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 – \texttt{ssh}

Documentation: \url{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

\texttt{$\text{ssh jharvard@login.rc.fas.harvard.edu}$}

Password:
Verification code:

### FASSE

\texttt{$\text{ssh jharvard@fasselogin.rc.fas.harvard.edu}$}

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

![Java desktop app screenshot]

Duo

Harvard University

jsmith@login.rc.fas.harvard.edu

904645
Login to Cannon and FASSE – at login node (1)

**Cannon**

```
$ ssh jharvard@login.rc.fas.harvard.edu
(jharvard@login.rc.fas.harvard.edu) Password:
[jharvard@login.rc.fas.harvard.edu] login
Welcome to HU's Faculty of Arts and Sciences. Hosted by Research Computing at HU.

--- 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/training/office-hours/](https://www.rc.fas.harvard.edu/training/office-hours/)

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

**FASSE**

```
$ ssh jharvard@login.login.rc.fas.harvard.edu
(jharvard@login.login.rc.fas.harvard.edu) Password:
(jharvard@login.login.rc.fas.harvard.edu) VerificationCode:
```

```
Welcome to FASSE. The FASSE cluster is for the research community.
```

```
--- Helpfull System Information ---
* 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/

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```

**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/](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/](https://www.rc.fas.harvard.edu/training/office-hours/) for details.
```

```
[jharvard@fasselogin81 -j]
```

[Image of Cannon and FASSE login nodes]
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 ~]$
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](https://fasseood.rc.fas.harvard.edu) and launch terminal
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/

```
#!/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

```bash
[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 sent 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](https://slurm.schedmd.com/sacct.html)

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

<table>
<thead>
<tr>
<th>JobID</th>
<th>JobName</th>
<th>Partition</th>
<th>State</th>
<th>Time</th>
<th>Start</th>
<th>End</th>
<th>Elapsed</th>
<th>MaxRSS</th>
<th>MaxVMSize</th>
<th>NNodes</th>
<th>NCPUS</th>
<th>NodeList</th>
</tr>
</thead>
<tbody>
<tr>
<td>2742999</td>
<td>py_job</td>
<td>test</td>
<td>COMPLETED</td>
<td>00:30:00</td>
<td>2023-09-21T12:03:20</td>
<td>2023-09-21T12:03:21</td>
<td>00:00:01</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>holy7c02410</td>
</tr>
<tr>
<td>2742999.bat+</td>
<td>batch</td>
<td></td>
<td>COMPLETED</td>
<td></td>
<td>2023-09-21T12:03:20</td>
<td>2023-09-21T12:03:21</td>
<td>00:00:01</td>
<td>0.01G</td>
<td>0.21G</td>
<td>1</td>
<td>1</td>
<td>holy7c02410</td>
</tr>
<tr>
<td>2742999.ext+</td>
<td>extern</td>
<td></td>
<td>COMPLETED</td>
<td></td>
<td>2023-09-21T12:03:20</td>
<td>2023-09-21T12:03:21</td>
<td>00:00:01</td>
<td>0.00G</td>
<td>0.17G</td>
<td>1</td>
<td>1</td>
<td>holy7c02410</td>
</tr>
</tbody>
</table>
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 – \texttt{seff}

1. Run a test batch job
2. Check job efficiency after the job has completed (with \texttt{seff} command)

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

\begin{itemize}
\item \texttt{[user@boslogin01 home]$ seff 1234567}
  \begin{itemize}
  \item Job ID: 1234567
  \item Cluster: odyssey
  \item User/Group: user/user\_lab
  \item State: COMPLETED (exit code 0)
  \item Nodes: 8
  \item Cores per node: 64
  \item CPU Utilized: 37-06:17:33
  \item CPU Efficiency: 23.94% of 155-16:02:08 core-walltime
  \item Job Wall-clock time: 07:17:49
  \item Memory Utilized: 1.53 TB (estimated maximum)
  \item Memory Efficiency: 100.03% of 1.53 TB (195.31 GB/node)
  \end{itemize}
\end{itemize}
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 in a 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

```bash
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/](https://docs.rc.fas.harvard.edu/)
- GitHub User_codes: [https://github.com/fasrc/User_Codes/](https://github.com/fasrc/User_Codes/)

Getting help

- Office hours: [https://www.rc.fas.harvard.edu/training/office-hours/](https://www.rc.fas.harvard.edu/training/office-hours/)
- Ticket
  - Portal: [http://portal.rc.fas.harvard.edu/rcrt/submit_ticket](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