HELIOS

About

- HELIOS is a computer cluster
  - computers are aggregated together to create a more powerful machine.
  - User can access a specific machine (node) inside the cluster

    or
  - use multiple nodes at the same time for task that are computation heavy

Connect to Helios

- Should have received your logging info

Connect with linux

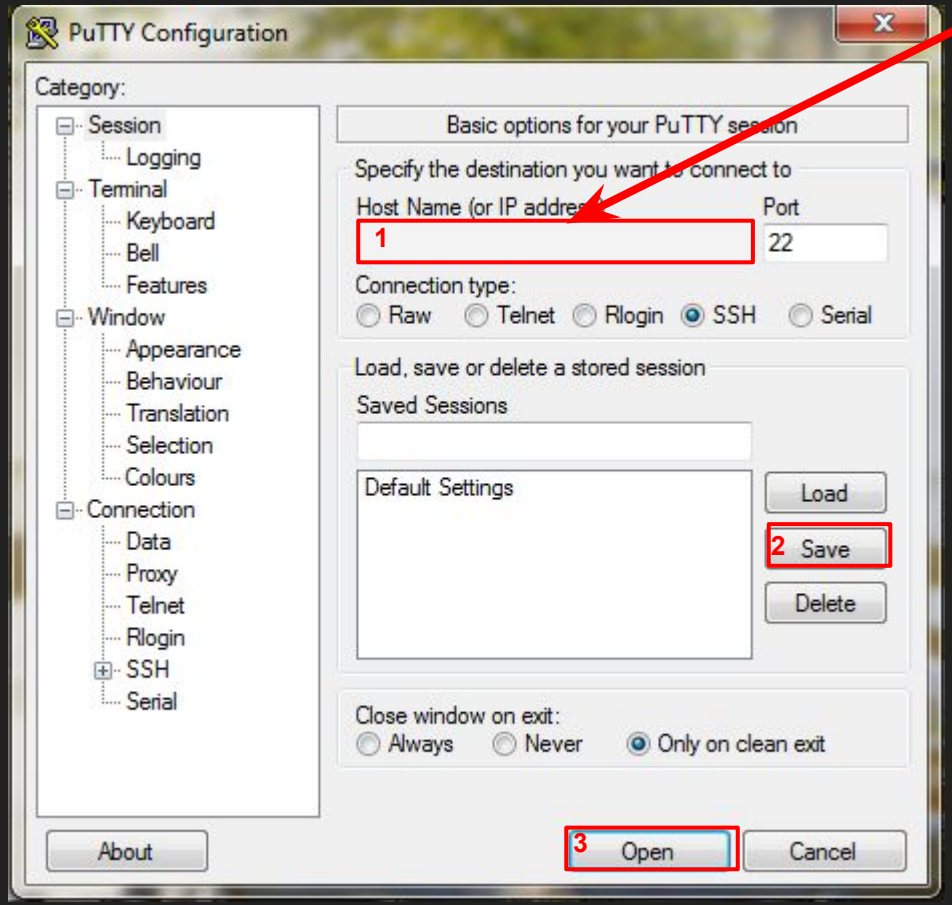
- `ssh <account-name>@helios.calculquebec.ca`

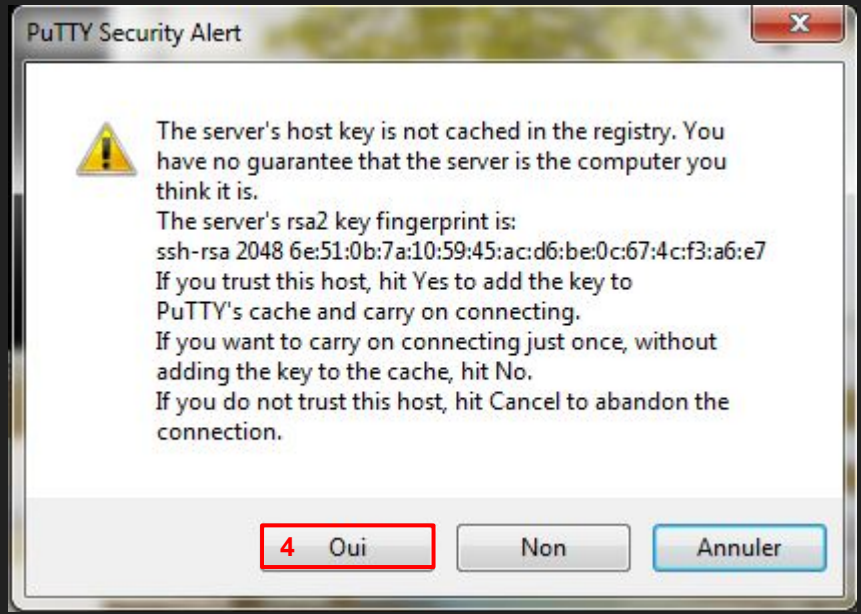
Connect with windows

- Multiple solutions
  a. Windows subsystem for linux
     - Makes ubuntu command line available on your windows machine
     - Can install all ubuntu packages
  b. Install putty
     - This is a ssh client for windows
  c. Use git bash
     - Git comes with ssh

Putty

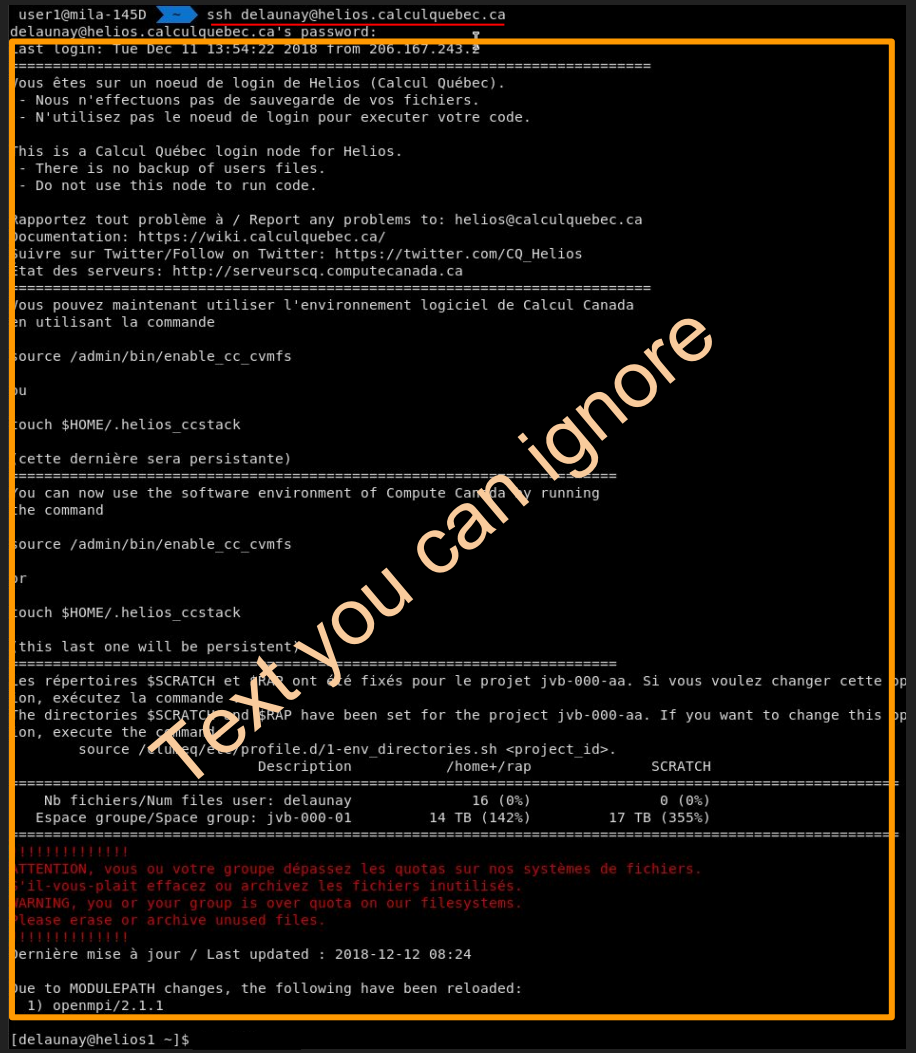
<account-name>@helios.calculquebec.ca





HELIOS

- Once connected you should see something like this →



Bash - A few useful functions

- mkdir: make directory

```
[delaunay@helios1 ~]$ mkdir my_project
```

- ls: list directories

```
[delaunay@helios1 ~]$ ls
my_project  script_moab
```

- cd: change directory

```
[delaunay@helios1 ~]$ cd my_project/
[delaunay@helios1 my_project]$
```

- pwd: print working directory

```
[delaunay@helios1 my_project]$ pwd
/home/delaunay/my_project
```

- cat: show file content

```
[delaunay@helios1 ~]$ cat .bashrc
```

- vi: open a file with vi
  - to edit file press i
  - to quit press ESC then enter :q

```
[delaunay@helios1 ~]$ vi .bashrc
```

More at https://github.com/LeCoupa/awesome-cheatsheets/blob/master/languages/bash.sh

How to run AI Stuff

- Compute Resource are shared among a lot of people
- You need to demand access to those resources
- The resources will be allocated to you by the ...
  - resource manager (torque) / job scheduler: moab
  - https://wiki.calculquebec.ca/w/Moab/en

How to run AI Stuff

```
> msub -N skynet_1 -A jvb-000-ag -l nodes=1:gpus=1,walltime=00:01:00 srun_1.pbs
```

- -N: job name
- -A: Account name (never changes)
- -l: Requested Resources
  - nodes=1 => 1 node
  - gpus=1 => 1 GPU
  - walltime=06:00:00 => Run for 6 hours
- -M: Email Notification
- -m: Event that triggers an email notification
  - -m bea (b: begin, e: ends, a: killed)

- All the output files will be placed inside the directory where the job was created
- Jobs can only run for 12 hours max!
- http://docs.adaptivecomputing.com/maui/commands/msub.php

How to run AI Stuff

- Singularity
  - Sandboxed Execution
  - You have control over the container (image)
  - Pre configured container to simplify your life

```
singularity exec --nv --bind source:dest container script.sh
```

- exec : execute a script
- --nv : mount NVIDIA GPUs
- --bind : make host folder (source) available inside the container (dest)
- container: image of the container you want to use
- script.sh: the script you want to run

How to run AI Stuff

- Create a batch wrapper

```
[delaunay@helios1 ~]$ cat srun_1.pbs
      #!/bin/bash

      module --force purge
      PATH=$PATH:/opt/software/singularity-3.0/bin/

      # set the working directory to where the job is launched
      cd "${PBS_O_WORKDIR}"

      # Singularity options
      IMAGE=/rap/jvb-000-aa/singularityimages/pytorch.simg

      FOLDERS=$RAP,$HOME,$SCRATCH

      SINGULARITY_EXEC="singularity exec --nv --bind $FOLDERS $IMAGE"

      # start your python script
      $SINGULARITY_EXEC python mnist.py
```

How to run AI Stuff

```
[delaunay@helios1 MixedPrecisionTutorial]$ msub -N skynet_1 -A jvb-000-ag -l nodes=1:gpus=1,walltime=00:01:00 run.pbs

371993
```

Job ID

```
[delaunay@helios1 MixedPrecisionTutorial]$ ls -all | grep 371993
-rw------- 1 delaunay jvb-000-01  1406 Dec 13 14:19 371993.err
-rw------- 1 delaunay jvb-000-01    64 Dec 13 14:19 371993.out
```

Job Output

Demo

```
# copy the example locally
git clone https://github.com/Delaunay/helios

# enter the example
cd helios

# Schedule the example to be run
msub -N skynet_1 -A jvb-000-ag -l nodes=1:gpus=1,walltime=00:01:00 srun_1.pbs

# Show <job_id>.out
watch tail -n 20 $(ls -rt | grep .out | tail -n 1)
```

How to run AI Stuff

- Specifying all the arguments can be tedious
- You can specify the arguments that do not change in your script itself!

```
#!/bin/bash
#PBS -N skynet_1
#PBS -A jvb-000-ag
#PBS -l nodes=1:gpus=1,walltime=00:01:00
```

How to run AI Stuff

```
# Schedule the example to be run
msub run_2.pbs

# Show <job_id>.out
watch tail -n 20 $(ls -rt | grep .out | tail -n 1)
```

How to run AI stuff interactively

```
> msub -N skynet_1 -A jvb-000-ag -l nodes=1:gpus=1,walltime=15:00 -I -qtest

> singularity shell --nv --bind $RAP,$HOME,$SCRATCH /rap/jvb-000-aa/singularityimages/pytorch.simg
```

- Useful for testing & debugging

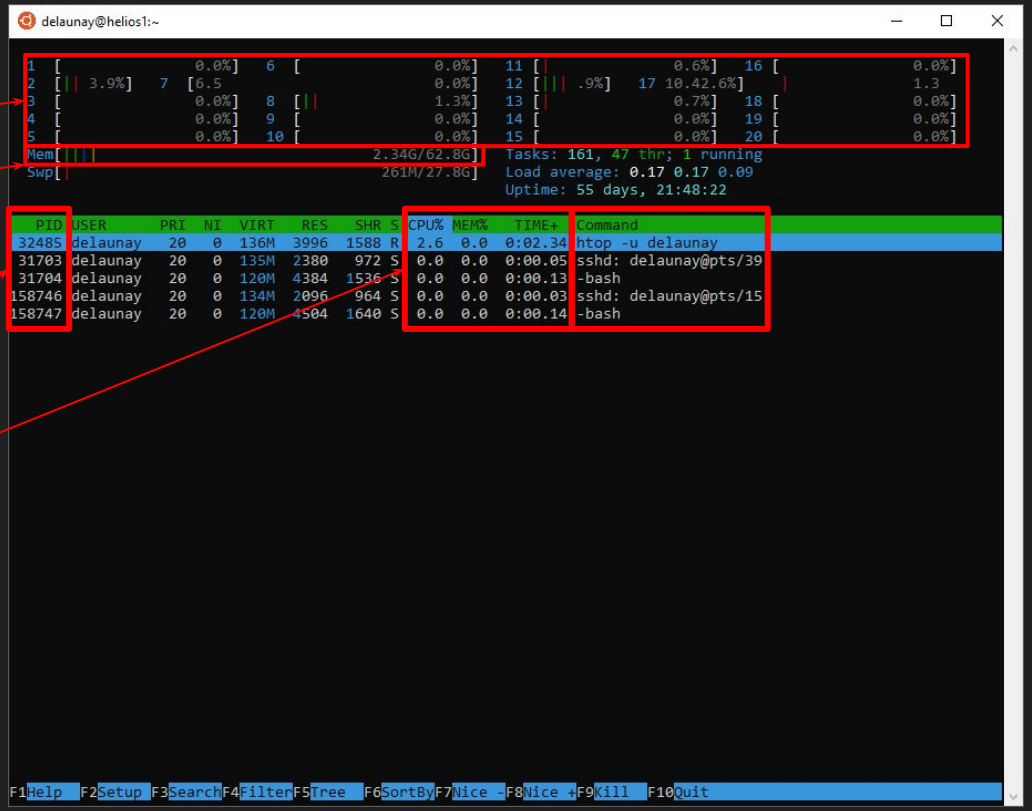
- The walltime/user time allocated to them is small

Monitor Jobs

- Email notification from moab
- `showq -w user=<username>`
  - Show the current jobs running for you
- `checkjob <jobid>`
  - Show details on a particular job (resource usage, status)
- `mjobctl -c <jobid>`
  - Cancel job

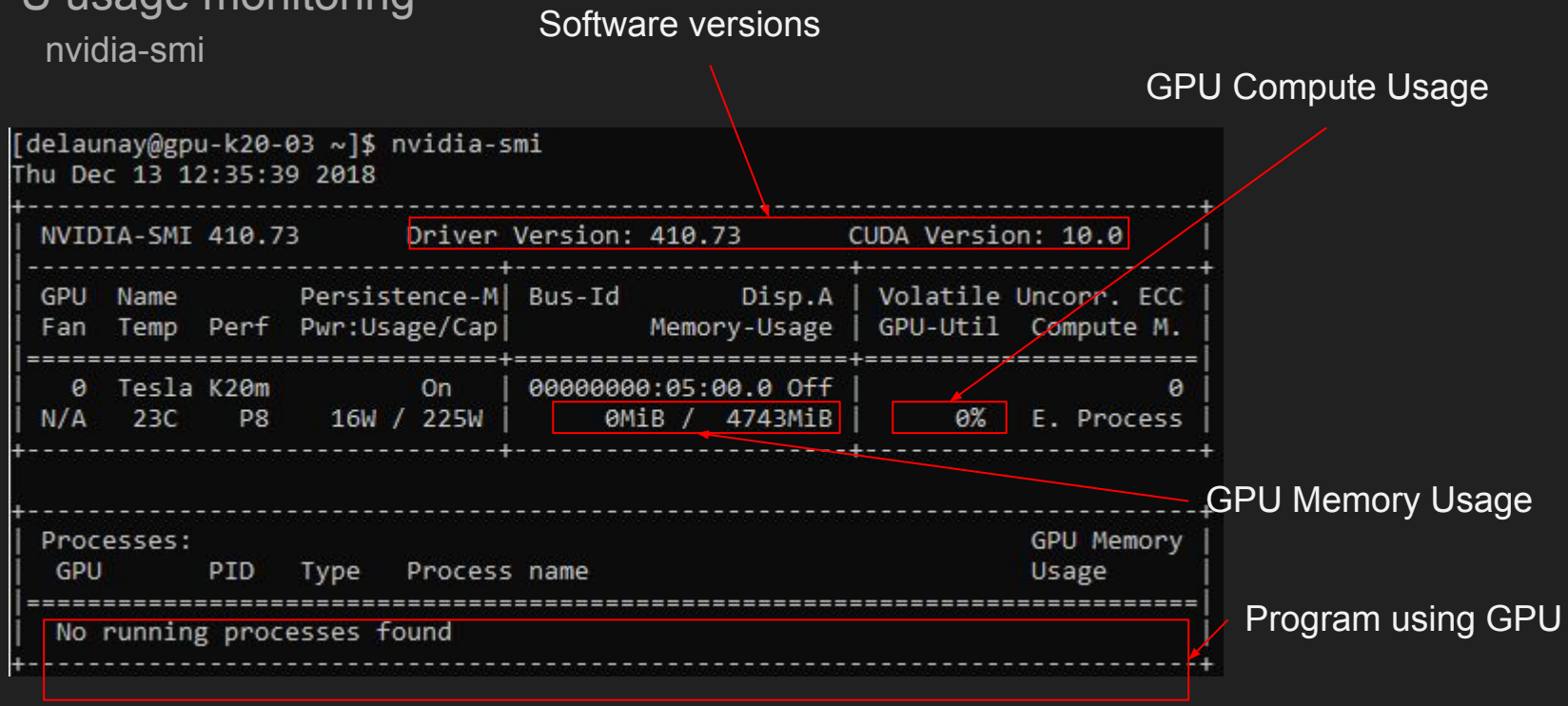
Monitor resource usage

- RAM and CPU usage monitoring
  - htop -u <username>
    - % usage per cores
    - Memory usage
    - PID: Program Identifier
    - Resource usage per program
- To kill a running program:
  - kill -9 <PID>



Monitor resource usage

- GPU usage monitoring
  - nvidia-smi



Monitor resource usage

- `nvidia-smi --loop=1 --query-gpu=utilization.gpu,utilization.memory,memory.used,memory.total --id=0 --format=csv`

```
[delaunay@gpu-k20-03 ~]$ nvidia-smi --loop=1 --query-gpu=utilization.gpu,utilization.memory,memory.used,memory.total --id=0 --format=csv
utilization.gpu [%], utilization.memory [%], memory.used [MiB], memory.total [MiB]
0 %, 0 %, 0 MiB, 4743 MiB
0 %, 0 %, 0 MiB, 4743 MiB
0 %, 0 %, 0 MiB, 4743 MiB
0 %, 0 %, 0 MiB, 4743 MiB
0 %, 0 %, 0 MiB, 4743 MiB
0 %, 0 %, 0 MiB, 4743 MiB
0 %, 0 %, 0 MiB, 4743 MiB
```

- --loop=1 run nvidia-smi every second
- --query-gpu specify which statistic to print
- --id=0 show statistic only for the first gpu
- --format=csv print each iteration as a new CSV line

Quality of life

- Modify your `~/.bashrc` to pre configure your environment

```
module --force purge

# make singularity 3 available
PATH=$PATH:/opt/software/singularity-3.0/bin/

# make a shortcut to create an interactive session
alias mdebug="msub -N skynet_1 -A jvb-000-ag -l nodes=1:gpus=1,walltime=01:00:00 -I -qtest"
export SINGULARITY_ARGS="--nv --bind $RAP,$HOME,$SCRATCH /rap/jvb-000-aa/singularityimages/pytorch.simg"

alias s_shell="singularity shell $SINGULARITY_ARGS"
alias s_exec="singularity exec $SINGULARITY_ARGS"

alias show_err="watch tail -n 20 $(ls -rt | grep .err | tail -n 1)"
alias show_out="watch tail -n 20 $(ls -rt | grep .out | tail -n 1)"
alias rm_logs="rm *.out *.err"
```

- reload the configuration

```
source ~/.bashrc
mdebug
```

More documentation

- How to use Compute Canada Clusters
  - https://github.com/SMART-Lab/smartdispatch/wiki/How-To-Use-Compute-Canada-Clusters
  - https://docs.computecanada.ca/wiki/Python
- nvidia-smi
  - http://developer.download.nvidia.com/compute/DCGM/docs/nvidia-smi-367.38.pdf
- Singularity
  - https://www.sylabs.io/guides/3.0/user-guide/index.html