for: • File Sharing • Large Files	**Not for** • Job Output • Temporary Files	
Configuration Files, Notes	Job Scripts, Shareable Files	

Core Filesystem Structure

/home (2GB)	/projects (250GB)	/scratch/alpine (10TB)
• Scripts and Code • Important files (small)	• Code/files/libraries • Software you are installing • Sharing files	• Output from running jobs • Large files/datasets • Sharing files • Cluster specific
Not for: • File Sharing • Large Files	**Not for** • Job Output • Temporary Files	**Not for** • Long Term Storage
Configuration Files, Notes	Job Scripts, Shareable Files	Job Output Files, Data Files



PetaLibrary Tiers

Active	Archive	Active + Archive	Archive + DR
• Performance Tier[1] • Accessible by All Nodes • No File Limit • Double Parity • lz4 compression			

[1] Slower than /scratch, [2] Per Terabyte

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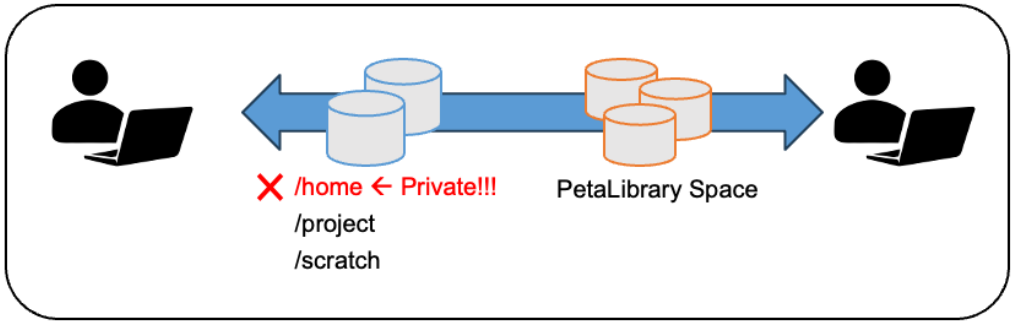
[1] Slower than /scratch, [2] Per Terabyte

Data Sharing: Within RC



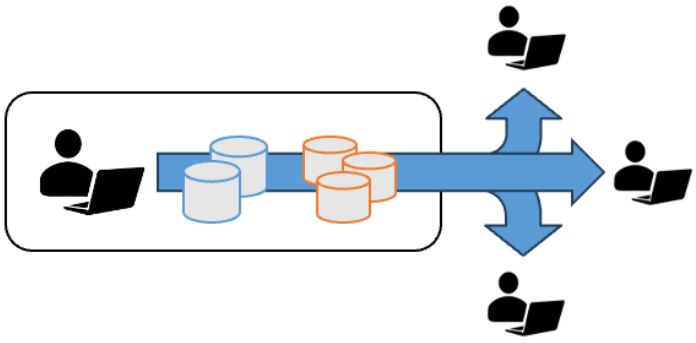
*Users manage access to their /project and /scratch directories.

RC Staff manage access to the PetaLibrary Space

Data Sharing: Outside RC

Large Data Transfers:

- Globus (Recommended)
- Data Transfer Nodes (DTN)
- Terminal/Command Line:
  - rsync
  - rclone
  - sftp
  - scp



DTN require internal CU Network access (VPN)

Acceptable data storage and use

CURC systems and services **should not be used to store** any data that is US government Classified, nor any Controlled Unclassified Information.

For users requiring storage for sensitive data types, please see the secure research computing resources:

https://www.colorado.edu/rc/secure-research-computing-resources

Cloud Computing

- CURC supports AWS, Azure, and GCP
- Alternative to HPC
- Enhance HPC

Cloudbursting

How to Access RC Resources?

1. Get an RC account
2. Set up two-factor authentication with Duo
3. Log in
4. Create greatness! (responsibly)

Getting an Account

- CU Boulder, CSU users and affiliates:
  - Request an account through the RC Account request portal: https://rcamp.rc.colorado.edu/accounts/account-request/create/organization
- AMC, RMACC users and affiliates:
  - Request an account through the ACCESS-CI User Registration Portal: https://identity.access-ci.org/new-user.html

Your RC Account

Access to:

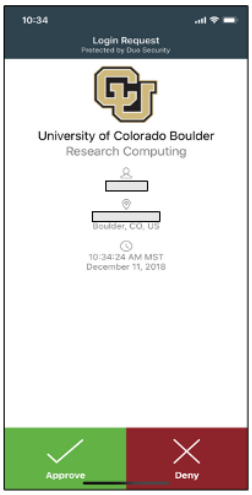
1. Alpine Cluster
2. Core Storage
3. PetaLibrary Storage*
4. Open OnDemand
5. Approximately 2,000 Service Units (SUs) per month

*If purchased

https://ondemand.rc.colorado.edu/
https://ondemand-rmacc.rc.colorado.edu/

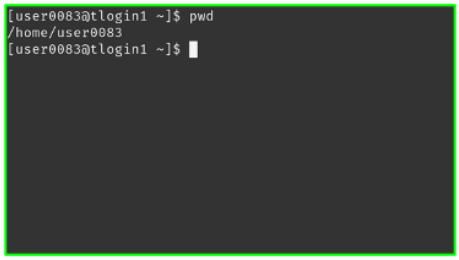
Duo Authentication

1. **Duo smartphone app (recommended)**
2. Phone Call/Text is an alternatives



Terminal Access

- Mac or Linux
  - Terminal application
- Windows
  - PuTTY
  - Powershell



- Open OnDemand (*alternative for CU affiliates*)
  - For those less familiar with Linux (ondemand.rc.colorado.edu/)

Demo: Logging in via Terminal

To login to an RC login node:

```
$ ssh <username>@login.rc.colorado.edu
```

Supply your IdentiKey* password and your Duo app will alert you to confirm the login

* Exclusive to CU and CSU accounts

Demo: logging in with OnDemand

CURC Open OnDemand is a browser based, integrated, single access point for all of your HPC resources at CU Research Computing.

- CU Boulder: Visit https://ondemand.rc.colorado.edu.
- Other RMACC Institutions: Visit https://ondemand-rmacc.rc.colorado.edu/