

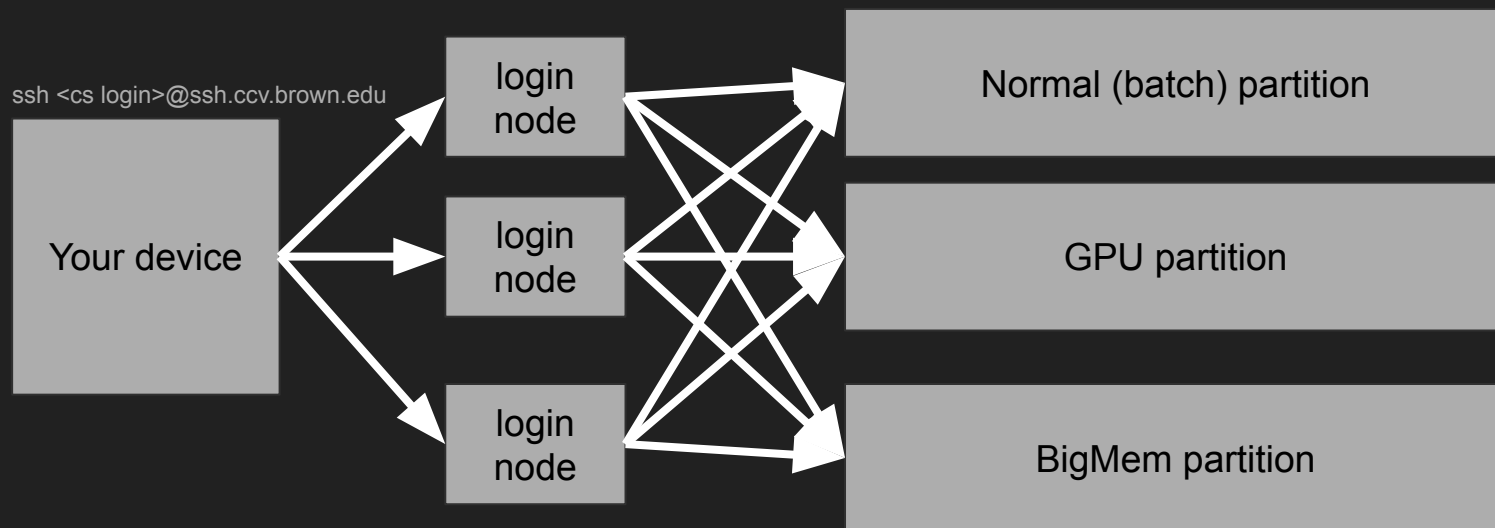
Final Project Gear-Up

Outline

- Using Oscar
 - Login v compute nodes
 - How to specify a job for particular partition
 - How to specify resources to use for a particular run
 - Measuring power in a completed job
- Using Full System Mode in gem5
 - Specifying custom OS
 - Specifying custom simulated file system
 - Adding custom scripts to simulated disk
- Discussing ideas!

Oscar

- Documentation: <https://docs.ccv.brown.edu/oscar>



Oscar

- Do not run tests in the login server! Submit them to one of the appropriate partitions or run an interactive session!

[login007.oscar.ccv.brown.edu Arbiter2] New violation of usage policy by sthoma41 (Samuel Thomas,...samuel_thomas@brown.edu) [Link](#)

[ccv-systems@brown.edu](#)
to me

Violation of usage policy

A violation of the usage policy by sthoma41 (Samuel Thomas,...samuel_thomas@brown.edu) on login007.oscar.ccv.brown.edu was automatically detected starting at 19:53 on 06/23.

This may indicate that you are running computationally-intensive work on the interactive login node (when it should be run on compute nodes instead). Please utilize the 'interact' command to initiate a SLURM session on a compute node and run your workloads there.

You now have the status **penalty1** because your usage has exceeded the thresholds for appropriate usage on the node. Your CPU usage is now limited to 80% of your original limit (8.0 cores) for the next 30 minutes. In addition, your memory limit is 80% of your original limit (40.0 GB) for the same period of time.

These limits will apply on login007.oscar.ccv.brown.edu.

High-impact processes

Usage values are recent averages. Instantaneous usage metrics may differ. The processes listed are probable suspects, but there may be some variation in the processes responsible for your impact on the node. Memory usage is expressed in GB and CPU usage is relative to one core (and may exceed 100% as a result).

Process	Average core usage (%)	Average memory usage (GB)
python3 (1)	15.98	2.58
other processes** (1)	0.35	0.02
vim (1)	0.06	0.00
ssh* (2)	0.01	0.00
bash (1)	0.00	0.00

Recent system usage

Utilization of sthoma41 on login007.oscar.ccv.brown.edu

Processes (ordered by usage)

- Threshold
- python3 (1)
- other processes** (1)
- vim (1)
- ssh* (2)
- bash (1)

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- Submitting batch jobs
 - a. Command line (i.e. `$ sbatch -n <num cpus> --mem=<s>gb -p <partition> <command> -t <hh:mm:ss>`)
 - b. Writing run script with `#SBATCH` declarations
- Interactive jobs
 - a. Same as batch job submission but with interactive terminal in compute node (good for debugging)
 - b. `$ interact -n <num cpus> --mem=<s>gb -p <partition> <command> -t <hh:mm:ss>`
- For full list of possible commands:
<https://docs.ccv.brown.edu/oscar/submitting-jobs/batch>

Oscar

- Measuring energy on Oscar
 - Requires Intel cores on batch partition
 - To see the available nodes, call `sfeature | grep intel`
- For new jobs you will have to add following constraint, so power usage gets recorded.
 - `#SBATCH --constraint=intel`
- Once the job is finished you can query via: `sacct -j <JOBID> -o user,account,partition,jobid,QOS,ConsumedEnergy,ConsumedEnergyRaw`
- Call `man sacct` for more details on how to format this output!

Oscar

- Let's go through an example!
- Sample program in `/data/oscar/csci1952/final-project-gearup!`

- We'll use the GAP benchmark suite and run some stuff!

Oscar

- Big applications that will take a while to run! (more than a few seconds)
- Studying impact of an application on *real* hardware!
- Studying impact of GPUs versus CPUs on a real application!

- Limitations: you're not a superuser, so libraries/versions need to be loaded dynamically (`module load <library>`)

Oscar Questions??

Full System Mode in gem5

- Custom disk images and OS kernels can be specified for applications
- Pre-built binaries exist in the gem5 resources: <https://resources.gem5.org/>
- Current support for FS mode is super buggy, and your life will be easier if you use the deprecated version (sorry!)

Full System Mode in gem5



Full System Mode in gem5

- You can download the binaries directly from the gem5 resources website
- Lots of different prebuilt OS kernel binaries and file systems with a bunch of different benchmark suites!
- Support for lots of different ISAs!

The screenshot displays two resource pages from the gem5-resources website. The top page is for 'x86-ubuntu-18.04-img', categorized as a 'disk-image'. It shows a table with one version (1.0.0) of size 656.2 MB, available for gem5 versions 23.0 and 23.1. A 'Download via Terminal' box contains the command: `wget https://storage.googleapis.com/dist.gem5.org/dist/develop/images/x86/ubuntu-18-04/x86-ubuntu.img.gz`. The author is Ayaz Akram, and the license is Unknown. The bottom page is for 'x86-linux-kernel-5.4.49', categorized as a 'kernel'. It shows a table with one version (1.0.0) of size 25.3 MB, available for gem5 versions 23.0 and 23.1. A 'Download via Terminal' box contains the command: `wget https://storage.googleapis.com/dist.gem5.org/dist/develop/kernels/x86/static/vmlinux-5.4.49`. The author is Unknown, and the license is Unknown. Both pages include a 'Depend on this resource' link pointing to 'x86-ubuntu-18.04-boot'.

gem5-resources /
x86-ubuntu-18.04-img

Category: **disk-image**

X86 VERSION 1.0.0 TAGS **x86** **fullsystem**

Readme Changelog Usage **Versions** Additional Info Raw

Version	Size	gem5 Versions	Links
1.0.0	656.2 MB	23.0, 23.1	

Download via Terminal

```
wget https://storage.googleapis.com/dist.gem5.org/dist/develop/images/x86/ubuntu-18-04/x86-ubuntu.img.gz
```

Author: **Ayaz Akram**
Source: [Repository \(GitHub\)](#)
License: **Unknown**
Depend on this resource: [x86-ubuntu-18.04-boot](#)

gem5-resources /
x86-linux-kernel-5.4.49

Category: **kernel**

X86 VERSION 1.0.0 TAGS **linux-kernel**

Readme Changelog Usage **Versions** Raw

Version	Size	gem5 Versions	Links
1.0.0	25.3 MB	23.0, 23.1	

Download via Terminal

```
wget https://storage.googleapis.com/dist.gem5.org/dist/develop/kernels/x86/static/vmlinux-5.4.49
```

Author: **Unknown**
Source: [Repository \(GitHub\)](#)
License: **Unknown**
Depend on this resource: [x86-ubuntu-18.04-boot](#)

Full System Mode in gem5 (setting up run env)

```
$ mkdir -p dist/binaries
```

```
$ mkdir -p dist/disks
```

```
$ wget --directory-prefix=dist/binaries <gem5 resource OS  
kernel url>
```

```
$ wget --directory-prefix=dist/disks <gem5 resource disk>
```

```
$ mkdir bootscripts
```

```
$ echo "echo Hello World!; /sbin/m5 exit;" >  
bootscripts/run_helloworld.rcS
```

Full System Model in gem5 (run_fs.sh)

```
#!/bin/sh
```

```
export CURR_DIR=$(pwd)
export M5_PATH=$CURR_DIR/dist
export KERNEL_PATH=$M5_PATH/binaries/<linux binary>
export CPU_TYPE=AtomicSimpleCPU
export DISK_PATH=$M5_PATH/disks/<disk image>
export SCRIPT_PATH=$CURR_DIR/bootscripts/run_helloworld.rcS
```

```
$CURR_DIR/build/<ISA>/gem5.opt -d $CURR_DIR/<results dir>
$CURR_DIR/configs/deprecated/example/fs.py --kernel $KERNEL_PATH
--cpu-type $CPU_TYPE --disk $DISK_PATH --caches --script=$SCRIPT_PATH
```

Full System Model in gem5

- What happens if I want to run a program that gem5 doesn't have a disk image for?

```
mkdir mnt
```

```
sudo python3 util/gem5img.py mount dist/disks/<filename>.img  
mnt
```

```
cp -r <my project dir> mnt/
```

```
sudo python3 util/gem5img.py umount mnt
```

- Then, make a bootscrip that calls your built project!

Full System Mode in gem5

- What happens if I want to use a custom OS?
- **Getting a new OS to work with gem5 can be pretty tedious because testing is slow!**
- I recommend following the steps put together by the gem5 developers, and understand the changes they made to the reserved address spaces, etc in the commit history (there are only a few gem5-related commits, most have to do with Linux configs):

https://www.gem5.org/documentation/general_docs/fullsystem/building_arm_kernel

Full System Mode in gem5

- If there's interest, let's go through an example!

Full System Mode in gem5

- If possible, I recommend using SE mode to run stuff where you can – it's faster and more intuitive
- If you want to test OS related-concepts, FS mode will be your friend – but start early! Also start early if you're using SE mode :-)

FS mode questions?

Project Ideas?
Brainstorming?
Questions?