



# EuroCC@Greece

<https://eurocc-greece.gr/newsletter/>

<https://www.linkedin.com/company/eurocc-greece>

<https://www.youtube.com/@euroccgreece9501>

[https://x.com/EuroCC\\_Greece](https://x.com/EuroCC_Greece)



**EuroHPC**  
Joint Undertaking



# EuroCC@Greece

The overall objective of the Greek National Competence Center is to enable the efficient uptake of HPC technologies with the 3-fold goal to:

- advance competitiveness in **research**
- improve the effectiveness of **government** services and
- promote innovation in **industry**

## The Greek Competence Center for High Performance Computing and Artificial Intelligence

Enhancing innovation capacity in Business, Industry and Science  
by utilizing advanced High Performance Computing services



# EuroCC@Greece

## Services

- Technological Support & Consulting
  - High-Performance Computing,
  - Artificial Intelligence, and
  - High-Performance Data Analytics
- Training and Skills Development
- Access to computational resources

<https://eurocc-greece.gr/>

## Fields of Applications

- Artificial Intelligence
- Machine Learning
- Computer Vision
- Large Language Models
- Finite Elements Analyses
- Computational Fluid Dynamics
- Molecular Simulations
- Atmospheric & Oceanic Sciences



# EuroCC@Greece

## Consortium

The Greek National Competence Center “EuroCC@Greece”, is run by a consortium of 5 institutions, namely

1. National Infrastructures for Research and Technology (coordinator) - **GRNET**
2. National Center for Scientific Research - **Demokritos**
3. Institute of Communication and Computer Systems - **NTUA**
4. Aristotle University of Thessaloniki - **AUTH**
5. Foundation for Research and Technology Hellas - **FORTH**



# The European High Performance Computing Joint Undertaking (EuroHPC JU)

is a joint initiative between the EU, European countries and private partners to develop a World Class Supercomputing Ecosystem.

[https://eurohpc-ju.europa.eu/index\\_en](https://eurohpc-ju.europa.eu/index_en)





## 9 operational systems, all ranking among the world's most powerful supercomputers:

1. LUMI in Finland #5
2. LEONARDO in Italy #6
3. MARENOSTRUM in Spain
4. VEGA in Slovenia
5. MELUXINA in Luxembourg
6. KAROLINA in Czechia
7. DEUCALION in Portugal
8. DISCOVERER in Bulgaria
9. JUPITER in Germany

**Underway:**  
DAEDALUS in Greece

1 **Frontier** - HPE Cray EX235a, AMD Optimized 3rd Generation EPYC 64C 2GHz, AMD Instinct MI250X, Slingshot-11, HPE

2 **Aurora** - HPE Cray EX - Intel Exascale Compute Blade, Xeon CPU Max 9470 52C 2.4GHz, Intel Data Center GPU Max, Slingshot-11, Intel

3 **Eagle** - Microsoft NDv5, Xeon Platinum 8480C 48C 2GHz, NVIDIA H100, NVIDIA Infiniband NDR, Microsoft

4 **Supercomputer Fugaku** - Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D, Fujitsu

5 **LUMI** - HPE Cray EX235a, AMD Optimized 3rd Generation EPYC 64C 2GHz, AMD Instinct MI250X, Slingshot-11, HPE

6 **Leonardo** - BullSequana XH2000, Xeon Platinum 8358 32C 2.6GHz, NVIDIA A100 SXM4 64 GB, Quad-rail NVIDIA HDR100 Infiniband, EVIDEN

7 **Summit** - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, IBM



LUMI  
FINLAND



LEONARDO  
ITALY



MELUXINA  
LUXEMBOURG



KAROLINA  
CZECH REPUBLIC



DISCOVERER  
BULGARIA



VEGA  
SLOVENIA



DEUCALIO  
PORTUGAL



MARENOSTRUM 5  
SPAIN

## 1. LUMI (CSC, Finland)

- LUMI-C: 1536 nodes, 128 cores/node, 256-1024 GB RAM/node
- GPU: 2560 nodes, 64 cores/node, 4 GPUs, 128 GB GPU-RAM
- Visualization: 64 nodes, 1 GPU, 48 GB GPU-RAM
- Peak Performance: 550 petaflops
- URL: <https://www.lumi-supercomputer.eu/lumis-full-system-architecture-revealed/>

## 2. Leonardo (Cineca, Italy)

- Booster Module: 3456 nodes, 32 cores/node, 512 GB RAM/node, 4 GPUs, 64 GB GPU-RAM
- Data Centric Module: 1536 nodes, 112 cores/node, 512 GB RAM/node
- Peak Performance: 323.4 petaflops
- URL: <https://leonardo-supercomputer.cineca.eu/hpc-system/>

## 3. MareNostrum 5 (Barcelona Supercomputing Center, Spain)

- General Purpose Partition: 6408 nodes, 112 cores/node, 256 GB RAM/node
- Accelerated Partition: 1120 nodes, 64 cores/node, 512 GB RAM/node, 4 GPUs, 64 GB GPU-RAM
- Peak Performance: 314 petaflops
- URL: <https://www.bsc.es/innovation-and-services/marenostrum/marenostrum-5>

#### 4. MeluXina (LuxProvide, Luxembourg)

- Cluster: 573 nodes, 128 cores/node, 512 GB RAM/node
- Accelerator-GPU: 200 nodes, 64 cores/node, 512 GB RAM/node, 4 GPUs, 40 GB GPU-RAM
- Large memory: 20 nodes, 128 cores/node, 4096 GB RAM/node
- Peak Performance: 18.29 petaflops
- URL: <https://docs.lxp.lu/system/overview/>

#### 5. Karolina (IT4I, Czech Republic)

- CPU: 828 nodes, 128 cores/node, 256-24000 GB RAM/node
- GPU: 72 nodes, 8 GPUs, 40 GB GPU-RAM
- Peak Performance: 15.69 petaflops
- URL: <https://www.it4i.cz/en/infrastructure/karolina>

## 6. Vega (IZUM, Slovenia)

- GPU partition: 60 nodes, 128 cores/node, 512 GB RAM/node, 4 GPUs, 40 GB GPU-RAM
- CPU node Standard: 768 nodes, 128 cores/node, 256 GB RAM/node
- CPU node Large Memory: 192 nodes, 128 cores/node, 1000 GB RAM/node
- Peak Performance: 10.05 petaflops
- URL: <https://doc.vega.izum.si/architecture/>

## 7. Deucalion (Guimarães, Portugal)

- ARM cluster: 1632 nodes, 48 cores/node
- X86 cluster: 500 nodes, 48+ cores/node
- Accelerated partition: 33 nodes
- Peak Performance: 10 petaflops
- URL: <https://macc.fccn.pt/resources#deucalion>

## 8. Discoverer (Sofia Tech Park, Bulgaria)

- CPU: 1128 nodes, 128 cores/node, 256 GB RAM/node
- CPU-Fat: 18 nodes, 128 cores/node, 1000 GB RAM/node
- Peak Performance: 5.94 petaflops
- URL: [https://docs.discoverer.bg/resource\\_overview.html](https://docs.discoverer.bg/resource_overview.html)

# ARIS – HPC Infrastructure in Greece Compute Nodes

## Nodes Summary

Node Type	Count	Accelerator	Memory	Cores
THIN nodes	48	w/o	512 GB	128@2.45 GHz (two sockets)
GPU nodes	3	4 x NVIDIA Ampere A100 80GB	512 GB	128@2.45 GHz + 4 x A100
FAT nodes	16	w/o	1024 GB	128@2.45 GHz (two sockets)

## File system overview

File system	Type	Env. Variable	Size	Lifetime	Backup	Quota
/users	GPFS	\$HOME	0.5 PB	Project duration	NO	*
/work	GPFS	\$WORKDIR	2 PB	Project duration	NO	*





# EuroCC@Greece

Publications

Greek supercomputer ARIS

<https://www.hpc.grnet.gr/en/publications/>

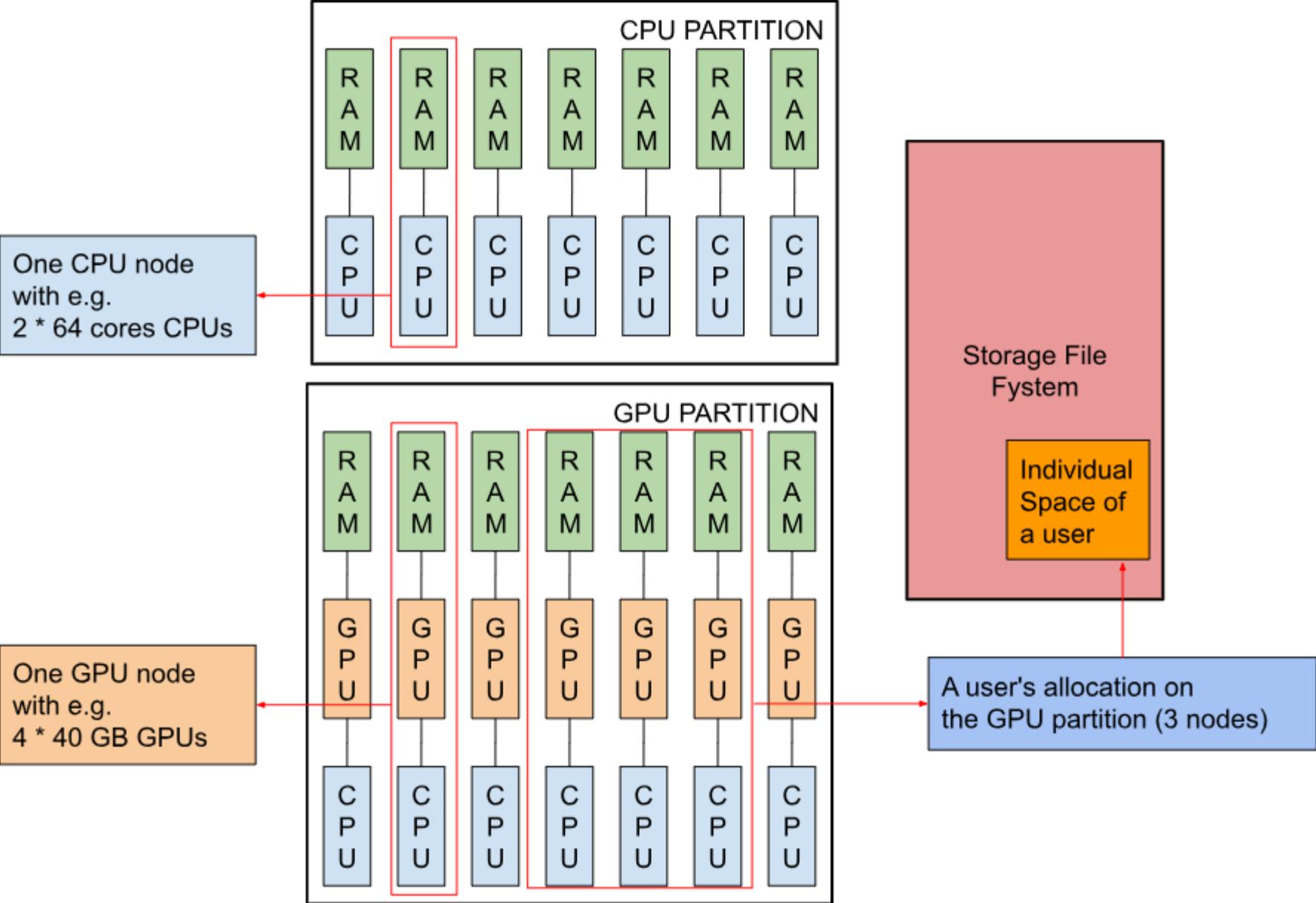
- In **fluid dynamics**, HPC powers **deep learning models** for super-resolution imaging and **turbulent flow reconstruction**, along with complex **multi-phase flow simulations**.
- **Materials science** benefits from HPC-driven **machine learning** and **molecular dynamics**, refining interatomic potentials for **pharmaceuticals**, and investigating **polymer mechanics**.
- **Computational chemistry** leverages quantum mechanical calculations for **thermoelectric materials**, **electronic structures**, and **drug binding** studies.
- **Astrophysics** research utilizes HPC for **modeling neutron star** thermoelectric effects and pulsar equations.
- **Atmospheric and oceanic sciences** apply HPC to turbulence modeling in **air pollution studies**, **weather forecasting**, and **sea surface simulations**.
- Additionally, HPC enhances radiation modeling for space applications and **Monte Carlo-based dosimetry** calculations, underscoring its vital role in advancing interdisciplinary research.

# The way is open to building a EuroHPC world-class supercomputer in Greece

- A hosting agreement has been signed between the **EuroHPC Joint Undertaking** and the National Infrastructures for Research and Technology (**GRNET**) in **Greece**, where **DAEDALUS**, a new **EuroHPC supercomputer**, will be located.
- The DAEDALUS supercomputer, with a total power of **89 PetaFlops**, will be the most powerful computing system in Greece and one of the leading systems in Europe.  
<https://grnet.gr/en/2025/03/26/daedalus-dc-ylopoihs-lavrio/>
- **Lavrion** Technological and Cultural Park (TCPL) [https://eurohpc-ju.europa.eu/way-open-building-eurohpc-world-class-supercomputer-greece-2022-11-28\\_en](https://eurohpc-ju.europa.eu/way-open-building-eurohpc-world-class-supercomputer-greece-2022-11-28_en)



# Example of an HPC cluster



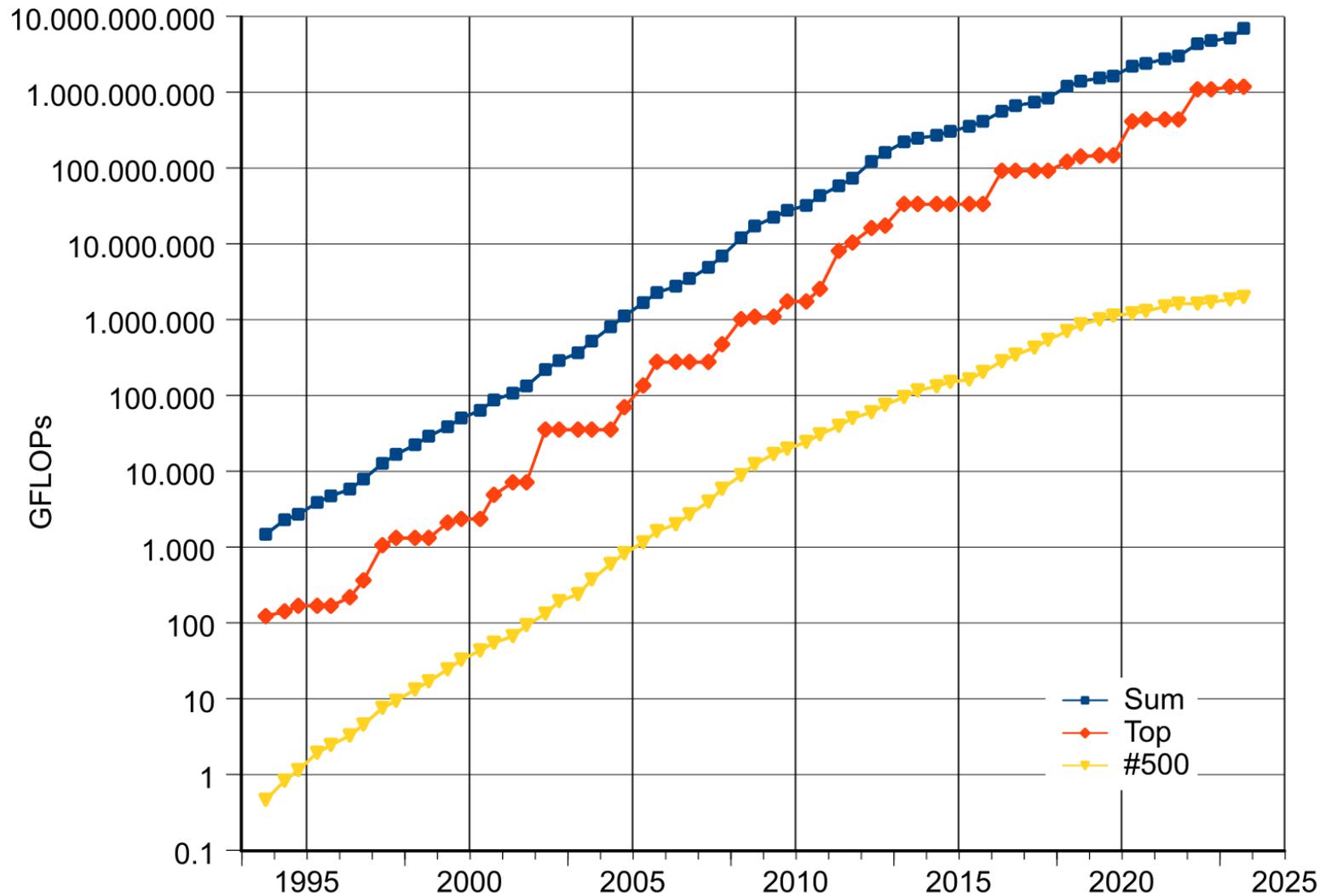
# Threads on 1 node of MeluXina supercomputer

<https://docs.lxp.lu/system/overview/>

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0[98.1%] 16[96.8%] 32[99.4%] 48[96.8%] 64[83.2%] 80[98.7%] 96[98.7%]112[100.0%] 128[98.1%] 144[96.2%] 160[98.1%] 176[98.1%] 192[96.2%] 208[96.8%]224[100.0%]240[98.1%]
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8[98.7%] 24[98.7%] 40[87.7%] 56[96.8%] 72[98.1%] 88[97.4%]104[97.4%]120[97.4%] 136[98.1%] 152[96.8%] 168[98.7%] 184[96.8%] 200[96.8%] 216[98.1%]232[96.2%]248[98.7%]
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Mem[|||||] 15.9G/503G Tasks: 43, 293 thr, 2911 kthr; 227 running
Swp[ ] 0K/0K Load average: 1.97 60.10 121.57
Uptime: 89 days, 01:38:08

[Main] [I/O]
PID USER PRI NI VIRT RES SHR S CPU%MEM% TIME+ Command
7131 u100425 20 0 6754M 244M 8424 R 2430.9 0.0 0:48.33 python __mult_proc_loop__.py
F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice -F8Nice +F9Kill F10Quit
```

# Growth of HPC systems



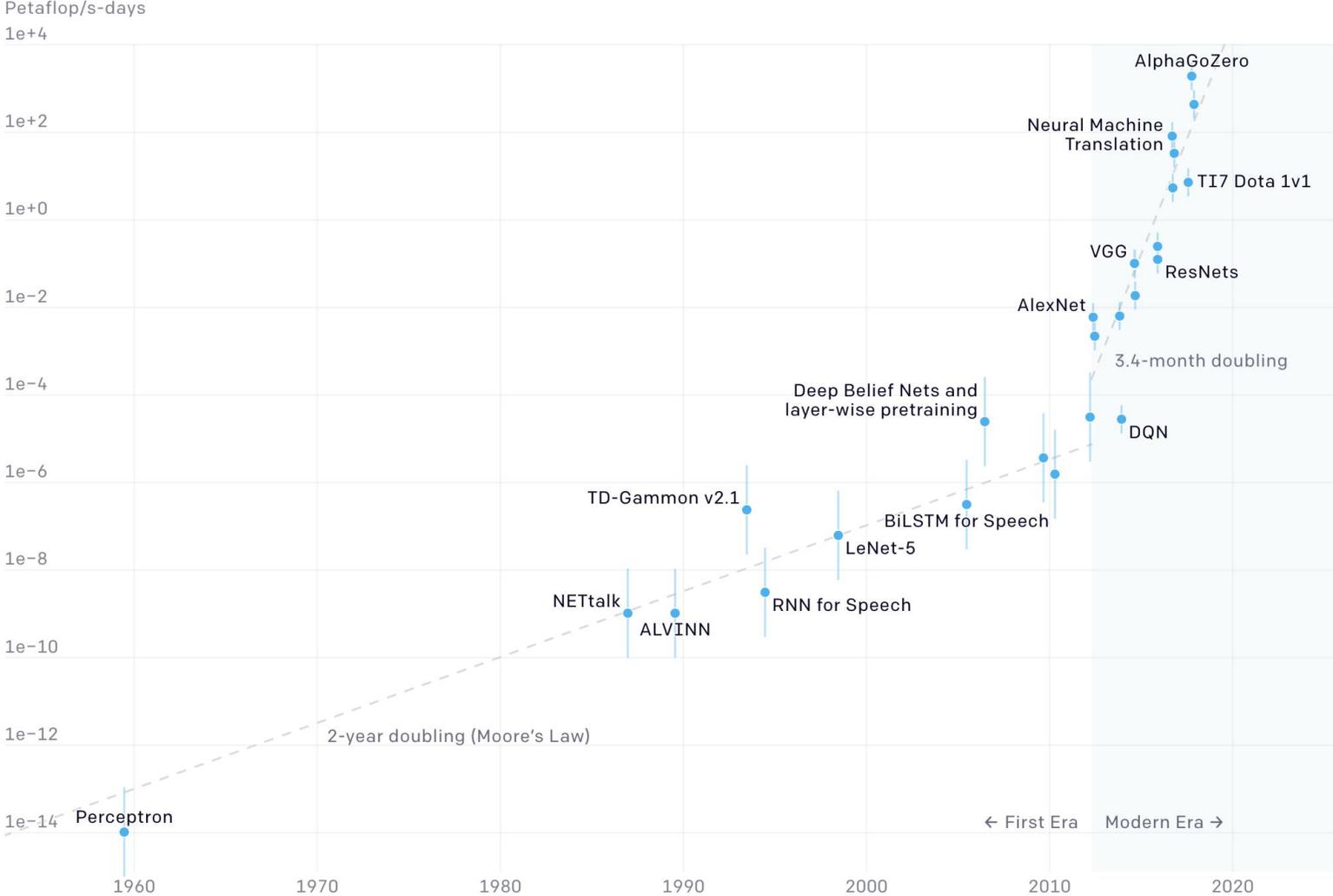
The new **El Capitan** system at the **Lawrence Livermore National Laboratory** in California, U.S.A., has debuted as the most powerful system on the list with an HPL score of 1.742 EFlop/s.  
<https://top500.org/>

<https://creativecommons.org/licenses/by-sa/3.0/>

<https://en.Wikipedia.org/wiki/TOP500#/media/File:Supercomputers-history.svg>

# Since 2102 we observe a 3.4-month doubling in computing power used to train AI models.

## Two Distinct Eras of Compute Usage in Training AI Systems



# FLOPS (Floating Point Operations Per Second)

X 200,000



0.05 km/h



1 km/h



100 km/h



1,000 km/h



10,000 km/h



1,000,000,000 km/h



1 TFlop

X 1,000,000



1 EFlop

Operations	Name	Abbreviation
1	FLOPS	FLOPS
$10^3$	Kilo FLOPS	KFLOPS
$10^6$	Mega FLOPS	MFLOPS
$10^9$	Giga FLOPS	GFLOPS
$10^{12}$	Tera FLOPS	TFLOPS
$10^{15}$	Peta FLOPS	PFLOPS
$10^{18}$	Exa FLOPS	EFLOPS

# Large Language Models on HPC

## Estimated GPU Hours for Training:

### 1. Small LLM (~8B):

- ~1.3M GPU hours (LLAMA 3 8B).

### 2. Medium LLM (~70B):

- ~6.4M-7.0M GPU hours (LLAMA 3/3.1 70B).

### 3. Large LLM (~405B):

- ~30.84M GPU hours (LLAMA 3.1 405B).
- Falcon 180B (slightly smaller): ~7M GPU hours.

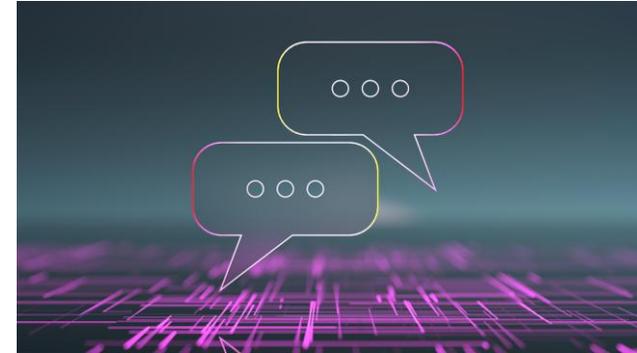
<https://huggingface.co/meta-llama/Meta-Llama-3-8B-Instruct>

<https://huggingface.co/meta-llama/Llama-3.3-70B-Instruct>

<https://huggingface.co/meta-llama/Llama-3.1-405B-Instruct>

<https://docs.lxp.lu/howto/llama3-vllm/>

<https://huggingface.co/blog/falcon-180b>



## Estimated GPU Requirements for Inference:

• **Small LLM (~8B):** ~80GB GPU RAM (LLAMA 3.1 8B).

• **Medium LLM (~70B):** ~320GB GPU RAM (GPTQ/int4 on Falcon).

**Large LLM (~405B):** ~800GB GPU RAM (FP8 on LLAMA 3.1).

# EuroHPC Access Modes

## [EuroHPC JU Call for Proposals – Extreme Scale Access Mode](#)

For applications with high-impact, high-gain innovative research

## [EuroHPC JU Call for Proposals – Regular Access Mode](#)

The expected impact in the application's domain should justify the need for large allocations

## [EuroHPC JU Call for Proposals – AI and Data-Intensive Applications Access Mode](#)

To support ethical artificial intelligence & machine learning

## [EuroHPC JU Call for Proposals – Development Access Modes](#)

To develop, test and optimise applications

## [EuroHPC JU Call for Proposals – Benchmark Access Modes](#)

To test or benchmark applications

[https://eurohpc-ju.europa.eu/access-our-supercomputers/access-policy-and-faq\\_en](https://eurohpc-ju.europa.eu/access-our-supercomputers/access-policy-and-faq_en)

<https://access.eurohpc-ju.europa.eu/>

# 2025 Cut off dates for EuroHPC Access Calls

**BENCHMARK ACCESS:**

- 1<sup>st</sup> day of each month

**DEVELOPMENT ACCESS:**

- 1<sup>st</sup> day of each month

**AI AND DATA INTENSIVE APPLICATIONS ACCESS:**

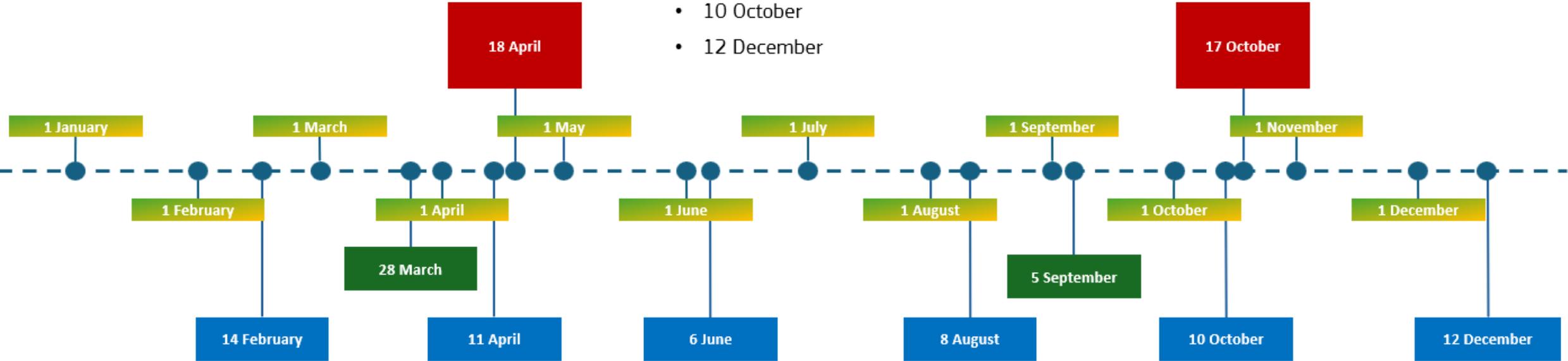
- 14 February
- 11 April
- 6 June
- 8 August
- 10 October
- 12 December

**REGULAR ACCESS:**

- 28 March
- 5 September

**EXTREME SCALE ACCESS:**

- 18 April
- 17 October



## Open Calls for Proposals



Cut-off ends in

3 hours

### EuroHPC Benchmark Access Call

● Open

The EuroHPC Benchmark call is designed for code scalability test...



Cut-off ends in

6 days

### EuroHPC Extreme Scale Access C...

● Open

The Extreme Scale Access mode is designed to serve research...



Cut-off ends in

7 days

### EuroHPC AI and Data-Intensive A...

● Open

The EuroHPC JU AI and Data-Intensive Applications Access cal...



<https://access.eurohpc-ju.europa.eu/>

Proposal for civilian purposes\* 

Is any part of the project confidential?\*

Yes  No 

### Research fields

Research field title\*

PE6 Computer Science and Informatics 

Research field sub-title\*

PE6\_7 Artificial intelligence, intelligent systems, natural language processing 

Research field share (%)\*

50

The sum of all research fields should not exceed the total of 100%



Cut-off ends in

3 hours

### EuroHPC Development Access Call

● Open

The EuroHPC Development call is designed for projects focusing on...

<https://access.eurohpc-ju.europa.eu/>

## Research fields #2

Research field title\*

PE6 Computer Science and Informatics



Research field sub-title\*

PE6\_11 Machine learning, statistical data processing and applications using signal



Research field share (%)\*

50

The sum of all research fields should not exceed the total of 100%

Remove

+ Research fields

AI set of technologies selection

Machine Learning

Natural Language Processing

Deep Learning



If applicable, please select used AI technologies. This is a multi-select field so you are able to choose more than one option.

<https://access.eurohpc-ju.europa.eu/>

## Partitions

Partition name\*

Code(s) used\*

This field is a multi-text field, for adding another code separate it with a comma

Requested amount of resources (node hours)\*

Average number of processes/threads\*

Average job memory (total usage over all nodes in GB)\*

Maximum amount of memory per process/thread (MB)\*

Total amount of data to transfer to/from (GB)\*

<https://access.eurohpc-ju.europa.eu/>

Partitions #2 

Partition name\*

Code(s) used\*

This field is a multi-text field, for adding another code separate it with a comma

Requested amount of resources (node hours)\*

Average number of processes/threads\*

Average job memory (total usage over all nodes in GB)\*

Maximum amount of memory per process/thread (MB)\*

<https://access.eurohpc-ju.europa.eu/>

## Frequently Asked Questions (FAQ)

[https://eurohpc-ju.europa.eu/access-our-supercomputers/access-policy-and-faq\\_en](https://eurohpc-ju.europa.eu/access-our-supercomputers/access-policy-and-faq_en)

- **How can I gain access to computation time on EuroHPC machines?**
  - You will need to **apply** to one of the open **access calls** that **EuroHPC** provides. The list of available calls can be found here.
- **Which organisations are eligible for access to EuroHPC machines?**
  - Any European organisation is eligible for access to perform Open Science research (the **results** of the work are made available for **open access**). This includes **public and private** academic and research institutions, public sector organisations, industrial enterprises and SMEs
- **What is the cost?**
  - Currently access is **free of charge**.
- **What are the participation conditions?**
  - Participation conditions depend on the specific access call that a research group has applied. In general users of EuroHPC systems commit to: **acknowledge** the use of the **resources** in their related publications, contribute to **dissemination** events, produce and submit a **report** after completion of a resource allocation. More information on participation conditions can be found in the call's Documents section.

# Our Training Events <https://eurocc-greece.gr/events-2/>



EURO Greece

**HPC Training Series**

**Course 1**

**HPC for beginners: basic concepts, MPI and OpenMP**

| PRESENTATION LANGUAGE: GREEK |

MARCH 29 | 09:45 EET | ONLINE



EURO Greece

**HPC Training Series**

**Course 2**

**Introduction to accelerators: GPUs / CUDA**

| PRESENTATION LANGUAGE: GREEK |

APRIL 19, 2024 | 10:00 EET | ONLINE



EURO Greece it.auth

**HPC Training Series**

**Course 3**

**Large Language Models (LLMs) on High Performance Computing (HPC) Systems**

| PRESENTATION LANGUAGE: GREEK |

APRIL 24, 2024 | 10:00 EET | ONLINE



EURO Greece

**HPC Training Series**

**Course 4**

**Intermediate-level Programming for HPC using Python**

| PRESENTATION LANGUAGE: ENGLISH |

MAY 29, 2024 | 10:00 EET | HYBRID



EURO Greece

**HPC Workshop**

"LARGE SCALE SCIENTIFIC COMPUTATIONS" BY NTUA  
SUPPORTED BY EUROCC@GREECE

| PRESENTATION LANGUAGE: GREEK |

JULY 11-14, 2024 | 10:00 - 16:00 EET | ON-SITE



EURO Greece

**HPC Training Series**

**Course 5**

**Computational Fluid Dynamics (CFD) using OpenFOAM on High Performance Computing (HPC)**

| PRESENTATION LANGUAGE: GREEK |

JUNE 14, 2024 | 09:30 EET | ONLINE



EURO Greece gnet DCoMEX

**Workshop**

**Data-driven Applications for Exascale Supercomputers**

SEPTEMBER 2-3, 2024 | 09:00 - 17:00 EET | ATHENS, GREECE



EURO Greece

**HPC Training Series**

**Course 6**

**Gradient-based & gradient-free Optimization, with applications to CFD & beyond**

| PRESENTATION LANGUAGE: GREEK |

OCTOBER 4, 2024 | 10:00 EET | ONLINE



EURO Greece

**HPC Training Series**

**Course 7**

**AI for Life Sciences**

**Vol. 1: Deep Learning for Health and Life Sciences**

| PRESENTATION LANGUAGE: GREEK |

NOVEMBER 1, 2024 | 10:00 EET | ONLINE

# Our Training Events <https://eurocc-greece.gr/events-2/>



**EURO Greece** **it.auth**

**HPC Training Series**

**Course 8**  
**Computational Chemistry and High Performance Computing (HPC)**

| PRESENTATION LANGUAGE: GREEK |

DECEMBER 9, 2024 | 10:00 EET | ONLINE



**EURO Greece**

**HPC Training Series**

**Course 9**  
**Running LLMs on HPC: Transformers, Inference & Deployment**

| PRESENTATION LANGUAGE: GREEK & ENGLISH |

JANUARY 17, 2025 | 10:00 EET | ONLINE



**EURO Greece** 

**HPC Training Series**

**Course 10**  
**Introduction to Computational Fluid Dynamics and OpenFOAM, using HPC**

| PRESENTATION LANGUAGES: GREEK & ENGLISH |

FEBRUARY 17, 2025 | 09:30 EET | ONLINE



**EURO Greece**

**HPC Training Series**

**Course 11**  
**HPC for Beginners: Basic Concepts, MPI and OpenMP**

| PRESENTATION LANGUAGE: GREEK |

MARCH 7, 2025 | 09:45 EET | ONLINE



**EURO Greece**

**HPC Training Series**

**Course 12**  
**Introduction to Accelerators: GPUs / CUDA**

| PRESENTATION LANGUAGE: GREEK |

APRIL 4, 2025 | 10:00 EET | ONLINE



**EURO Greece**

**HPC Training Series**

**Course 13**  
**The Weather Research and Forecasting (WRF) Model on HPC**

| PRESENTATION LANGUAGE: GREEK |

APRIL 28, 2025 | 09:45 EET | ONLINE

# HPC Training Series - Course 19

## "OpenMP for Shared-Memory Parallel Programming - Hands-On"



JANUARY 26, 2026 | 11:00 EET | ONLINE

**11:00** → 11:10 **Introduction to EuroCC@Greece & the Training Series**

Speaker: Nikos Bakas (GRNET)

**11:10** → 11:20 **Motivation for OpenMP: simplicity, portability & incremental parallelisation**

Speaker: Iakovos Panourgias (GRNET)

**11:20** → 11:35 **Shared-memory systems: UMA, NUMA and real HPC nodes (caches, sockets)**

Speaker: Iakovos Panourgias (GRNET)

**11:35** → 11:55 **Threaded programming model & fork-join; OpenMP "Hello, world" in C/C++ and Fortran**

Speaker: Iakovos Panourgias (GRNET)

**11:55** → 12:10 **Race conditions & parallel loops: from serial loop to omp parallel for/do**

Speaker: Iakovos Panourgias (GRNET)

**12:10** → 12:25

Break

**12:25** → 12:45 **OpenMP basics: parallel regions & data sharing (shared, private, first/lastprivate, default)**

Speaker: Iakovos Panourgias (GRNET)

**12:45** → 13:05 **Worksharing & scheduling: for/do, sections, single, master, schedule(static/dynamic/guided)**

Speaker: Iakovos Panourgias (GRNET)

**13:05** → 13:25 **Synchronisation: barrier, critical, atomic, locks, ordered, master/masked; avoiding races**

Speaker: Iakovos Panourgias (GRNET)

**13:25** → 13:40 **Reductions, collapse for nested loops & small exercises**

Speaker: Iakovos Panourgias (GRNET)

**13:40** → 13:50 **Performance tips & Q&A: scheduling, NUMA, false sharing, env vars, timing & debugging tools**



# EuroCC@Greece

<https://eurocc-greece.gr/newsletter/>

<https://www.linkedin.com/company/eurocc-greece>

<https://www.youtube.com/@euroccgreece9501>

[https://twitter.com/EuroCC\\_Greece](https://twitter.com/EuroCC_Greece)



**EuroHPC**  
Joint Undertaking

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