



Getting Started on the FASRC clusters with Command Line Interface

Learning objectives

- Log in via `ssh` to Cannon and FASSE
- How to start an interactive job
- How to submit a batch job
- Check job status
- Cluster software modules

Login to Cannon and FASSE – ssh

Documentation: <https://docs.rc.fas.harvard.edu/kb/terminal-access/>



Mac: Terminal, iTerm2



Linux: Xterm or Terminal

Windows



SSH client: Putty



Bash emulator: Git bash

Cannon

```
$ ssh jharvard@login.rc.fas.harvard.edu  
Password:  
Verification code:
```

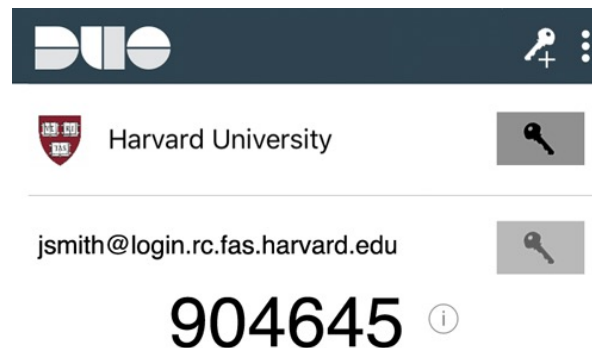
FASSE

```
$ ssh jharvard@fasselogin.rc.fas.harvard.edu  
Password:  
Verification code:
```

Login to Cannon and FASSE – 2 factor authentication

- Execute the ssh command, then:
 - Type your password (*cursor won't move!*), press enter
 - Type the 6-digit verification code (2-Factor Authentication)
 - Separate from HarvardKey
 - Updates token every 30 seconds
 - You can only use a token once

Java desktop app



Login to Cannon and FASSE – at login node (1)

Cannon

FASSE

```
jharvard@local-machine $ ssh jharvard@login.rc.fas.harvard.edu
(jharvard@login.rc.fas.harvard.edu) Password:
(jharvard@login.rc.fas.harvard.edu) verificationCode:
Last failed login: Mon Sep 18 18:54:44 EDT 2023 from 132.248.81.29 on ssh:notty
There were 3 failed login attempts since the last successful login.
Last login: Tue Aug 22 12:57:45 2023
!!!!!!!!!!!!!!!!!!!! Cannon Cluster !!!!!!!!!!!!!!!!!!!!!
Welcome to Cannon, a secure HPC resource for the research community,
hosted by Research Computing at HU's Faculty of Arts and Sciences.

+----- Helpful Documentation: -----+
| https://docs.rc.fas.harvard.edu/kb/quickstart-guide/ |
| https://docs.rc.fas.harvard.edu/kb/running-jobs/ |
| https://docs.rc.fas.harvard.edu/kb/convenient-slurm-commands/ |
+-----+

+----- NEWS & UPDATES: -----+
+ OFFICE HOURS: Wednesdays noon-3pm, see website for details +
+ Check our training schedule at: https://www.rc.fas.harvard.edu/upcoming-training/ +
+-----+

NEXT MAINTENANCE: OCTOBER 2ND 7-11AM
https://www.rc.fas.harvard.edu/maintenance

ROCKY 8: Welcome to the new operating system! For more on the
changes on the cluster see:
https://docs.rc.fas.harvard.edu/kb/rocky-8-transition-guide/

OFFICE HOURS: Are held on Zoom from 12-3PM EST on Wednesdays.
See https://www.rc.fas.harvard.edu/training/office-hours/ for details.
[jharvard@holylgin03 ~]$
```

```
jharvard@local-machine $ ssh jharvard@fasselgin.rc.fas.harvard.edu
(jharvard@fasselgin.rc.fas.harvard.edu) Password:
(jharvard@fasselgin.rc.fas.harvard.edu) VerificationCode:
Last login: Tue Jun 20 11:02:27 2023
!!!!!!!!!!!!!!!!!!!! FASSE Cluster !!!!!!!!!!!!!!!!!!!!!
Welcome to FASSE, a secure HPC resource for the research community,
hosted by Research Computing at HU's Faculty of Arts and Sciences.

+----- Helpful Documentation: -----+
| https://docs.rc.fas.harvard.edu/kb/quickstart-guide/ |
| https://docs.rc.fas.harvard.edu/kb/running-jobs/ |
| https://docs.rc.fas.harvard.edu/kb/convenient-slurm-commands/ |
+-----+

+----- NEWS & UPDATES: -----+
+ OFFICE HOURS: Wednesdays noon-3pm, see website for details +
+ Check our training schedule at: https://www.rc.fas.harvard.edu/upcoming-training/ +
+-----+

NEXT MAINTENANCE: OCTOBER 2ND 7-11AM
https://www.rc.fas.harvard.edu/maintenance

ROCKY 8: Welcome to the new operating system! For more on the
changes on the cluster see:
https://docs.rc.fas.harvard.edu/kb/rocky-8-transition-guide/

OFFICE HOURS: Are held on Zoom from 12-3PM EST on Wednesdays.
See https://www.rc.fas.harvard.edu/training/office-hours/ for details.
[jharvard@fasselgin01 ~]$
```

Login to Cannon and FASSE – at login node (2)

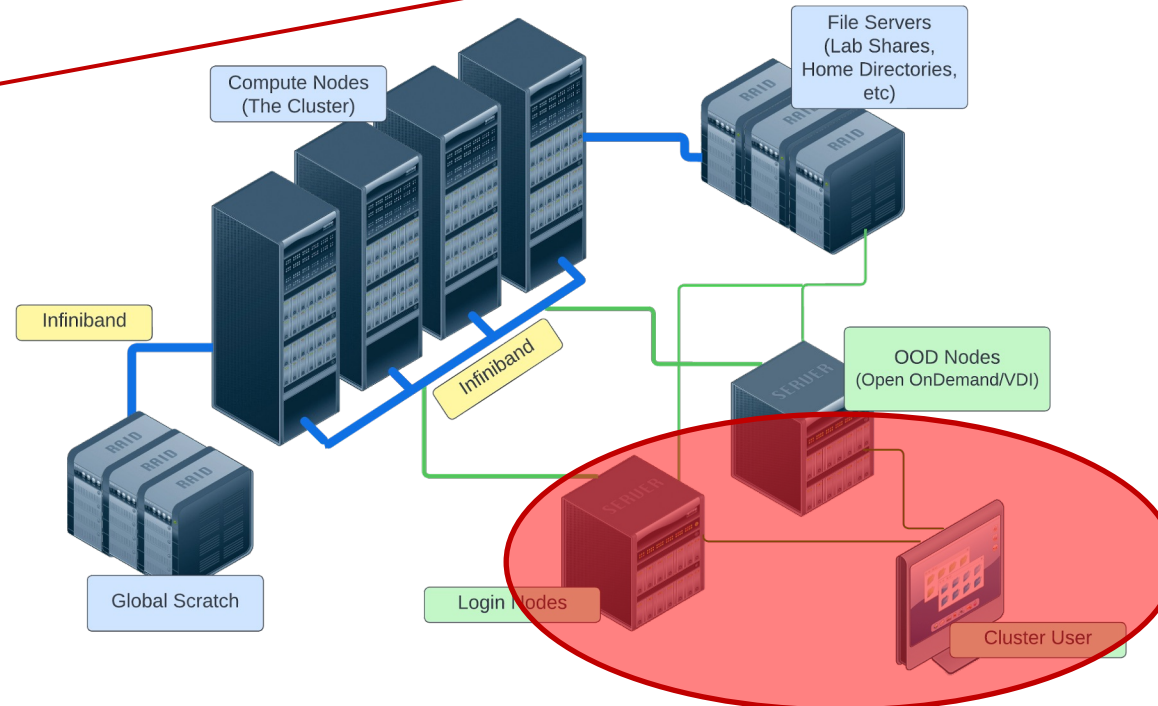
Cannon

```
[jharvard@boslogin01 ~]$
```

Name of the login node assigned to you

FASSE

```
[jharvard@fasselogin01 ~]$
```



Login vs. compute nodes

- Login nodes
 - limited to 1 core and 4G of memory
 - not designed for analysis
 - not anything compute- or memory-intensive
 - best practice is to request a compute node as soon as you login
- Compute node via interactive job
 - work a compute node interactively – testing, debugging, installing software
 - request resources from slurm using salloc command
 - session will only last as long as the network connection is active
 - cannot be idle for more than 1h, session will freeze

Interactive job on Cannon (1)

Requesting an interactive job

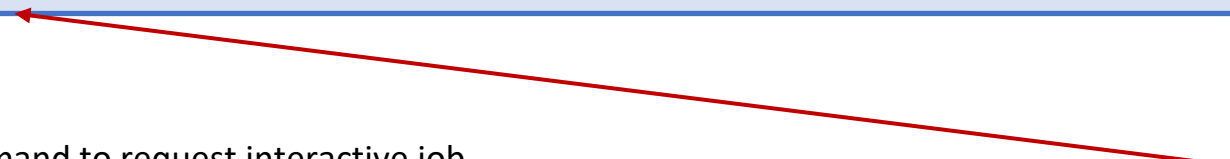
```
[jharvard@boslogin01 ~]$ salloc --partition test --mem-per-cpu 1G --time 01:00:00
salloc: Pending job allocation 2741096
salloc: job 2741096 queued and waiting for resources
salloc: job 2741096 has been allocated resources
salloc: Granted job allocation 2741096
salloc: Nodes holy7c02410 are ready for job
[jharvard@holy7c02410 ~]$
```

`salloc` - slurm command to request interactive job

`--partition test` - requesting a compute node in a specific partition

`--mem-per-cpu 1G` - memory requested in GB (if no unit is specified, the default is MB)

`--time 00:01:00` - time requested (1 hour, format HH:MM:SS or D-HH:MM)



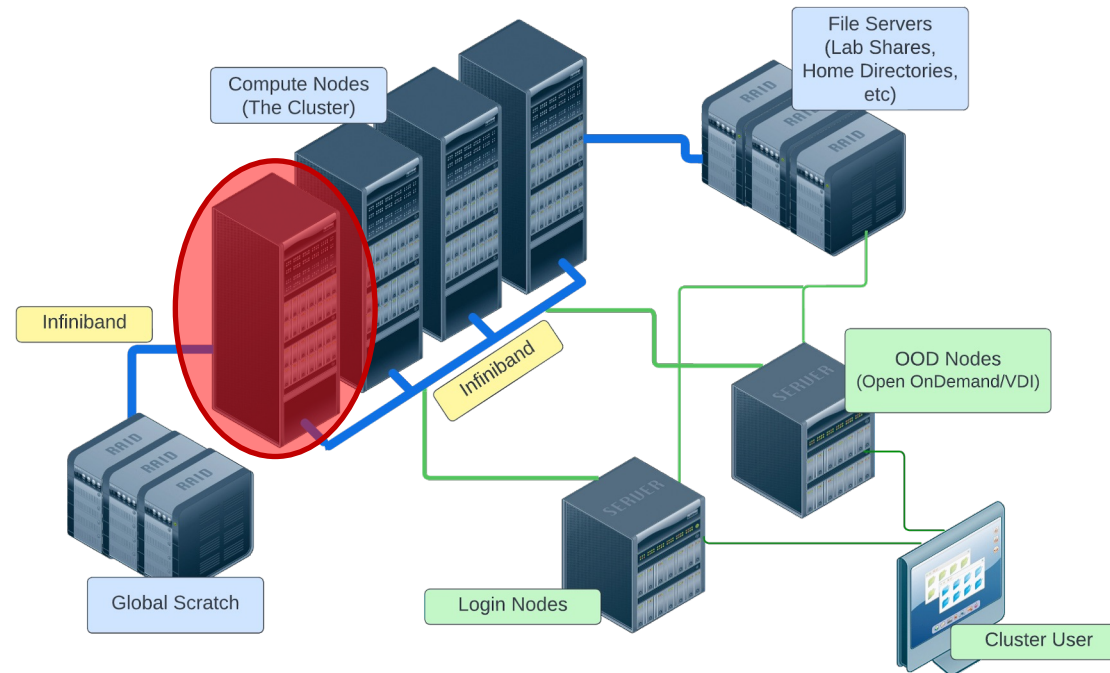
Name of the compute
node assigned to you

Interactive job on Cannon (2)

Requesting an interactive job

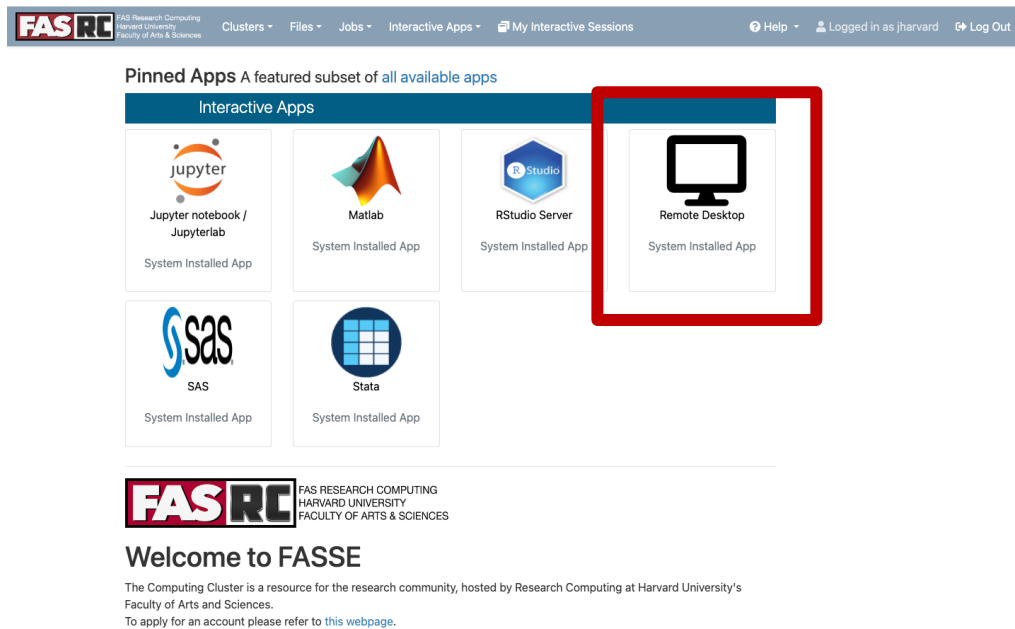
```
[jharvard@holy7c02410 ~]$
```

Name of the compute node assigned to you



Interactive job on FASSE

- You cannot request an interactive job on FASSE
- You must use Remote Desktop app on Open OnDemand <https://fasseood.rc.fas.harvard.edu> and launch terminal



The screenshot shows the FAS RC Open OnDemand web interface. At the top, there is a navigation bar with the FAS RC logo, user information (Logged in as jharvard), and a Log Out button. Below the navigation bar, there is a section titled "Pinned Apps A featured subset of all available apps". Underneath this, there is a sub-section titled "Interactive Apps" which contains six app tiles: Jupyter, Matlab, RStudio Server, Remote Desktop, SAS, and Stata. The "Remote Desktop" tile is highlighted with a red rectangular box. Below the app tiles, there is a "Welcome to FASSE" message and a brief description of the computing cluster.

FAS RC FAS Research Computing
Harvard University
Faculty of Arts & Sciences

Clusters Files Jobs Interactive Apps My Interactive Sessions Help Logged in as jharvard Log Out

Pinned Apps A featured subset of all available apps

Interactive Apps

Jupyter
Jupyter notebook / Jupyterlab
System Installed App

Matlab
System Installed App

RStudio Server
System Installed App

Remote Desktop
System Installed App

SAS
System Installed App

Stata
System Installed App

FAS RC FAS RESEARCH COMPUTING
HARVARD UNIVERSITY
FACULTY OF ARTS & SCIENCES

Welcome to FASSE

The Computing Cluster is a resource for the research community, hosted by Research Computing at Harvard University's Faculty of Arts and Sciences.
To apply for an account please refer to [this webpage](#).

Batch job

Documentation:

<https://docs.rc.fas.harvard.edu/kb/running-jobs/>

- Automate job
- No interaction
- Can close your terminal/laptop and job will keep running
- Partitions
 - Cannon:
<https://docs.rc.fas.harvard.edu/kb/running-jobs/>
 - FASSE:
<https://docs.rc.fas.harvard.edu/kb/fasse/>

slurm script runscript.sh

slurm directives

```
#!/bin/bash
#SBATCH -J py_job           # Job name
#SBATCH -p test             # Partition(s) (separate with
                            # commas if using multiple)
#SBATCH -c 1                # Number of cores
#SBATCH -t 0-00:30:00      # Time (D-HH:MM:SS)
#SBATCH --mem=500M         # Memory
#SBATCH -o py_%j.o         # Name of standard output file
#SBATCH -e py_%j.e         # Name of standard error file

# load software environment
module load python/3.10.12-fasrc01

# print a statement
echo "This is our test slurm script"

# execute python code
python hello_world.py
```

Test first!!

ALWAYS test the job submission script first:

- To ensure the job will complete without errors
- To ensure you understand the resource needs and have requested them appropriately

Submitting a batch job

```
[jharvard@boslogin01 python]$ sbatch runscript.sh  
Submitted batch job 2742999  
[jharvard@boslogin01 python]$
```

Job monitoring – sacct

Documentation:

- sacct = slurm accounting database
 - every 30 sec the node collects the amount of cpu and memory usage that all of the process ID are using for the given job. After the job ends this data is set to slurmdb
- Common flags (i.e., options)
 - `-j jobid` or `--name=jobname`
 - `-S starttime YYYY-MM-DD` and `-E endtime YYYY-MM-DD`
 - `-o output_options`
 - See slurm docs for more options: <https://slurm.schedmd.com/sacct.html>

```
[jharvard@boslogin01 ~]$ sacct --format=JobID,Jobname,partition,state,time,start,end,elapsed,MaxRss,MaxVMSize,nnodes,ncpus,nodelist --units=G -j 2742999
```

JobID	JobName	Partition	State	Timelimit	Start	End	Elapsed	MaxRSS	MaxVMSize	NNodes	NCPUS	NodeList
2742999	py_job	test	COMPLETED	00:30:00	2023-09-21T12:03:20	2023-09-21T12:03:21	00:00:01			1	1	holy7c02410
2742999.bat+	batch		COMPLETED		2023-09-21T12:03:20	2023-09-21T12:03:21	00:00:01	0.01G	0.21G	1	1	holy7c02410
2742999.ext+	extern		COMPLETED		2023-09-21T12:03:20	2023-09-21T12:03:21	00:00:01	0.00G	0.17G	1	1	holy7c02410

Memory usage

1. Run a test batch job
2. Check memory usage after the job has completed (with `sacct` command)

```
[jharvard@boslogin01 ~]$ sacct -j 2742999 -o ReqMem,MaxRSS
  ReqMem      MaxRSS
-----
    500M
          7512K
          4348K
[jharvard@boslogin01 ~]$ sacct -j 2742999 -o ReqMem,MaxRSS --units=G
  ReqMem      MaxRSS
-----
    0.49G
          0.01G
          0.00G
```

Job efficiency summary – `seff`

1. Run a test batch job
2. Check job efficiency after the job has completed (with `seff` command)

```
[jharvard@boslogin01 ~]$ seff 2742999
Job ID: 2742999
Cluster: odyssey
User/Group: jharvard/jharvard_lab
State: COMPLETED (exit code 0)
Cores: 1
CPU Utilized: 00:00:00
CPU Efficiency: 0.00% of 00:00:01 core-walltime
Job Wall-clock time: 00:00:01
Memory Utilized: 7.34 MB
Memory Efficiency: 1.47% of 500.00 MB
```

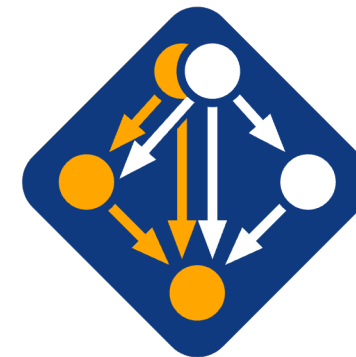
```
[user@boslogin01 home]# seff 1234567
Job ID: 1234567
Cluster: odyssey
User/Group: user/user_lab
State: COMPLETED (exit code 0)
Nodes: 8
Cores per node: 64
CPU Utilized: 37-06:17:33
CPU Efficiency: 23.94% of 155-16:02:08 core-walltime
Job Wall-clock time: 07:17:49
Memory Utilized: 1.53 TB (estimated maximum)
Memory Efficiency: 100.03% of 1.53 TB (195.31 GB/node)
```

Software – LMOD module system

- Software is loaded incrementally using modules, to set up your shell environment (e.g., PATH, LD_LIBRARY_PATH, and other environment variables)
- Keep module load commands on slurm batch script
 - Keeps your interactive working environment simple
 - Is a record of your research workflow (reproducible research!)
 - Keep .bashrc module loads sparse, lest you run into software and library conflicts

```
module load matlab/R2022b-fasrc01 # recommended
module load matlab                # most recent version
module list                        # show loaded modules
module purge                       # unload all loaded modules
module spider matlab              # search for modules with matlab in the name
module display matlab/R2022b-fasrc01 # show the details of the module
```


Spack



- For software that does not have a module, you can install it with Spack:
<https://docs.rc.fas.harvard.edu/kb/spack/>
- Install Spack in a Holyoke storage location, such as `holylabs`
 - Package installation is best done in an interactive session with 8 cores 12GB as Spack needs more resources
`salloc --partition test --time 0-04:00 --mem 12G --cpus-per-task 8`

FASRC documentation

- FASRC docs: <https://docs.rc.fas.harvard.edu/>
- GitHub User_codes: https://github.com/fasrc/User_Codes/
- Getting help
 - Office hours: <https://www.rc.fas.harvard.edu/training/office-hours/>
 - Ticket
 - Portal: http://portal.rc.fas.harvard.edu/rcrt/submit_ticket (requires login)
 - Email: rchelp@rc.fas.harvard.edu

Upcoming trainings

Training calendar: <https://www.rc.fas.harvard.edu/upcoming-training/>

GPU Computing on the FASRC clusters (9/26)

- Audience
 - users familiar with command-line interface
 - users can submit interactive and batch jobs
- Content
 - how you can use CUDA/OpenACC
 - Examples
 - Nvidia containers



Thank you :)
FAS Research Computing