

Concepts in Cluster Computing – Introduction to Flux

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Roadmap

- Flux overview
- Software Modules
- PBS script creation
- Job submission
- Job monitoring
- Advanced topics

Flux

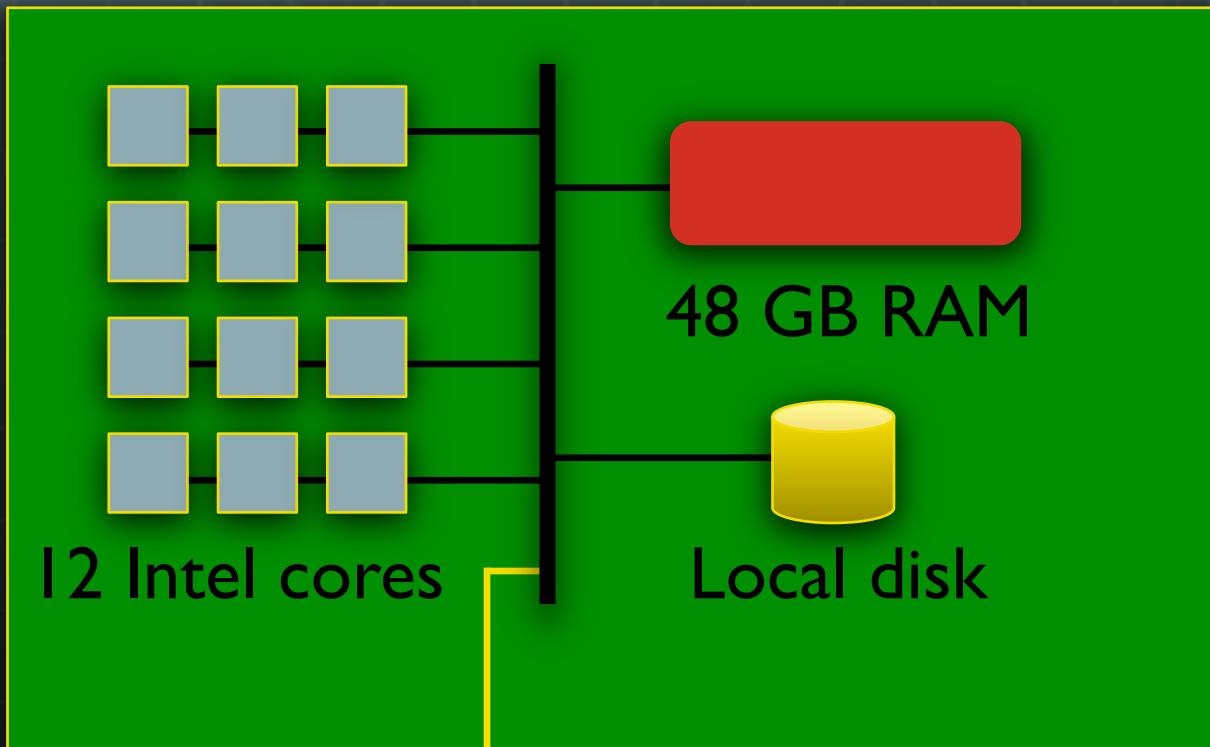
Flux

- ➊ Flux is a university-wide shared computational discovery / high-performance computing service.
- ➋ Interdisciplinary
 - ➌ Provided by Advanced Research Computing at U-M (ARC)
 - ➌ Operated by ARC Technical Services (ARC-TS)
 - ➌ Hardware procurement, software licensing, billing support by U-M ITS
 - ➌ Used across campus
- ➌ Collaborative since 2010
 - ➌ Advanced Research Computing at U-M (ARC)
 - ➌ College of Engineering's IT Group (CAEN)
 - ➌ Information and Technology Services (ITS)
 - ➌ Medical School
 - ➌ College of Literature, Science, and the Arts
 - ➌ School of Information

<http://arc-ts.umich.edu/resources/compute-resources/>



A Flux node

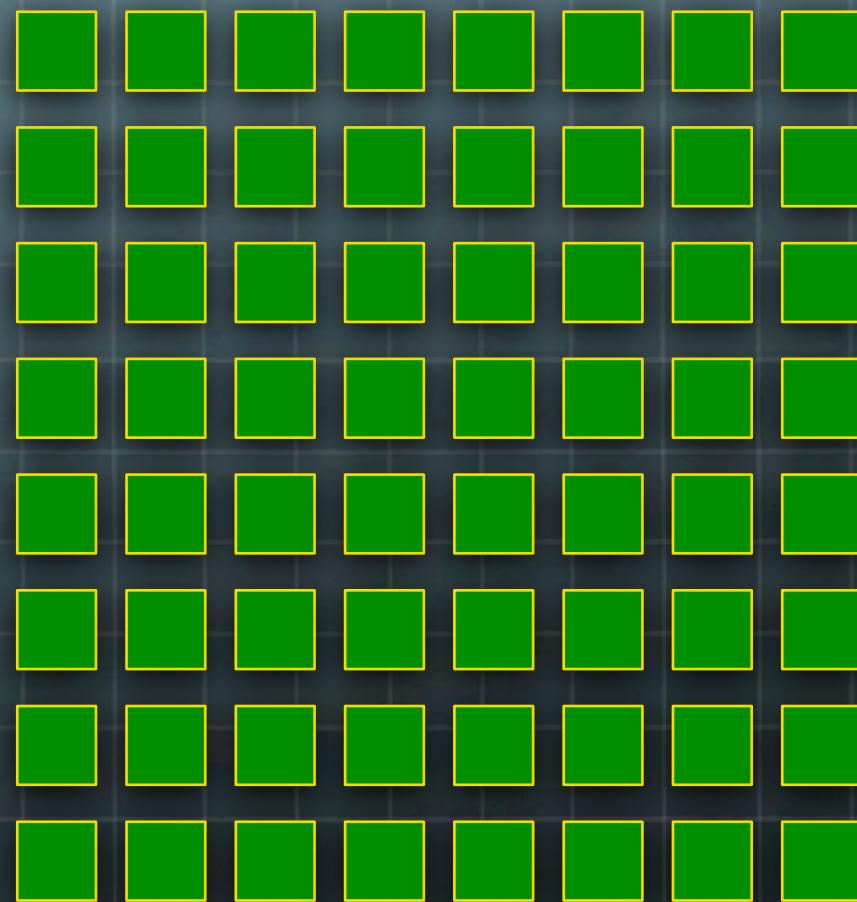


The Flux cluster

Login nodes



Compute nodes



Data transfer node



Storage



Using Software on Flux

Access to Software

- Software modules have been installed on Flux to make it easy to use the software which you need. Use the module command to setup the software for your session.

```
module avail  
module list  
module load software_package  
module unload software_package  
module swap software_package  
module whatis software_package
```

- You can create your own modules in your /home directory if you wish to install software yourself.

PBS Script Creation

PBS Script Creation

- PBS = Portable Batch System
- With so many users on the system and a finite number of resources, the scheduler takes job requests and allocates resources, assigns which compute node(s) the job will run on and maintains ‘fair sharing’ of the cluster.
- The scheduler also maintains job logs which are useful for:
 - selecting the proper amount of resources to request
 - troubleshooting issues with a user’s workflow
 - identifying hardware issues with the compute nodes

A Sample PBS Script

Scheduler Directives

```
#PBS -N Rcoinflip
#PBS -A micro612w16_fluxod
#PBS -q fluxod
#PBS -l nodes=1:ppn=1,pmem=3GB,walltime=1:00:00,qos=flux
#PBS -M uniqname@umich.edu
#PBS -m abe
#PBS -j oe
#PBS -V
```

```
# Include the next three lines always
if [ "x${PBS_NODEFILE}" != "x" ] ; then
    cat $PBS_NODEFILE # contains a list of the CPUs you were using if
run with PBS
fi
```

```
# Always add this line to change to the working directory of the program.
Otherwise
# the script will be run from the users /home directory
cd $PBS_O_WORKDIR
echo $PBS_O_WORKDIR
```

```
# Put your job commands after this line
R CMD BATCH --no-save --no-restore coinflip.R
```

← Your workflow goes here

/scratch



What is /scratch?

/scratch is a high performance file system connected to fast networking which allows for high throughput reads/writes



Why should I use /scratch?

In a word... performance



What should I do with my files on /scratch

Once your program is done running, copy your results files to your /home directory or other storage you have access to



Your /scratch space for this class is:

/scratch/micro612w16_fluxod/*unique name*



WARNING: /scratch is NOT backed up. Make sure that files contained on /scratch are not your only copy.

Job Submission

Job Submission

- For a job to run on the Flux cluster, you must submit the job to the scheduler.
- On Flux, the command to send jobs to the scheduler is:

```
qsub PBS_script_name
```

- Useful commands for working with queued jobs:

```
qdel <job ID #> - removes the job from the queue (will work  
also if the job is running)
```

```
qhold <job ID #> - puts the job on hold (pause)
```

```
qrelease <job ID #> - releases a held job (resume)
```

```
qalter <job ID #> - alters the PBS directives for a submitted job
```

Job Monitoring

Job Monitoring

- Often when you have very long jobs and/or very many jobs, you wish to know the status of your job(s). There are a variety of ways you can monitor your jobs.

`qstat -u <uniqname>` - list job info for a user

`showq -w user=<uniqname>` - details regarding the status of blocked, eligible and active jobs

`qstat -f <job ID #>` - list all the attributes for a given job

`checkjob -vv <job ID #>` - list job details for a given job

Job Submission Example

- First, let's get the files into your /scratch directory.

type: `cd /scratch/micro612w16_fluxod/uniqname`
 `cp ../dmontag/coinflip.* .`

- Next, modify coinflip.pbs to send email to your uniqname.

type: `nano coinflip.pbs`
modify: `#PBS -M uniqname@umich.edu`
save and exit

- Now, let's load the R module so that our program will run

type: `module load R`

- Finally, submit the job

type: `qsub coinflip.pbs`

Advanced Topics

Advanced Topics

- Job dependencies – Start a job after some condition
- Job arrays – Submit one job for multiple data files
- Interactive jobs – Use a command line on a compute node
- wget - Grab files from websites
- Globus - another, very useful way to copy files (web based)
See <https://www.globus.org/> for details

Useful Links

-  <http://arc.umich.edu/>
-  <http://arc-ts.umich.edu/software/torque/>
-  <http://arc-ts.umich.edu/software/>
-  <http://fluxhpc.blogspot.com/>
-  https://twitter.com/ARCTS_UMI/
-  <http://www.mais.umich.edu/mtoken/>
-  <https://www.globus.org/>

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