

## Table of Contents

- How our clusters work
- The clusters : Baobab, Yggdrasil and Bamboo
- How do our clusters work ?
  - Overview
  - Cost model
    - Price per hour
      - Free CPU Hour Allocation
      - Progressive Pricing for HPC Compute Hours
  - Purchasing or Renting Private Compute Nodes
    - Key Rules and Details
    - Cost of Renting a Compute Node
    - Usage Limits
    - CPU and GPU server example pricing
      - AMD CPU
      - GPU H100 with AMD
      - GPU RTX4090 with AMD
- Use Baobab for teaching
- How do I use your clusters ?
- For advanced users
  - Infrastructure schema
  - Compute nodes
    - CPUs models available
    - GPUs models available
    - Bamboo
      - CPU MODELS — bamboo
      - GPUs on Bamboo
    - Baobab
      - CPU MODELS — baobab
      - GPUs on Baobab
    - Yggdrasil
      - CPU MODELS — yggdrasil
      - GPUs on Yggdrasil
- Monitoring performance

# How our clusters work

We expect the HPC clusters users to know what an HPC cluster is and what parallel computing is. As all HPC clusters are different, it is important for any users to have a general understanding of the clusters they are working on, what they offer and what are their limitations.

This section gives an overview of the technical HPC infrastructure and how things work at the University of Geneva. More details can be found in the corresponding sections of this documentation.

The last part of this page gives more details for advanced users.

# The clusters : Baobab, Yggdrasil and Bamboo

The University of Geneva owns three HPC clusters or supercomputers : **Baobab**, **Yggdrasil** and **Bamboo**.

As for now, they are completely separated entities, each of them with their own private network, storage, and login node. What is shared is the accounting (user accounts and job usage).

Choose the right cluster for your work:

- You can use every clusters, but try to stick to one of them.
- Use the cluster where the private partition you have access to is located.
- If you need to access other servers not located in Astro, use Baobab or Bamboo to save bandwidth.
- As your data are stored locally on each cluster, avoid to use both clusters if this involves a lot of data moving between cluster.

You can't submit jobs from one cluster to the other one. This may be done in the future.

Baobab is physically located at Uni Dufour in Geneva downtown, while Yggdrasil is located at the [Observatory of Geneva](#) in Sauverny and Bamboo is located in [campus Biotech](#)

cluster name	datacentre	Interconnect	public CPU	public GPU	Total CPU size	Total GPU size
Baobab	Dufour	IB 100GB EDR	~900	0	~13'044	273
Yggdrasil	Astro	IB 100GB EDR	~3000	44	~8'008	52
Bamboo	Biotech	IB 100GB EDR	~5700	20	~5'700	20

## How do our clusters work ?

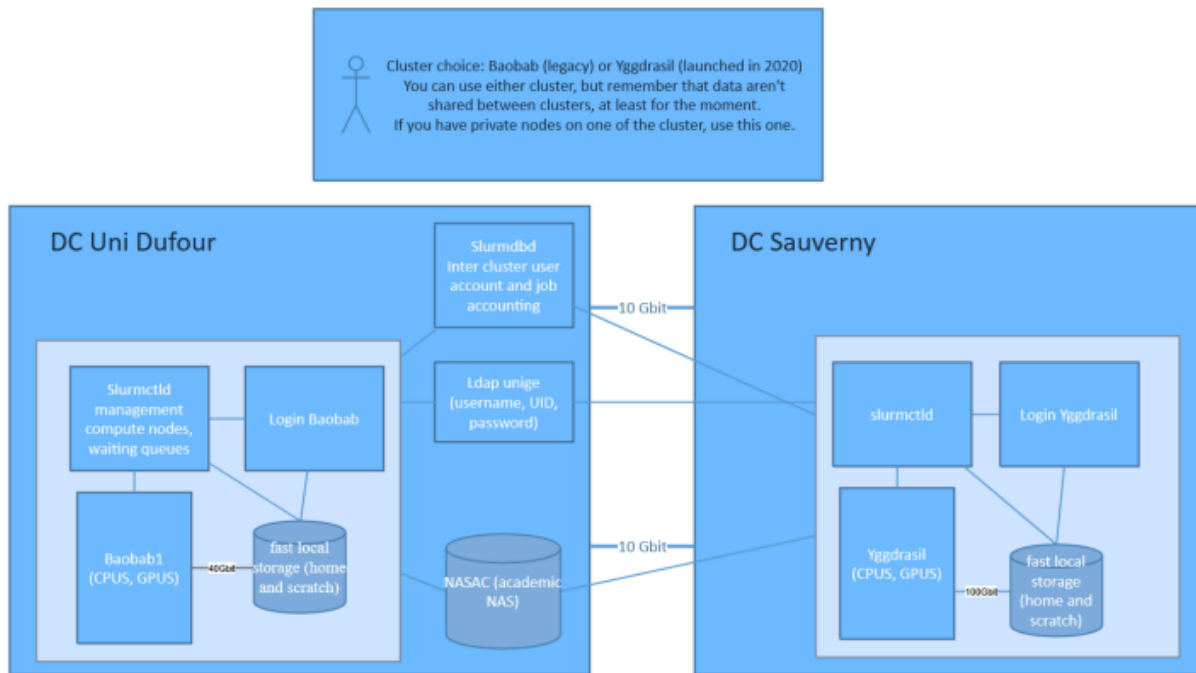
### Overview

Each cluster is composed of :

- a **login node** (aka **headnode**) allowing users to connect and submit *jobs* to the cluster. Each user is limited to 2 CPU cores and 8 GB of RAM on the login node.
- many **compute nodes** which provide the computing power. The compute nodes are not all identical ; they all provide CPU cores (from 8 to 128 cores depending on the model), and some nodes also have GPUs or more RAM (see [below](#)).
- **management servers** that you don't need to worry about, that's the HPC engineers' job. The management servers are here to provide the necessary services such as all the applications (with EasyBuild / module), Slurm job management and queuing system, ways for the HPC engineers to (re-)deploy compute nodes automatically, etc.
- **BeeGFS** storage servers which provide "fast" parallel file system to store the data from your \$HOME and for the scratch data (\$HOME/scratch).

All those servers (login, compute, management and storage nodes) :

- run with the GNU/Linux distribution [Rocky](#).
- are inter-connected on high speed InfiniBand network
  - 40Gbit/s (QDR) for Baobab.
  - 100Gbit/s (EDR) for Yggdrasil.
  - 100Gbit/s (EDR) for Bamboo.



In order to provide hundreds of software and versions, we use EasyBuild / module. It allows you to load the exact version of a software/library that is compatible with your code. [Learn more about EasyBuild/module](#)

When you want to use some cluster's resources, you need to connect to the login node and submit a *job* to Slurm which is our job management and queuing system. The job is submitted with an *sbatch* script (a Bash/shell script with special instructions for Slurm such as how many CPU you need, which *Slurm partition* to use how long your script will run and how to execute your code). Slurm will place your job in a queue with other users' jobs, and find the fastest way to provide the resources you asked for. When the resources are available, your job will start. [Learn more about Slurm](#)

One important note about Slurm is the concept of *partition*. When you submit a job, you have to specify a *partition* that will give you access to some specific resources. For instance, you can submit a job that will use only CPU or GPU nodes.

## Cost model

In September 2024, we

announced

via our mailing list (Some of the information is now obsolete. Please see below for the updated information.) that our service would become a paid offering. Users can find detailed information about this change on the page below and in our [FAQ](#). We are committed to providing transparent communication and ensuring you have all the necessary details about our new pricing model.

Our service remains free in specific cases:

- **Free usage** as part of an educational course.
- **Free usage** through the annual allocation of CPU hours.


For additional needs, paid options are available:

- **Pay-per-hour** based on the FNS rate table.
- **Purchase or rent** compute nodes for more intensive workloads.

### Summary:

- Starting this year, you receive a **CPU hours credit** based on the hardware you own (if any) in the cluster (private partition).
- You can find instructions on how to check your annual credit here: [Resources Available for Research Groups](#). If you know your research group has bought some compute nodes but your PI doesn't appear in the report, please contact us.
- The credit calculation in the provided script assumes a **5-year hardware ownership period**. However, **if** this policy was introduced after your compute nodes were purchased, we have extended the production duration by two years.
- To ensure **flexibility and simplicity**, we have standardized resource usage by converting CPU Memory, and GPU hours into CPU hours, using different conversion ratios depending on the GPU type. More details can be found here: [Resource Accounting Uniformization](#).
- You can use your credit across all three clusters (**Baobab, Yggdrasil, and Bamboo**), not just on your private compute nodes. However, when using your own compute nodes, you will receive a **higher priority**.
- To check your group's current resource usage, visit: [Report and Statistics with sreport](#).

### Price per hour



Since we have [unified our resources](#), we refer to **CPUhours** in a generic way, which may include CPU hours, GPU hours, or memory usage. Please refer to the conversion table for details. This means that any previous references specifically mentioning GPUs should no longer be considered. We'll update the table.

### Overview:

Unit operational costs, CHF	Uptime (h)	67 000 000
U.1 User fee 1 (direct costs) CPU	CHF/h	0,0157
U.2 User fee 2 (direct costs + other direct costs) CPU	CHF/h	0,0284
U.3 User fee 3 (direct costs + other direct costs + indirect costs) CPU	CHF/h	0,0287

You can find the whole table that you can send to the FNS [here](#).

University of Geneva members will be charged the cost indicated by line "U1". The line U2 and U3 are for external users such as company that would use the cluster.

### Free CPU Hour Allocation

Each PI (Principal Investigator) is entitled to 100,000 CPU hours per year free of charge. This allocation applies per PI, not per individual user. See [how to check PI and user past usage](#)..

## Progressive Pricing for HPC Compute Hours

A tiered pricing model applies to compute hour billing. Discounts increase as usage grows: once you reach 200K, 500K, and 1,000K compute hours, an additional 10% reduction is applied at each threshold. This ensures cost efficiency for large-scale workloads.

Usage (Compute Hours)	Discount Applied
0 - 199,999	Base Rate
200,000 - 499,999	Base Rate -10%
500,000 - 999,999	Base Rate -20%
1,000,000+	Base Rate -30%

## Purchasing or Renting Private Compute Nodes

Research groups have the option to purchase or rent “private” compute nodes to expand the resources available in our clusters. This arrangement provides the group with a **private partition**, granting higher priority access to the specified nodes (resulting in reduced wait times) and extended job runtimes of up to **7 days** (compared to 4 days for public compute nodes).

### Key Rules and Details

- **Shared Integration:** The compute node is added to the corresponding shared partition. Other users may utilize it when the owning group is not using it. For details, refer to the [partitions](#) section.
- **Usage Limit:** Each research group may consume up to **60% of the theoretical usage credit associated with the compute node**. This policy ensures fair access to shared cluster resources. . See the [Usage limit](#) policy for more details
- **Cost:** In addition to the base cost of the compute node, a **15% surcharge** is applied to cover operational expenses such as cables, racks, switches, and storage (not yet valid).
- **Ownership Period:** The compute node remains the property of the research group for **5 years**. After this period, the node may remain in production but will only be accessible via public and shared partitions.
- **Warranty and Repairs:** Nodes come with a **3-year warranty**. If the node fails after this period, the research group is responsible for **100% of repair costs**. Repairing the node involves sending it to the vendor for diagnostics and a quote, with a maximum diagnostic fee of **420 CHF**, even if the node is irreparable.
- **Administrative Access:** The research group does not have administrative rights over the node.
- **Maintenance:** The HPC team handles the installation and maintenance of the compute node, ensuring it operates consistently with other nodes in the cluster.
- **Decommissioning:** The HPC team may decommission the node if it becomes obsolete, but it will remain in production for at least **5 years**.

### Cost of Renting a Compute Node

The cost of renting a compute node is calculated based on the vendor price of the node, adjusted to account for operational and infrastructure expenses. Specifically, we add 15% to the vendor price to

cover additional costs, such as maintenance and administrative overhead. The total cost is then amortized over an estimated 5-year lifespan of the compute node to determine the monthly rental rate.

For example, consider a CPU compute node with a vendor price of **14,361 CHF**. Adding **15% for extra costs** brings the total to **16,515.15 CHF**. Dividing this by 60 months (5 years) results in a monthly rental cost of approximately **275.25 CHF**.

Currently, we only rent standard AMD compute nodes, which have two 64-CPU cores and 512 GB of RAM. You will receive 1.34 million billing credits per year with this model.

The minimum rental period for a compute node is six months. Any unused allocated resources will be lost at the end of the year.

For more details or to request a specific quote, please contact the HPC support team.

## Usage Limits

Users are entitled to utilize up to 60% of the computational resources they own or rent within the cluster. Example calculation if you rent a compute node with 128 CPU cores and 512GB RAM for one year:

- **CPU contribution:** 128 cores × 1.0 (factor)
- **Memory contribution:** 512 GB × 0.25 (factor)
- **Time period:** 24 hours × 365 days
- **Max usage rate:** 0.6

Total:  $(128 \times 1.0 + 512 \times 0.25) \times 24 \times 365 \times 0.6 = \mathbf{1,342,848 \text{ core-hours}}$

This credit can be used across any of our three clusters – Bamboo, Baobab, and Yggdrasil – regardless of where the compute node was rented or purchased.

The main advantage is that you are not restricted to using your private nodes, but can access the three clusters and even the GPUs.

We are developing scripts to allow to check the usage and the amount of hours you have the right to use regarding the hardware your group owns.

The key distinction when using your own resources is that you benefit from a higher scheduling priority, ensuring quicker access to computational resources. As well, you are not restricted to using your private nodes, but can access the three clusters and even the GPUs.

For more details, please contact the HPC support team.

## CPU and GPU server example pricing

See below the current price of a compute node (without the extra 15% and without VAT)

## AMD CPU

- 2 x 64 Core AMD EPYC 7742 2.25GHz Processor
- 512GB DDR4 3200MHz Memory (16x32GB)
- 100G IB EDR card
- 960GB SSD
- ~ 14'442.55 CHF TTC
  
- 2 x 96 Core AMD EPYC 9754 2.4GHz Processor
- 768GB DDR45 4800MHz Memory (24x32GB)
- 100G IB EDR card
- 960GB SSD
- ~ 16'464 CHF TTC

Key differences:

- + 9754 has higher memory performance of up to 460.8 GB/s vs 7763 which has 190.73 GB/s
- + 9754 has a bigger cache
- - 9754 is more expensive
- - power consumption is 400W for 9754 vs 240W for 7763
- - 9754 is more difficult to cool as the inlet temperature for air colling must be 22° max

## GPU H100 with AMD

- 2 x 64 Core AMD EPYC 9554 3.15GHz Processor
- 768GB DDR4 4800MHz ECC Server Memory (24x 32GB / 0 free slots)
- 1 x 7.68TB NVMe Intel 24x7 Datacenter SSD (14PB written until warranty end)
- 4 x nVidia Ampere H100 94GB PCIe GPU (max. 8 GPUs possible)
- ~ 124k CHF HT
- ~ 28,5k CHF HT per extra GPU

## GPU RTX4090 with AMD

- 2 x 64 Core AMD EPYC 9554 3.10GHz Processor
- 384 GB DDR4 4800MHz ECC Server Memory
- 8 x nVidia RTX 4090 24GB Graphics Controller
- ~ 44k CHF HT

We usually install and order the nodes twice per year.

If you want to ask a financial contribution from UNIGE you must complete submit a request to the [COINF](#).

# Use Baobab for teaching

Baobab, our HPC infrastructure, supports educators in providing students with hands-on HPC experience.

Teachers can request access via [dw.unige.ch](final link to be added later, use hpc@unige.ch in the meantime), and once the request is fulfilled, a special account named <PI\_NAME>\_teach will be created for the instructor. Students must specify this account when submitting jobs for course-related work (e.g., --account=<PI\_NAME>\_teach).

A shared storage space can also be created optionally, accessible at /home/share/<PI\_NAME>\_teach and/or /srv/beegfs/scratch/shares/<PI\_NAME>\_teach.

**All student usage is free of charge if they submit their job to the correct account.**

We strongly recommend that teachers use and promote our user-friendly web portal at [OpenOnDemand](#) which supports tools like Matlab, JupyterLab, and more. Baobab helps integrate real-world computational tools into curricula, fostering deeper learning in HPC technologies.

## How do I use your clusters ?

Everyone has different needs for their computation. A typical example of usage of the cluster would consist of these steps :

- connect to the login node
- this will give you access to the data from your \$HOME directory
- execute an sbatch script which will request resources to Slurm for the estimated runtime (i.e. : 16 CPU cores, 8 GB RAM for up to 7h on partition "shared-cpu"). The sbatch will contain instructions/commands :
  - for Slurm scheduler to access compute resources for a certain time
  - to load the right application and libraries with module for your code to work
  - on how to execute your application.
- the Slurm job will be placed in the Slurm queue
- once the requested resources are available, your job will start and be executed on one or multiple compute nodes (which can all access the BeeGFS \$HOME and \$HOME/scratch directories).
- all communication and data transfer between the nodes, the storage and the login node go through the InfiniBand network.

If you want to know what type of CPU and architecture is supported, check the section [For Advanced users](#).

## For advanced users

### Infrastructure schema



## Compute nodes

Both clusters contain a mix of “public” nodes provided by the University of Geneva, a “private” nodes in general funded 50% by the University through the [COINF](#) and 50% by a research group for instance. Any user of the clusters can request compute resources on any node (public and private), but a research group who owns “private” nodes has a higher priority on its “private” nodes and can request a longer execution time.

## CPUs models available

Several CPU models are available across the three clusters. The table below summarizes the available resources.

Model	Generation	Architecture	Cores per Socket	Freq
<a href="#">E5-2660V0</a>	V3	Sandy Bridge EP	8	
<a href="#">E5-2643V3</a>	V5	Haswell-EP	6	3.4GHz
<a href="#">E5-2630V4</a>	V6	Broadwell-EP	10	2.2GHz
<a href="#">E5-2637V4</a>	V6	Broadwell-EP	4	2.2GHz
<a href="#">E5-2643V4</a>	V6	Broadwell-EP	6	3.4GHz
<a href="#">E5-2680V4</a>	V6	Broadwell-EP	14	2.4GHz
<a href="#">EPYC-7601</a>	V7	Naples	32	2.2GHz
<a href="#">EPYC-7302P</a>	V8	Rome	16	3.0GHz
<a href="#">EPYC-7742</a>	V8	Rome	64	2.25GHz
<a href="#">GOLD-6234</a>	V9	Cascade Lake	8	3.30GHz
<a href="#">GOLD-6240</a>	V9	Cascade Lake	18	2.60GHz
<a href="#">GOLD-6244</a>	V9	Cascade Lake	8	3.60GHz
<a href="#">SILVER-4208</a>	V9	Cascade Lake	8	2.10GHz
<a href="#">SILVER-4210R</a>	V9	Cascade Lake	10	2.6GHz
<a href="#">EPYC-72F3</a>	V10	Milan	8	3.7GHz
<a href="#">EPYC-7763</a>	V10	Milan	64	2.45GHz
<a href="#">EPYC-9554</a>	V11	Genoa	64	3.10GHz
<a href="#">EPYC-9654</a>	V12	Genoa	96	3.70GHz
<a href="#">EPYC-9754</a>	V13	Genoa	128	3.70GHz

## GPUs models available

Several GPU models are available across the three clusters. The table below summarizes the available resources.

Model	Memory	GRES	Constraint gpu arch	Compute Capability	CUDA min → max	Feature	Billing Weight
<a href="#">A100 40GB</a>	40GB	nvidia_a100-pcie-40gb	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_8_0	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_A100_PCIE_40GB	5
<a href="#">A100 80GB</a>	80GB	nvidia_a100_80gb_pcie	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_8_0	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_A100_80GB_PCIE	8
<a href="#">RTX 2080 Ti</a>	11GB	nvidia_geforce_rtx_2080_ti	COMPUTE_TYPE_TURING	COMPUTE_CAPABILITY_7_5	10.0 → 13.0	COMPUTE_MODEL_NVIDIA_GEFORCE_RTX_2080_TI	2

Model	Memory	GRES	Constraint gpu arch	Compute Capability	CUDA min → max	Feature	Billing Weight
<a href="#">RTX 3080</a>	10GB	nvidia_geforce_rtx_3080	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_7_0	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_GEFORCE_RTX_3080	3
<a href="#">RTX 3090</a>	24GB	nvidia_geforce_rtx_3090	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_8_6	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_GEFORCE_RTX_3090	5
<a href="#">RTX 4090</a>	24GB	nvidia_geforce_rtx_4090	COMPUTE_TYPE_ADA	COMPUTE_CAPABILITY_8_9	11.8 → 13.0	COMPUTE_MODEL_NVIDIA_GEFORCE_RTX_4090	8
<a href="#">RTX 5090</a>	32GB	nvidia_geforce_rtx_5090	COMPUTE_TYPE_BLACKWELL	COMPUTE_CAPABILITY_12_0	12.8 → 13.0	COMPUTE_MODEL_NVIDIA_GEFORCE_RTX_5090	10
<a href="#">H100</a>	94GB	nvidia_h100_nvl	COMPUTE_TYPE_HOPPER	COMPUTE_CAPABILITY_9_0	11.8 → 13.0	COMPUTE_MODEL_NVIDIA_H100_NVL	14
<a href="#">H200</a>	141GB	nvidia_h200_nvl	COMPUTE_TYPE_HOPPER	COMPUTE_CAPABILITY_9_0	11.8 → 13.0	COMPUTE_MODEL_NVIDIA_H200_NVL	17
<a href="#">RTX 5000</a>	32GB	nvidia_rtx_5000	COMPUTE_TYPE_ADA	COMPUTE_CAPABILITY_8_9	11.8 → 13.0	COMPUTE_MODEL_NVIDIA_RTX_5000	9
<a href="#">RTX A5000</a>	25GB	nvidia_rtx_a5000	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_8_6	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_RTX_A5000	5
<a href="#">RTX A5500</a>	24GB	nvidia_rtx_a5500	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_8_6	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_RTX_A5500	5
<a href="#">RTX A6000</a>	48GB	nvidia_rtx_a6000	COMPUTE_TYPE_AMPERE	COMPUTE_CAPABILITY_8_6	11.0 → 13.0	COMPUTE_MODEL_NVIDIA_RTX_A6000	8
<a href="#">RTX Pro 6000</a>	96GB	nvidia_rtx_pro_6000_blackwell	COMPUTE_TYPE_BLACKWELL	COMPUTE_CAPABILITY_9_0	12.8 → 13.0	COMPUTE_MODEL_NVIDIA_RTX_PRO_6000_BLACKWELL	16
<a href="#">Titan RTX</a>	24GB	nvidia_titan_rtx	COMPUTE_TYPE_TURING	COMPUTE_CAPABILITY_7_5	10.0 → 13.0	COMPUTE_MODEL_NVIDIA_TITAN_RTX	1
<a href="#">Titan X</a>	12GB	nvidia_titan_x	COMPUTE_TYPE_PASCAL	COMPUTE_CAPABILITY_6_1	8.0 → 12.9	COMPUTE_MODEL_NVIDIA_TITAN_X	1
<a href="#">P100</a>	12GB	tesla_p100-pcie-12gb	COMPUTE_TYPE_PASCAL	COMPUTE_CAPABILITY_6_0	8.0 → 12.9	COMPUTE_MODEL_TESLA_P100_PCIE_12GB	1
<a href="#">V100</a>	32GB	tesla_v100-pcie-32gb	COMPUTE_TYPE_VOLTAGE	COMPUTE_CAPABILITY_7_0	9.0 → 12.9	COMPUTE_MODEL_TESLA_V100_PCIE_32GB	3

We don't have mixed GPUs models on the same node. Every GPU node has only one GPU model.

See [here](#) how to request GPU for your jobs.

## Bamboo

### CPU MODELS — bamboo

Model	Generation	Architecture	Freq	Nb core	Memory	Nodeset
<a href="#">EPYC-72F3</a>	V10	Milan	3.7GHz	128	1024GB	cpu[044-045]
<a href="#">EPYC-7742</a>	V8	Rome	2.25GHz	128	251GB	cpu[049-052]
<a href="#">EPYC-7742</a>	V8	Rome	2.25GHz	128	512GB	cpu[001-043]
<a href="#">EPYC-7763</a>	V10	Milan	2.45GHz	128	512GB	cpu[046-048]

### GPUs on Bamboo

GPU model	Architecture	Mem	Compute Capability	Slurm resource	Nb per node	Nodes	Peer access between GPUs (nvlink)
RTX 3090	Ampere	25GB	8.6	nvidia_geforce_rtx_3090	8	gpu[001,002]	NO
A100	Ampere	80GB	8.0	nvidia_a100_80gb_pcie	4	gpu[003]	YES
H100	Hopper	94GB	9.0	nvidia_h100_nvl	1	gpu[004]	NO
H200	Hopper	144GB	9.0	nvidia_h200_nvl	4	gpu[005]	NO
H200	Hopper	144GB	9.0	nvidia_h200_nvl	4	gpu[006]	YES
RTX Pro 6000	Blackwell	97GB	9.0	nvidia_rtx_pro_6000_blackwell	4	gpu[008]	NO
RTX 5090	Blackwell	32GB	12	nvidia_geforce_rtx_5090	4	gpu[009-010]	

## Baobab

### CPU MODELS — baobab

Since our clusters are regularly expanded, the nodes are not all from the same generation. You can see the details in the following table.

Model	Generation	Architecture	Freq	Nb core	Memory	Nodeset
<a href="#">E5-2630V4</a>	V6	Broadwell-EP	2.2GHz	20	86GB	cpu199
<a href="#">E5-2630V4</a>	V6	Broadwell-EP	2.2GHz	20	94GB	cpu[173-185,187-198,200-201,205-213,220-229,237-244,247-264]
<a href="#">E5-2630V4</a>	V6	Broadwell-EP	2.2GHz	20	224GB	cpu246
<a href="#">E5-2630V4</a>	V6	Broadwell-EP	2.2GHz	20	251GB	cpu245
<a href="#">E5-2637V4</a>	V6	Broadwell-EP	2.2GHz	8	503GB	cpu[218-219]
<a href="#">E5-2643V4</a>	V6	Broadwell-EP	3.4GHz	12	62GB	cpu[202,216-217]
<a href="#">E5-2660V0</a>	V3	Sandy Bridge EP		16	62GB	cpu001
<a href="#">E5-2680V4</a>	V6	Broadwell-EP	2.4GHz	28	503GB	cpu203
EPYC-7742	V8	Rome	2.25GHz	128	503GB	cpu[273-277,285-307,314-335]
EPYC-7742	V8	Rome	2.25GHz	128	1007GB	cpu[312-313]
<a href="#">EPYC-9654</a>	V12	Genoa	3.70GHz	192	768GB	cpu[350,352]
<a href="#">GOLD-6240</a>	V9	Cascade Lake	2.60GHz	36	187GB	cpu[084-090,265-272,278-284,308-311,336-349]
<a href="#">GOLD-6244</a>	V9	Cascade Lake	3.60GHz	16	754GB	cpu351

The “generation” column is just a way to classify the nodes on our clusters. In the following table you can see the features of each architecture.

	MMX	SSE	SSE2	SSE3	SSSE3	SSE4.1	SSE4.2	AVX	F16C	AVX2	FMA3	NB AVX-512 FMA
Westmere-EP	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	
Sandy Bridge-EP	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	
Ivy Bridge-EP	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	
Haswell-EP	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	
Broadwell-EP	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

	MMX	SSE	SSE2	SSE3	SSSE3	SSE4.1	SSE4.2	AVX	F16C	AVX2	FMA3	NB AVX-512 FMA
Naples	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
Rome	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
Milan	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
Genoa	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
Cascade Lake	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	2

### GPUs on Baobab

In the following table you can see which type of GPU is available on Baobab.

GPU model	Architecture	Mem	Compute Capability	Slurm resource	Legacy Slurm resource	Nb per node	Nodes
Titan X	Pascal	12GB	6.1	nvidia_titan_x	titan	6	gpu[002]
P100	Pascal	12GB	6.0	tesla_p100-pcie-12gb	pascal	6	gpu[004]
P100	Pascal	12GB	6.0	tesla_p100-pcie-12gb	pascal	5	gpu[005]
P100	Pascal	12GB	6.0	tesla_p100-pcie-12gb	pascal	8	gpu[006]
P100	Pascal	12GB	6.0	tesla_p100-pcie-12gb	pascal	4	gpu[007]
Titan X	Pascal	12GB	6.1	nvidia_titan_x	titan	7	gpu[008]
Titan X	Pascal	12GB	6.1	nvidia_titan_x	titan	8	gpu[009-010]
RTX 2080 Ti	Turing	11GB	7.5	nvidia_geforce_rtx_2080_ti	turing	2	gpu[011]
RTX 2080 Ti	Turing	11GB	7.5	nvidia_geforce_rtx_2080_ti	turing	8	gpu[015]
RTX 2080 Ti	Turing	11GB	7.5	nvidia_geforce_rtx_2080_ti	turing	8	gpu[013,016]
RTX 2080 Ti	Turing	11GB	7.5	nvidia_geforce_rtx_2080_ti	turing	4	gpu[018-019]
RTX 3090	Ampere	25GB	8.6	nvidia_geforce_rtx_3090	ampere	8	gpu[025]
RTX 3090	Ampere	25GB	8.6	nvidia_geforce_rtx_3090	ampere	8	gpu[017,021,026,034-035]
RTX A5000	Ampere	25GB	8.6	nvidia_rtx_a5000	ampere	8	gpu[044,047]
RTX A5500	Ampere	25GB	8.6	nvidia_rtx_a5500	ampere	8	gpu[046]
RTX A6000	Ampere	48GB	8.6	nvidia_rtx_a6000	ampere	8	gpu[048]
RTX 3080	Ampere	10GB	8.6	nvidia_geforce_rtx_3080	ampere	8	gpu[023-024,036-43]
A100	Ampere	40GB	8.0	nvidia_a100_40gb_pcie	ampere	3	gpu[027]
A100	Ampere	40GB	8.0	nvidia_a100-pcie-40gb	ampere	6	gpu[022]
A100	Ampere	40GB	8.0	nvidia_a100-pcie-40gb	ampere	1	gpu[028]

GPU model	Architecture	Mem	Compute Capability	Slurm resource	Legacy Slurm resource	Nb per node	Nodes
A100	Ampere	40GB	8.0	nvidia_a100-pcie-40gb	ampere	4	gpu[020,030-031]
A100	Ampere	80GB	8.0	nvidia_a100-pcie-80gb	ampere	4	gpu[029]
A100	Ampere	80GB	8.0	nvidia_a100-pcie-80gb	ampere	3	gpu[032-033]
A100	Ampere	80GB	8.0	nvidia_a100-pcie-80gb	ampere	2	gpu[045]
RTX 4090	Ada Lovelace	24GB	8.9	nvidia_geforce_rtx_4090	-	8	gpu[049]
RTX 5000	Ada Lovelace	32GB	8.9	nvidia_rtx_5000	-	4	gpu[050]

Link to see the GPU details <https://developer.nvidia.com/cuda-gpus#compute>

## Yggdrasil

### CPU MODELS — yggdrasil

Since our clusters are regularly expanded, the nodes are not all from the same generation. You can see the details in the following table.

Model	Generation	Architecture	Freq	Nb core	Memory	Nodeset
EPYC-7742	V8	Rome	2.25GHz	128	503GB	cpu[123-124,135-150]
EPYC-7742	V8	Rome	2.25GHz	128	1007GB	cpu[125-134]
<a href="#">EPYC-7763</a>	V10	Milan	2.45GHz	128	503GB	cpu[151-158]
<a href="#">EPYC-9654</a>	V12	Genoa	3.70GHz	192	773GB	cpu[159-164]
<a href="#">GOLD-6240</a>	V9	Cascade Lake	2.60GHz	36	184GB	cpu001
<a href="#">GOLD-6240</a>	V9	Cascade Lake	2.60GHz	36	187GB	cpu[002-057,059-082,091-097]
<a href="#">GOLD-6240</a>	V9	Cascade Lake	2.60GHz	36	204GB	cpu058
<a href="#">GOLD-6240</a>	V9	Cascade Lake	2.60GHz	36	1510GB	cpu[120-122]
<a href="#">GOLD-6244</a>	V9	Cascade Lake	3.60GHz	16	754GB	cpu[113-115]

The “generation” column is just a way to classify the nodes on our clusters. In the following table you can see the features of each architecture.

	SSE4.2	AVX	AVX2	NB AVX-512 FMA
Intel Xeon Gold 6244	YES	YES	YES	2
Intel Xeon Gold 6240	YES	YES	YES	2
Intel Xeon Gold 6234	YES	YES	YES	2
Intel Xeon Silver 4208	YES	YES	YES	1

Click here to [Compare Intel CPUs](#).

### GPUs on Yggdrasil

In the following table you can see which type of GPU is available on Yggdrasil.

GPU model	Architecture	Mem	Compute Capability	Slurm resource	Nb per node	Nodes	Peer access between GPUs
Titan RTX	Turing	24GB	7.5	turing	8	gpu[001,002,004]	NO
Titan RTX	Turing	24GB	7.5	turing	6	gpu[003,005]	NO
Titan RTX	Turing	24GB	7.5	turing	4	gpu[006,007]	NO
V100	Volta	32GB	7.0	volta	1	gpu[008]	YES

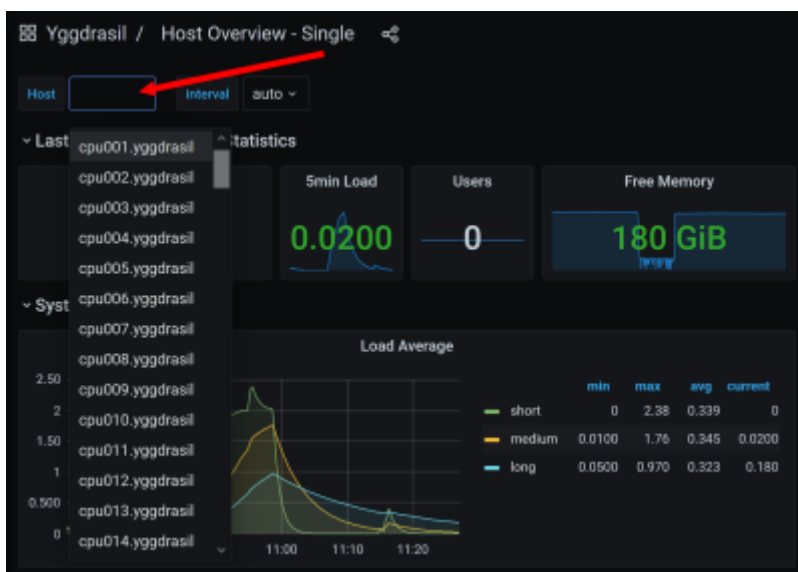
Link to see the GPU details <https://developer.nvidia.com/cuda-gpus#compute>

## Monitoring performance

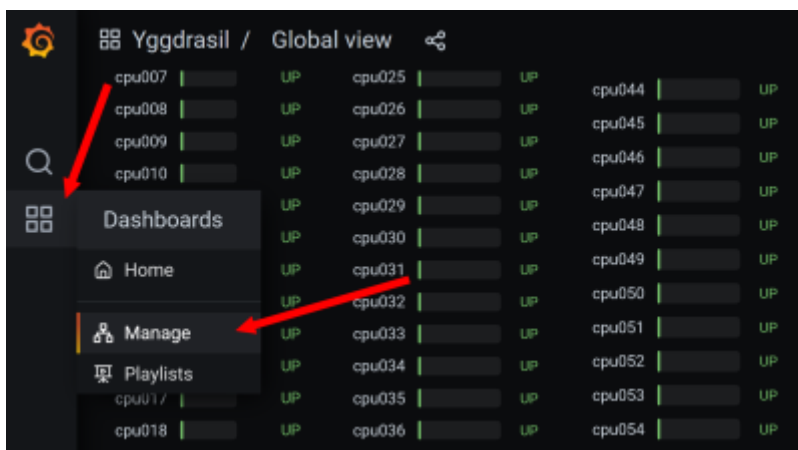
In order to follow system resources, you can go to <https://monitor.hpc.unige.ch/dashboards>

You can reach node metrics for the last 30 days and BeeGFS metrics for the last 6 months.

For checking resources on a specific node, go to “Baobab - General” or “Yggdrasil - General” and click on “Host Overview - Single”. You will be able to choose the node you want to check in the form at the top :



For going back to the dashboard list, click on the four squares on the left panel :



The “General” dashboard in “Yggdrasil - General” and “Baobab - General” folders gives an overview of the cluster : total load and memory used, and how many nodes are up/down.

You can see GPU metrics too under “Cuda - GPU” dashboards.

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