

High Performance, Advanced, and Cloud Research Computing for Windsor Researchers

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SHARCNET / Compute Ontario / Digital Research Alliance of Canada

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Land Acknowledgement

I am located at the University of Windsor.

The University of Windsor sits on the traditional territory of the **Three Fires Confederacy of First Nations**, which includes the **Ojibwa**, the **Odawa**, and the **Potawatomi**. We respect the longstanding relationships with First Nations people in this 100-mile Windsor-Essex peninsula region and the straits —les détroits— of Detroit.



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The University of Windsor is a founding member of **SHARCNET**, now a consortium of approximately 20 Ontario academic institutions, which provide high performance computing clusters, storage, and cloud resources and services to its researchers. SHARCNET is also part of Compute Ontario which is part of the **Digital Research Alliance of Canada (formerly Compute Canada)**. Collectively these organizations work together to seamlessly provide Canadian researchers access to **compute clusters, storage, and clouds** to do high-performance, advanced, and cloud computing research. This presentation will introduce and explain these facilities and services, how such can be **accessed and used** by researchers and their students. This presentation will also discuss the **Resource Allocation Competition (RAC)** (this year's applications are due by Nov. 3).



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Compute
Ontario

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Outline

- 1 Academic Research Computing at UWindor
- 2 About SHARCNET, Compute Ontario, and the Alliance
- 3 Our Resources
- 4 Compute Cluster
- 5 2027 Resource Allocation Competition
- 6 Questions, Answers, and Discussion



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Campus IT:

- ITS (Information Technology Services): <https://www.uwindsor.ca/itservices/>
- Excepting what is in an individual lab or what is negotiated with ITS, making use of ITS **only-used-on-campus** storage is appropriate when using *under* 1 TB (approx.) of storage without (currently) any significant CPU/GPU computational needs associated with that data.



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<https://www.sharcnet.ca>



SHARCNET:

- **Shared Hierarchical Academic Research Computing Network**
- provides free access to high performance, advanced, and cloud computing and corresponding **compute, cloud, and storage** resources and services to researchers
- biweekly webinars, self-paced courses, summer school courses, and more



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- Started in 2001.
- Founding members:
 - Fanshawe College, University of Guelph, McMaster University, Sheridan College, Western University, Wilfred Laurier University, University of Windsor
- Today's members includes these institutions:
 - ... Brock, Conestoga, Durham, Fields Institute, Lakehead, Laurentian, Nipissing, Ontario College of Art and Design University (OCAD), Ontario Tech University, Perimeter Institute, Trent, Waterloo, York
- Part of *Compute Ontario* which is part of the *Digital Research Alliance of Canada*.



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SHARCNET provides:

- compute (clusters)
- clouds
- storage
- Research Data Management (RDM) resources
- training on various advanced research computing, data science, machine learning topics



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<https://computeontario.ca>



Compute Ontario:

- Plays a key role in coordinating Ontario's advanced research computing and big data focus
- CO's partners include:
 - Centre for Advanced Computing (CAC)
 - HPC4Health
 - SciNet
 - SHARCNET



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<https://www.alliancecan.ca>



Alliance regional partners include:

- ACENET for New Brunswick, Nova Scotia, P.E.I., Newfoundland and Labrador
- Calcul Québec (CQ) for Québec
- Compute Ontario (CO) for Ontario
- Prairies DRI (P-DRI) for Alberta, Saskatchewan, and Manitoba
- BC DRI (BC-DRI) for British Columbia



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When Should Our Resources/Services Be Used

Consider using our resources and services when:

- computing, cloud, and storage resources are **needed** that **exceed what one has available** at his/her school

Who uses our resources and services across Canada?

- **graduate students** and **postdocs**
- **faculty** and other researchers at various institutions



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A supercomputer is:

- a **networking** of many **computers** in a **single** location that
- are able to function as a single computer or as many individual/groupings of computers
- lots of **CPU cores**
- lots of **GPU cores** (where available)
- lots of **RAM**
- lots of **disk space**

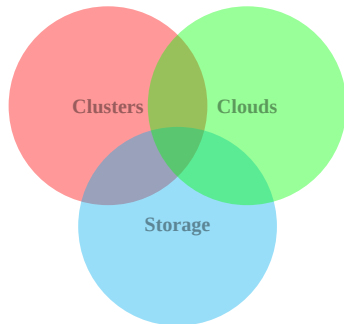


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HPC clusters:

- have lower latencies, higher bandwidths, and more CPU, GPU, RAM, and storage resources than typical consumer devices
- can run large and exascale simulations that need dedicated access to dozens/hundreds/thousands of CPU and GPU cores
- jobs run with the resources requested

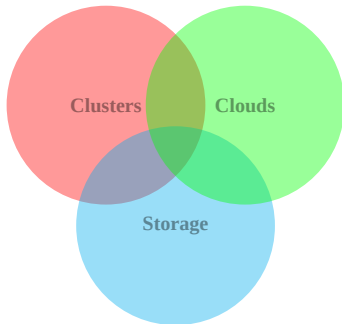


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Clouds:

- e.g., to run web services (24/7/365)
- CPU and GPU resources are usually over-committed (shared)
 - This can be discussed with cloud admins when the cloud instance is being set up.



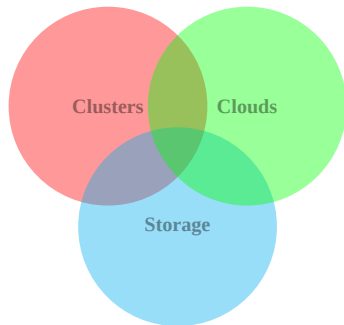
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Available Resources (cont.)



Storage:

- e.g., to store terrabytes of research data



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Available Resources (cont.)

Cluster	Purpose	Managed By	Location
fir .alliancecan.ca	general	BC-DRI	Simon Fraser University (British Columbia)
killarney .alliancecan.ca	PAICE	Vector Institute, SciNet	University of Toronto (Ontario)
MonarQ	quantum	CQ	École de technologie supérieure (Québec)
narval .alliancecan.ca	general	CQ	École de technologie supérieure (Québec)
nibi .alliancecan.ca	general	SHARCNET	University of Waterloo (Ontario)
rorqual .alliancecan.ca	general	CQ	École de technologie supérieure (Québec)
tamia .alliancecan.ca	PAICE	Mila, CQ	Université Laval (Québec)
trillium .alliancecan.ca	large parallel	SciNet	University of Toronto (Ontario)
vulcan .alliancecan.ca	PAICE	P-DRI	University of Alberta (Alberta)

- The main clusters are fir, narval, nibi, and trillium.
- PAICE: *Pan-Canadian AI Compute Environment* which are specialized GPU clusters



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Available Resources (cont.)

Compute cluster hardware summary (approximate):

Resource	Fir	Killarney	Narval	Nibi	Rorqual	Tamia	Trillium	Vulcan
Purpose	General	PAICE	General	General	General	PAICE	LP	PAICE
Nodes	1,032	178	1,340	752	779	73	1,287	252
CPU Kinds	EPYC	Intel	EPYC	Intel, MI300A	EPYC, Intel	Intel	EPYC	Intel
CPU Cores	175,104	11,232	83,216	140,928	137,664	3,824	241,056	16,128
GPU Kinds	H100	L40S, H100	A100	H100, MI300A	H100	H100	H100	L40S
Physical GPUs	640	672, 80	636	288, 36	372	308	252	1008
RAM (TB)	855	104	433	647	565	43	941	126
Storage (PB)	51	1.7	41	25	68.6		29	5

- LP: “Large Parallel”
- **NOTE:** For interactive visualization use, L40S is better than H100.



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Available Resources (cont.)

Cloud	Managed By	Location
arbutus .cloud.alliancecan.ca	BC-DRI	University of Victoria (British Columbia)
beluga .cloud.alliancecan.ca	CQ	École de technologie supérieure (Québec)
cedar .cloud.alliancecan.ca	BC-DRI	Simon Fraser University (British Columbia)
nibi .cloud.alliancecan.ca	SHARCNET	University of Waterloo (Ontario)

NOTE: There is no “default” cloud account: one needs to first submit a ticket and work with cloud admins to set their cloud instance up.



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Approximate compute cluster storage amounts:

Space	Initial Quota	Backed Up	Description
/home	50 GB	Yes	personal data
/project	1 TB	Yes	research group data
/scratch	20 TB	No	files deleted after 60d
nearline	1+ TB	n/a	offline group storage

- Actual nearline quota differs by cluster.
- PAICE systems have different initial quota amounts and backup policies.



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- Cost:
 - Access is **free** to research faculty at Canadian academic research institutions.
 - We are funded directly and indirectly through various federal and provincial grants.
- Limited to **research**, e.g., undergraduate course work is not permitted.
- Faculty members (PIs) **sponsor** some number of users, e.g., their students.
- Compute jobs are associated with a **sponsor**.
- Users can have more than one **sponsor**.
- All accounts must be renewed **every year** to remain active.



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IMPORTANT

- If you already have/had a CCDB account, a new one will not be made so don't apply for a new account!
- Instead **to re-activate an inactive account** log in to the CCDB web site, i.e., <https://ccdb.alliancecan.ca/>, and **apply for a new role**.



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Accessing Resources (cont.)

To obtain an account, apply for it by following these instructions:

- ① Go to <https://docs.alliancecan.ca>.
- ② Click on **Getting an account** in the left-hand side menu which will take you to:
 - https://docs.alliancecan.ca/wiki/Apply_for_a_CCDB_account



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If you are doing work under a sponsor...

- It is very important that your sponsor **first** acquires/activates his/her account **before** you can apply for your own account.
- Ask your sponsor for his/her **CCRI number** before you apply for your own account.
- If your sponsor's account becomes inactive and that is your only sponsor then your account is implicitly deactivated (even if you activated your account).
- There is only one sponsor per research group, but, a sponsor is also able to be sponsored and therefore can run jobs under the other sponsor's account.



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Multi-factor Authentication (MFA)

- To access most resources, you **must** have multi-factor authentication (MFA) configured in your CCDB account.
- For more information, see: https://docs.alliancecan.ca/wiki/Multifactor_authentication



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Compute cluster login access using a web browser:

- Fir: <https://jupyterhub.fir.alliancecan.ca/>
- Narval: <https://jupyterhub.narval.alliancecan.ca/>
- Nibi: <https://ondemand.sharcnet.ca>
- Rorqual: <https://jupyterhub.rorqual.alliancecan.ca/>
- Trillium: <https://ondemand.scinet.utoronto.ca>



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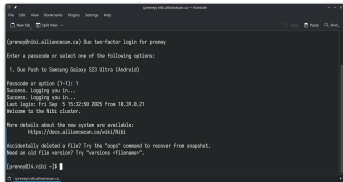
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Accessing Resources (cont.)

Compute cluster login access using SSH/SFTP:

- Fir: fir.alliancecan.ca
- Killarney: killarney.alliancecan.ca
- Narval: narval.alliancecan.ca
- Nibi: nibi.alliancecan.ca
- Rorqual: rorqual.alliancecan.ca
- Tamia: tamia.alliancecan.ca
- Trillium: trillium.alliancecan.ca
- Vulcan: vulcan.alliancecan.ca



```
gpreney@ibi.alliancecan.ca: ~$ ssh -p 22222
(gpreney@ibi.alliancecan.ca) Run two-factor login for preney
Enter a passcode or select one of the following options:
1. One Push to Samsung Galaxy S23 Ultra (Android)

Passcode or option (1-1): 1
Success: logging you in...
Success: logging you in...
Last login: Fri Sep 5 19:22:59 2025 from 10.28.8.21
Welcome to the Nibi cluster.

Here details about the new system are available:
https://docs.alliancecan.ca/wiki/Nibi

Accidentally deleted a file? Try the "ops" command to recover from snapshot.
Need an old file version? Try "versions <filename>".

(gpreney@ibi.alliancecan.ca) ~$
```

NOTE: If your computer/site blocks SSH then you will not be able to access these resources with SSH. Use a web portal instead to access such (directly or indirectly).



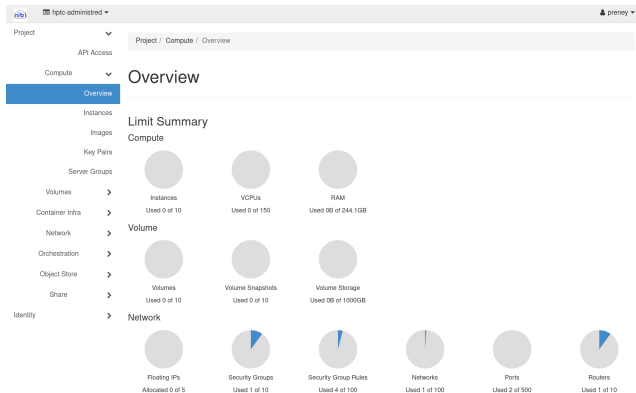
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Accessing Resources (cont.)



Our cloud node management portals use OpenStack.

See our “quick start” documentation at https://docs.alliancecan.ca/wiki/Cloud_Quick_Start.



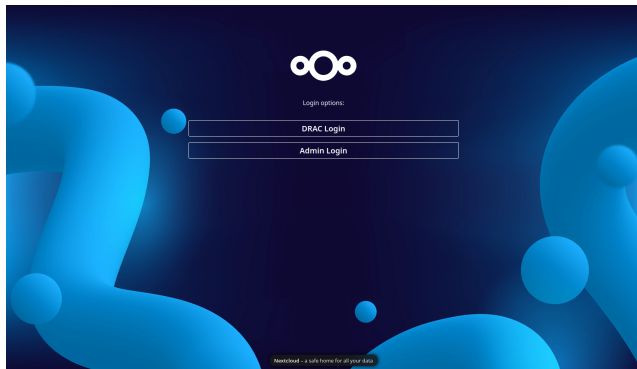
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Accessing Resources (cont.)



NextCloud is available for use.

See our “NextCloud” documentation at <https://docs.alliancecan.ca/wiki/Nextcloud>.



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AIaaS: “AI as a Service”

- **URL:** <https://docs.alliancecan.ca/wiki/Nibi> and look for Brine.
- SHARCNET runs an AI system for AI services.
- Capable of running models that support, chat, audio transcription, etc.
- Typical use cases include:
 - retrieval-augmented generation systems
 - agents or workflow automation
 - document-processing pipelines
 - code assistance
 - audio transcription
 - workloads that currently use a commercial API or a locally hosted model

NOTE: If this is of interest to you, contact us stating such in a ticket (email support@tech.alliancecan.ca).



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Types of Accounts

Default access:

- **Compute:**
 - No limit with respect to CPU or GPU cores but lower priority (longer wait times).
- **Storage:** (limited)
 - 50 GB home quota
 - 1 TB project quota
 - 20 TB scratch quota (max: 60 days when over 1 TB)
 - 10 TB nearline quota
- **Cloud:** (limited)
 - 80 virtual CPU years
 - 25 virtual CPU years (persistent)
 - 10 TB volume and snapshot storage
- **Must be requested:** No.



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Types of Accounts (cont.)

Rapid Access Service (RAS) access:

- **Compute:**
 - Can explicitly (and infrequently) ask for *temporary* increase in specific job priority.
- **Storage:**
 - Up to 40 TB project quota (total across Canada)
 - Up to 100 TB nearline quota
- **Cloud:**
 - Moderate explicitly asked for and granted increases.
 - 10 TB volume and snapshot storage
- **Must be requested:** Yes.



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Types of Accounts (cont.)

Resource Allocation Competition (RAC) access:

- **Compute:**

- Best assurance of priority access to a granted allocation.

- **Storage:**

- 40+ TB project quota (total across Canada)
- 100+ TB nearline quota

- **Cloud:**

- 80 VCPU years
- 3.6 (vGPU) RGU years
- 25 VCPU years (persistent)
- 10 TB volume and snapshot storage

- **Must be requested:** Yes, via an annual application.

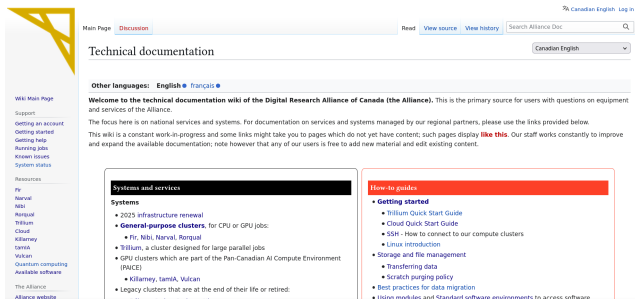


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Canadian English Log in

Main Page Discussion Read View source View history Search Alliance Doc

Technical documentation

Canadian English

Other languages: English français

Welcome to the technical documentation wiki of the Digital Research Alliance of Canada (the Alliance). This is the primary source for users with questions on equipment and services of the Alliance.

The focus here is on national services and systems. For documentation on services and systems managed by our regional partners, please use the links provided below.

This wiki is a constant work-in-progress and some links might take you to pages which do not yet have content; such pages display **like this**. Our staff works constantly to improve and expand the available documentation; note however that any of our users is free to add new material and edit existing content.

Systems and services

Systems

- 2025 infrastructure renewal
- General-purpose clusters**, for CPU or GPU jobs:
 - Fir, Nibl, Narval, Ronquai
- Trillium, a cluster designed for large parallel jobs
- GPU clusters which are part of the Pan-Canadian AI Compute Environment (PAICE)
 - Killarney, tamIA, Vulcan
- Legacy clusters that are at the end of their life or retired:

How-to guides

Getting started

- Trillium Quick Start Guide
- Cloud Quick Start Guide
- SSH - How to connect to our compute clusters
- Linux introduction

Storage and file management

- Transferring data
- Scratch purging policy

Best practices for data migration

- Using modules and Standard software environments to access software

Wiki Main Page

Support

Getting an account

Getting started

Getting help

Running jobs

Known issues

System status

Resources

Fir

Narval

Nibl

Ronquai

Trillium

Cloud

Killarney

tamIA

Vulcan

Quantum computing

Available software

The Alliance

Alliance website

We have useful technical documentation in our wiki at <https://docs.alliancecan.ca>.



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SHARCNET has:

Online training materials and courses at
<https://training.sharcnet.ca>.



YouTube channel videos at
<https://youtube.sharcnet.ca>.



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Documentation Resources (cont.)

Compute Ontario has:

Past summer school courses at
<https://training.computeontario.ca>.



NOTE: Since the summer of 2025,
ACENET participated in the Compute
Ontario Summer School event.

Some webinar videos can be found at
[https://www.computeontario.ca/
training-colloquia](https://www.computeontario.ca/training-colloquia).



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Online user-specific (job) portals:

- General: <https://portal.alliancecan.ca>
- Narval: <https://portail.narval.calculquebec.ca/>
- Nibi: <https://portal.nibi.sharcnet.ca/>
- Rorqual: <https://metrix.rorqual.alliancecan.ca/>
- Tamia: <https://portail.tamia.ecpia.ca/>
- Trillium: <https://my.scinet.utoronto.ca>
- Vulcan: <https://portal.vulcan.alliancecan.ca/>



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Globus (file transfer) end-points:

- Fir: alliancecan##fir-globus
- Narval: Compute Canada - Narval
- Nibi: alliancecan##nibi
- Rorqual: alliancecan##rorqual
- Trillium: alliancecan##trillium (filesystem) and alliancecan##hpss (nearline)
- Tamia: TamIA's Globus v5 Server
- Vulcan: Vulcan Globus v5



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Support through tickets.

To open a ticket send an email to:
support@tech.alliancecan.ca.



Support from expert staff via:

- ticketing system
- video conferencing
- direct email (ticketing system is preferred)
- in-person (if at the same institution)
- telephone (if needed)



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Compute Cluster: Environment

- Operating System: 64-bit Linux
- Supported programming languages include:
 - C, C++, Fortran, Java, Julia, MATLAB, Octave, Python, R, etc.
- A large variety of open source and some commercial software packages.
- Parallel development including:
 - **C**: multithreading since its 2011 standard
 - **C++**: multithreading since its 2011 standard
 - **Fortran**: since its 2003 standard
 - **Julia**: shared and distributed memory
 - **MPI, Chapel**: shared and distributed memory
 - **OpenMP, pthreads**: shared memory
 - **CUDA, OpenACC, OpenCL**: GPUs
- Data science support:
 - DASK, Julia, Jupyter, Python, R, etc.



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Compute Cluster: Environment (cont.)

- Container technology: Apptainer
 - Docker cannot be used at all.
 - Apptainer should be used with Docker images.
 - Since podman is also installed, it can also be used instead of Apptainer.
- Compiler toolchains:
 - GNU Compiler Collection (GCC)
 - Clang/LLVM
 - Intel OneAPI
 - NVIDIA nvhpc Toolkit

One can also install additional software in one's own account.



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Compute Cluster: Clusters Are Different Than Your Computer

Enterprise supercomputing clusters:

- consume lots of resources including power
- can run 24/7/365 doing computations
 - Don't run 24/7/365 on your computer or it won't last!
- require submitting work to be run as “jobs”
 - jobs are (fairly) queued (and so don't run instantly)
 - Remember there are many other users —not just you!

This following is a video link of the nibi server room:

- Click this link to view with external viewer.



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Compute Cluster: Clusters Are Different Than Your Computer (cont.)

On clusters:

- There are many users able to submit jobs to run at any time.
 - unlike on your own computer where you are likely the only user
- Each submitted job needs to provide:
 - how much **RAM** the job requires (at most),
 - how many **CPUs** the job requires,
 - (if needed) how many **GPUs** the job requires,
 - how much **time** the job will run (at most) for, and,
 - which **sponsor account** the job is to be run under.
- Once a job has been submitted, the scheduler determines when the job can be run.
- Jobs normally run **non-interactively** with **no access** to a keyboard, mouse, or screen.
- Job **input and output** typically needs to be from/to **files** stored on disk.



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Compute Cluster: Using a Compute Cluster

- Generally each cluster has a **login node** and a set of **compute nodes**.
- Program development, debugging, and testing can be done:
 - Via a login node within an interactive scheduler job,
 - on a login node *if and only if* such does not significantly use resources (time, CPUs/GPUs, and/or RAM), or,
 - using your own computer.
- Jobs are usually submitted from a login node.
- Login node access is via SSH or one of the web portals.



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Compute Cluster: Maximizing Job Throughput

All jobs are submitted to a queue for the scheduler to schedule and run:

- Your research team ideally wants to always have jobs **in the queue** waiting to be run to maximize throughput.
- Each individual in every research team has the same fair-share priority of the entire team in terms of job submission.



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Compute Cluster: Supported Software

A list of available software on our clusters can be see at:

- https://docs.alliancecan.ca/wiki/Available_software



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



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Compute Cluster: Why Use Supercomputing Resources?

On your own computers or your lab computers, you:

- do not have sufficient CPU/GPU cores
- do not have sufficient memory (RAM or storage)
- need a lot of disk space, e.g., hundreds of GBs or TBs
- need to run a lot of simulations using hundreds of CPU/GPU cores
- need to run web services
- need to run an SQL database service to service compute jobs / cloud resources
- need to make use of cloud resources



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2027 Resource Allocation Competition: Overview

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

- peer-reviewed competition
- for research projects that need resources significantly beyond what is normally available



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2027 Resource Allocation Competition: Overview (cont.)

There are two kinds of RAC awards:

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



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2027 Resource Allocation Competition: Overview (cont.)

Key dates for the 2027 RAC:

- RRG and RPP application deadline:
 - From Sept. 23 to Nov. 3, 2026 at 11:59 P.M. (no extensions of deadline)
- Information sessions: see web site link below for slides and recordings.
- 2027 RAC result announcements: Late March 2027
- 2027 RAC allocation start: Early April 2027
- URL: https://docs.alliancecan.ca/wiki/Resource_Allocation_Competition



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2027 Resource Allocation Competition: Minimums

Q. Should your research team apply for a RAC?

A. Only if your team will need to use one or more more than the following slides' minimums.



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2027 Resource Allocation Competition: Minimums (cont.)

Every 2027 RRG (compute) and RAC application must meet at least one of these minimum requirements:

- CPU core years or equivalent: 200 years (on a specific cluster)
 - $CoreEquivYears = \max(CoreYears, MemRequested/4GB)$
 - $MemRequested = CoreYears * MemPerCoreRequested$
- Reference GPU units (RGPU): 25 (on a specific cluster)
- Project storage: 41 TB across all clusters
- Nearline storage: 101 TB across all clusters
- A submission is required if any dCache storage is needed.
- URL: https://docs.alliancecan.ca/wiki/RAC_application_guide



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2027 Resource Allocation Competition: Minimums (cont.)

Every 2027 RPP (cloud) RAC application must meet at least one of these minimum requirements:

- virtual CPU years (VCPU): 81 compute, 26 persistent
- virtual GPU years (VGPU) in RGU years: 3.6
- RAM (GB): 301 compute, 51 persistent
- floating IP address: 3
- volume and snapshot storage: 11 TB
- shared filesystem storage: 11 TB
- object storage: 11 TB
- URL: https://docs.alliancecan.ca/wiki/RAC_application_guide



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IMPORTANT!

The 2027 RAC will **not** accept:

- applications that exceed 10 pages (before references) as a PDF,
- always base your application using one of the templates provided
 - e.g., see links under “Application pathways” at https://docs.alliancecan.ca/wiki/RAC_application_guide



- references must be submitted as a separate document (if the total number of pages in the entire application including references will exceed 10 pages)



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2027 Resource Allocation Competition: Your RAC Application

Please be aware of the following concerning applications:

- Normally one should only be submitting **one** application.
- In some cases, one might submit one RRG and one RPP application—but discuss and confirm such beforehand by consultation before submitting the application.
- Be aware that submitting what was previously submitted might not wind up being awarded the same amount of resources.
 - e.g., others RAC submissions have evolved and with finite resources this may wind up reducing what is awarded
 - e.g., the application's justifications of its needs is important
 - e.g., the (re-)computed scientific score is important



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One can request staff interaction for RAC applications by sending an email requesting such to support@tech.alliancecan.ca to open a ticket.



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2027 Resource Allocation Competition: Getting Help / Advice (cont.)

Ask for help, guidance, discussion, etc. in advance of your submission especially if your application involves large or very large amounts of resources, e.g.,

Type	Resource	Small	Medium	Large	Very large
HPC	CPU (core-years)	≤ 500	$500 < x \leq 2500$	$2500 < x \leq 10000$	> 10000
HPC	GPU (RGU-years)	≤ 50	$50 < x \leq 250$	$250 < x \leq 500$	> 500
Cloud	vGPU (RGU-years)	≤ 5	$5 < x \leq 10$	$10 < x \leq 25$	> 25
Cloud	compute (vCPU-years)	≤ 50	$50 < x \leq 250$	$250 < x \leq 1000$	> 1000
Cloud	persistent (vCPU-years)	≤ 25	$25 < x \leq 100$	$100 < x \leq 250$	> 250
HPC	project storage (TB)	≤ 50	$50 < x \leq 250$	$250 < x \leq 1000$	> 1000
HPC	nearline storage (TB)	≤ 250	$250 < x \leq 1000$	$1000 < x \leq 2500$	> 2500
Cloud	volume and snapshot storage (TB)	≤ 10	$10 < x \leq 50$	$50 < x \leq 250$	> 250
Cloud	object storage (TB)	≤ 10	$10 < x \leq 50$	$50 < x \leq 250$	> 250
Cloud	shared filesystem (TB)	≤ 10	$10 < x \leq 50$	$50 < x \leq 250$	> 250



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Questions, Answers, and Discussion

Thank you!

Questions, answers, and discussion.



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