SHARCNET, Compute Ontario, and the Digital Research Alliance of Canada

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What is SHARCNET?

- URL: `https://www.sharcnet.ca/`
- Started in 2001.
- The University of Windsor was one of the founding members:
  - Fanshawe, Guelph, McMaster, Sheridan, Western Ontario, Wilfred Laurier, Windsor
- Today it is made up of **19 Ontario universities and colleges**:
  - … Brock, Conestoga, Durham, Lakehead, Laurentian, Nipissing, Ontario College of Art and Design University, Ontario Tech University, Perimeter Institute, Trent, Waterloo, York
- Part of **Compute Ontario** which is part of **Compute Canada**.
  - **NOTE:** Generally you need not worry about these details –we all function as a Canada-wide team.

What is SHARCNET? (con't)

SHARCNET provides:

- **S**hared **H**ierarchical **A**cademic **R**esearch **C**omputing **Net**work.
- access to high performance, advanced, and cloud computing and corresponding **compute, cloud, and storage** resources to Canadian researchers
- support staff to **support** researchers with such
- weekly new user seminars, biweekly webinars, summer school courses, and other training activities, e.g., `https://training.sharcnet.ca`

What is Compute Ontario?

Compute Ontario, `https://computeontario.ca`:

- Plays a key role in coordinating Ontario's **advanced research computing and big data** focus
- Has these four partners:
  - SHARCNET (19 institutions)
  - SciNet (University of Toronto)
  - Centre for Advanced Computing (Queen's)
  - HPC4Health (Hospital for Sick Children, Princess Margaret Cancer Centre at UHN)

What is the Digital Research Alliance of Canada

Compute Canada, `https://www.alliancecan.ca`:

- Has these regional partners:
  - ACENET (New Brunswick, Nova Scotia, P.E.I., Newfoundland and Labrador institutions)
  - Calcul Québec (Québec institutions)
  - Compute Ontario (Ontario institutions)
  - Prairies DRI (Alberta, Saskatchewan, Manitoba institutions)
  - B.C. DRI (British Columbian institutions)
- Through its member consortia, the Alliance provides high-performance, advanced, and cloud computing resources to researchers across Canada.

Some Important Details

- Cost:
  - Free to Canadian researchers.
  - Corporate and foreign researchers can obtain access if the Canadian researcher is the project PI.
  - We are funded directly and indirectly through various grants.
- Limited to research.
  - e.g., undergraduate course-work is not permitted
- All accounts are tied to a **Sponsor PI** who supervises research projects.
  - Statistics are collected and used for reporting purposes, e.g., grants funding us.

Getting Access

To obtain access:

- `https://docs.alliancecan.ca`
- Click **Getting an Account**.

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Overview

Compute Clusters:

- **beluga**.computecanada.ca (general purpose cluster)
- **cedar**.computecanada.ca (general purpose cluster)
- **graham**.computecanada.ca (general purpose cluster)
- **narval**.computecanada.ca (general purpose cluster)
- **niagara**.computecanada.ca (large parallel jobs cluster)
  - e.g., jobs $>=$ 1040 cores

Cloud Systems:

- **arbutus.cloud**.computecanada.ca
- **east.cloud**.computecanada.ca
- **graham.cloud**.computecanada.ca
- **cedar.cloud**.computecanada.ca

cedar.computecanada.ca

Cedar cluster information:

- **Location:** Simon Fraser University.
- **Total CPU cores:** 100,400 over 2,470 nodes.
  - **CPU Chipsets:** Intel E5-2650 v4 Broadwell 2.2 GHz; Intel E5-2683 v4 Broadwell 2.1 GHz; Intel Silver 4216 Cascahde Lake 2.1 GHz; Intel E7-4809 v4 Broadwell 2.1 GHz; Intel Platinum 8160F Skylake 2.1 GHz; Intel Platinum 8260 Cascade Lake 2.4 GHz.
- **Total RAM:** 478 TB, i.e., between 125 and 3022 GB per node.
- **Total GPU Cores:** 1352 NVIDIA P100 Pascal (each with 12, 16, or 32 GB RAM).
- **Total Storage:** 14 PB (`/home`: 526 TB; `/scratch`: 5.4 PB; `/project`: 23 PB)
- **Node Interconnect:** Intel OmniPath v1 (100 Gb/s).

Source: `https://docs.alliancecan.ca/wiki/Cedar`

graham.computecanada.ca

Graham cluster information:

- **Location:** University of Waterloo.
- **Total CPU cores:** 41,628 over 1,263 nodes.
  - **CPU Chipsets:** Intel E5-2683 v4 Broadwell 2.1 GHz; Intel E7-4850 v4 Broadwell 2.1 GHz; Intel Xeon Silver 4110 Skylake 2.1 GHz; Intel Xeon Gold 5120 Skylake 2.2 GHz; Intel Xeon Gold 6238 Cascade Lake 2.1 GHz; Intel Xeon Gold 6248 Cascade Lake 2.5 GHz.
- **Total RAM:** 191 TB, i.e., between 124 and 3022 GB per node.
- **Total GPU Cores:** 376 total, i.e., 536 NVIDIA P100 Pascal, V100 Volta, and T4 Turing GPUs (each with 12 to 32 GB RAM)
- **Node Interconnect:** Mellanox FDR (56 Gb/s), and, Mellanox EDR (100 Gb/s).
- **Has Visualization Nodes:** Yes.

Source: `https://docs.alliancecan.ca/wiki/Graham`

niagara.computecanada.ca

Niagara cluster information:

- **Location:** University of Toronto.
- **Total CPU cores:** 80,640 over 2,016 nodes with 40 cores per node.
  - **CPU Chipsets:** Intel Skylake (AVX512) 2.4GHz.
- **Total RAM:** 407 TB, i.e., 202 GB per node (approx. 4 GB per core).
- **Total GPU Cores:** None.
- **Total Storage:** 24.5 PB (`/home`: 200 TB; `/scratch`: 7 PB; `/project`: 2 PB; Burst buffer: 232 TB; Archive: 15 PB)
- **Node Interconnect:** Mellanox EDR (100 Gb/s; Dragonfly+ w/four wings each with up to 432 nodes).
- **Purpose:** Large parallel jobs.

Source: `https://docs.alliancecan.ca/wiki/Niagara`

Narval cluster information:

- **Total CPU cores:** 85,760 over 1340 nodes.
  - **CPU Chipset:** AMD Rome 7532 (EPYC) 2.4 GHz; AMD Milan 7413 (EPYC) 2.65 GHz; AMD Rome 7502 (EPYC) 2.5 GHz.
- **Total GPU Cores:** 636 NVIDIA A100s with 40 GB RAM each.
- **Node Interconnect:** Mellanox HDR (100 Gb/s).
- **Min, Max Job Length:** 1h, 7d (168h).

Source: `https://docs.alliancecan.ca/wiki/Beluga`

arbutus.cloud.computecanada.ca

Arbutus cloud information:

- **Location:** University of Victoria
- **Total Compute Cores:** 14,968 over 456 nodes.
- **Total RAM:** 147 TB, i.e., between 128 and 1024 GB per node.
- **Total (Ceph) storage:** 5.7 PB.

Source: `https://docs.alliancecan.ca/wiki/Cloud_resources`

cedar.cloud.computecanada.ca

Arbutus cloud information:

- **Location:** Simon Fraser University
- **Total Compute Cores:** 960.
- **Total RAM:** 7.7 TB, i.e., 256 GB per node.
- **Total (Ceph) storage:** 500 TB.

Source: `https://docs.alliancecan.ca/wiki/Cloud_resources`

east.cloud.computecanada.ca

East cloud information:

- **Location:** Université de Sherbrooke
- **Total Compute Cores:** 576 over 36 nodes.
- **Total RAM:** 4.6 TB, i.e., 128 GB per node.
- **Total (Ceph) storage:** 100 TB.

Source: `https://docs.alliancecan.ca/wiki/Cloud_resources`

Graham cloud information:

- **Location:** University of Waterloo
- **Total Compute Cores:** 768 over 24 nodes.
- **Total RAM:** 5.6 TB, i.e., between 128 and 512 GB per node.
- **Total (Ceph) storage:** 84 TB.

Source: `https://docs.alliancecan.ca/wiki/Cloud_resources`

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What is a Compute Job?

A job is a program running on one or more processing units (CPUs / GPUs / nodes).

- Normally jobs are executed **non-interactively**.
- They are **submitted**, **queued**, and scheduled in **fair-share** manner.
  - i.e., there is no graphical user interface —everything is command line.
  - This means your jobs have to run **without** human input!
  - All machines are running the Linux operating system.
  - Numerous programs and tools are already installed.
  - Fair-share information: `https://docs.alliancecan.ca/wiki/Job_scheduling_policies`

Supported Software and Systems

Available software on our clusters:

- `https://docs.alliancecan.ca/wiki/Modules`

Upon request, we work with researchers to help install and use software on our systems.

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Resource Allocation Competition (RAC)

Each year there is a Resource Allocation Competition (RAC):

- Peer-reviewed competition
- For projects that need resources beyond what is available by default.

Resource Allocation Competition (RAC) (con't)

There are two competitions:

- **Research Platforms and Portals (RPP)** which primarily involves using cloud(s).
- **Resources for Research Groups (RRG)** which primarily involves using compute cluster(s).

RAC 2022 Info: `https://training.sharcnet.ca/course/view.php?id=50`

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JupyterHub

JupyterHub is how SHARCNET, Compute Ontario, and the Digital Research Alliance of Canada:

- serve Jupyter notebooks to all of its users via the web
- a login runs as a (compute) job on a cluster
- access to software, etc. installed on the clusters

JupyterHub (con't)

Our JupyterHub portals:

- **beluga:** `https://jupyterhub.beluga.computecanada.ca/`
- **cedar:** `https://jupyterhub.cedar.computecanada.ca/`
- **graham:** `https://jupyterhub.sharcnet.ca/`
- **narval:** `https://jupyterhub.narval.computecanada.ca/`
- **niagara:** `https://jupyter.scinet.utoronto.ca/`

i.e., see `https://docs.alliancecan.ca/wiki/JupyterHub`.

JupyterHub (con't)

IMPORTANT: Nodes running Jupyter do not have Internet access.

This means that one must manually upload any needed Jupyter files to the clusters via a login node using **SSH** since Jupyter will **not** be able to download anything from the Internet.

- e.g., see `https://docs.alliancecan.ca/wiki/Transferring_data`

JupyterHub (con't)

We have a lot of software available, e.g.,

- Regular software: `https://docs.alliancecan.ca/wiki/Modules`
- Python wheels: `https://docs.alliancecan.ca/wiki/Available_Python_wheels`

JupyterHub (con't)

To install software in our Python wheels in Jupyter:

- Type in a code cell: `!pip install --no-index <name-of-package>`

Write and run such in a cell before any code runs in the notebook.