

# Overlall themes

- Today: Cedar down for software updates (today only), /project expansion (/project unavailable March 1-4)
- (Our explanations should not sound like excuses)
- (We do *not* want to project an idea that Cedar is unstable and users should avoid it)
- Our goals are to:
  - ▶ provide as much uptime as possible
  - ▶ have all resources (CPUs, GPUs, memory, storage, bandwidth) to be utilized as much as possible
  - ▶ minimize gaps in scheduling between jobs
  - ▶ minimize turnaround for your jobs
- When hardware/etc problems occur, we want you to know how you can work around them
- We want to show you how certain workflows can lead to system instabilities

# Major causes of system instability

- Node failures: a node needs rebooting
- File system problems: Lustre object storage servers can get overloaded with lots of small requests
  - ▶ 4 OSS servers on Cedar handling `/home` and `/scratch`
  - ▶ 10 OSS servers on Cedar handling `/project`
  - ▶ these are paired into groups of two
    - one in a pair goes down  $\Rightarrow$  the other one will take over
    - both go down  $\Rightarrow$  the entire filesystem will hang
- Scheduler failures
- Oversubscription of nodes, GPUs
- No software stack synchronization between login and compute nodes
- Networking problems (within or outside our control)

# What do you see?

- Sluggish jobs
- Jobs not starting / taking unusually long to start
  - ▶ many valid reasons why your job's starting time can be pushed into the future
- Slurm not responding, or producing unusual output
  - ▶ e.g. a job will be stuck in 'Prolog' R (running) state for a long time, not producing any output
- Shell not responding to simple commands or very slow
- Output files missing from your working directory
- Inside running jobs see "module not found"
  - ▶ typically requires manual intervention
- Cannot log in

# What can you do about these instabilities?

- Report problems to `support@computecanada.ca` with details:
  - ▶ system you are using
  - ▶ job IDs of affected jobs
  - ▶ detailed description of the problem
  - ▶ time/date it was first encountered
- Pay attention to login messages
  - ▶ terminal output from anything in your `~/.bash_profile` or `~/.bashrc` (e.g. when loading a module or activating a virtual environment ) might force important system messages scroll past the top of the terminal
  - ▶ these may contain both general system notices and `/scratch` purge notifications specifically for you
- Check `http://status.computecanada.ca` for updates and recent incidents
- Sometimes you could work around a temporary filesystem problem by submitting jobs from another filesystem
  - ▶ on Cedar `/scratch,/home` files are handled by different servers than `/project`


# What can you do? (cont.)

- Do *not* delete and resubmit jobs that have been waiting in a queue for a long time until confirming with `support@computecanada.ca`
  - ▶ otherwise we can't analyze why a job is waiting, and priority may be lost
- Expect a backlog of jobs after a system problem
  - ▶ do *not* swamp the system with a bunch of new jobs – be selective about what is most important to you
  - ▶ make sure that job parameters are chosen carefully to match the needs of particular jobs

# These workflows will create problems

- Running anything CPU-intensive on the head node
- Submitting large number of jobs
- Issuing too many requests to the scheduler
  - ▶ classical example: running `watch queue ...`
  - ▶ submitting thousands of jobs and then cancelling them
- Complex/unrealistic job dependencies can make Slurm unstable
- Not testing first on a small scale (and gradual scaling up)
  - ▶ large parallel jobs
  - ▶ many serial jobs and large job arrays
  - ▶ large computational problems in general
- Assuming perfect parallel scaling
  - ▶ your 64-core job may be slower than 32-core ...

- Excessive and/or “bad” I/O, i.e. anything resulting in high load on Lustre object storage servers
  - ▶ avoid high I/O workflows: lots of small files, read/write in chunks smaller than 1MB, reading small blocks from large files
- Using nested parallelism in black-box pipelines
  - ▶ e.g. submitting serial jobs each of which launches multiple threads, sometimes asking for all cores on a node
  - ▶ your pipeline should be adapted to the cluster; if not sure, please talk to us
- Moving files from one filesystem to another (e.g. /home → /scratch) when close to the quota can lead to data loss
  - ▶ use copy instead
- Storing a large number of small files
  - ▶ organize your code's output
  - ▶ use **tar** or even better **dar** (<http://dar.linux.free.fr>, supports indexing, differential archives, encryption)

- Checkpointing to be prepared for system failures
- Break your job into pieces (if possible)
- Only request resources (memory, running time) needed
  - ▶ with a bit of a cushion, maybe 115-120% of the measured values
  - ▶ use `sacct` to estimate your completed code's memory usage
- Be aware that some filesystems are not backed up (e.g. `/scratch`), and some have a purge policy (`/scratch`)  **have a backup plan**
- If a file's path changes, our backup system will interpret it as a new file
  - ⇒ unnecessary load on the filesystems
    - ▶ be careful with renaming large directories



# Other best practices (cont.)

- If you still need to do lots of small I/O from inside your job:
  - ▶ use Slurm-generated directory `$SLURM_TMPDIR` (pointing to `/localscratch/${USER}.${SLURM_JOBID}.0` on a node's SSD) for both input and output
    - don't forget to move files out before your job terminates: everything in `$SLURM_TMPDIR` will be deleted
  - ▶ use `$TMPDIR` RAM disk (pointing to `/tmp`)
    - don't forget to allocate additional memory to your job
    - don't forget to move the results before your job terminates
- Port your workflow to another CC's general-purpose cluster, to run it there in case of failures
  - ▶ data management part may not be so easy, but Globus should help
  - ▶ also try to port your workflows (have accounts, appropriate input data, programs installed) to local clusters where available (Grex, Orcinus, Plato)
- If you received a `/scratch` purge warning, do *not* wait to transfer data to local systems or other clusters
  - ▶ always pay attention to `/scratch` purge notices (email and system login message)