

Introduction to HPC2N, Kebnekaise and HPC

Birgitte Brydsö,
Pedro Ojeda May, and others at HPC2N

HPC2N
Umeå University

18. January 2024



HPC2N (HPC2N at a glance)

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- A part of **National Academic Infrastructure for Supercomputing in Sweden (NAISS)**



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- Software for e-Science applications
- All levels of user support
 - Primary, advanced, dedicated
 - Application Experts (AEs)

Primary objective: to raise the national and local level of HPC competence and transfer HPC knowledge and technology to new users in academia and industry.

HPC2N is hosted by



UMEÅ UNIVERSITY

Partners:



HPC2N (funding and collaborations)

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- Involved in several **projects and collaborations**



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 - 0.5 – 3 days; ready-to-run exercises
 - Introduction to HPC2N and Kebnekaise
 - Parallel programming and tools (OpenMP, MPI, debugging, perf. analyzers, Matlab, R, MD simulation, ML, GPU, ...)
 - **Using Python in an HPC environment**, week 20, 2024
 - **Introduction to running R, Python, and Julia in HPC**, 12-14 March 2024
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System and support

- Erik Andersson
- **Birgitte Brydsö**
- Niklas Edmundsson (Tape coord)
- Ingemar Fällman
- Magnus Jonsson
- Roger Oscarsson
- **Åke Sandgren**
- Mattias Wadenstein (NelC, Tier1)
- **Lars Viklund**

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- Contact through regular support
 - If you have a specific problem/question and/or need consultation

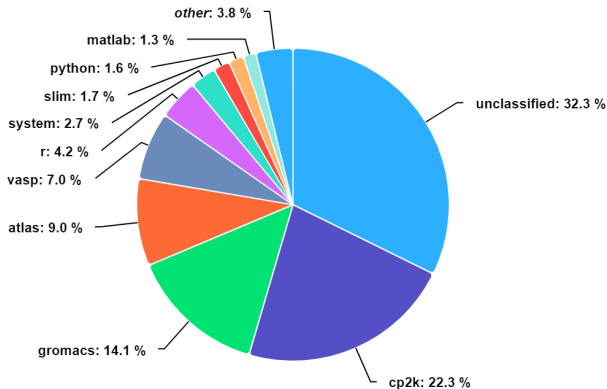
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 - **Machine learning and artificial intelligence** (several new projects)

HPC2N (users by software)

Core hour usage per software for Kebnekaise @ HPC2N

Period: 2023-01-01 - 2023-09-01



Highcharts.com

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 - 2 dual NVIDIA A100 GPU nodes
 - one many-core AMD Zen3 CPU node

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 - **Long term storage**
- Also **SweStore** — disk based (dCache)
 - Research Data Storage Infrastructure, for active research data and operated by NAISS, WLCG

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- I will cover more details in the next section, where we go more into detail about HPC2N and Kebnekaise.

What is HPC?

High Performance Computing (definition)

“High Performance Computing most generally refers to the practice of **aggregating computing power** in a way that delivers much **higher performance** than one could get out of a typical desktop computer or workstation in order to **solve large problems** in science, engineering, or business.”¹

¹<https://insidehpc.com/hpc-basic-training/what-is-hpc/>

- **Aggregating computing power**

- 533 nodes in 15 racks totalling 16504 cores
- Compared to 4 cores in a modern laptop

²728 trillion (billion)

³200 billion (milliard)

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- **Solve large problems**

- When does a problem become large enough for HPC?
- Are there other reasons for using HPC resources? (Memory, software, support, etc.)

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High Performance Computing (large problems)

- A problem can be large for two main reasons:
 - ① **Execution time**: The time required to form a solution to the problem is very long
 - ② **Memory / storage use**: The solution of the problem requires a lot of memory and/or storage

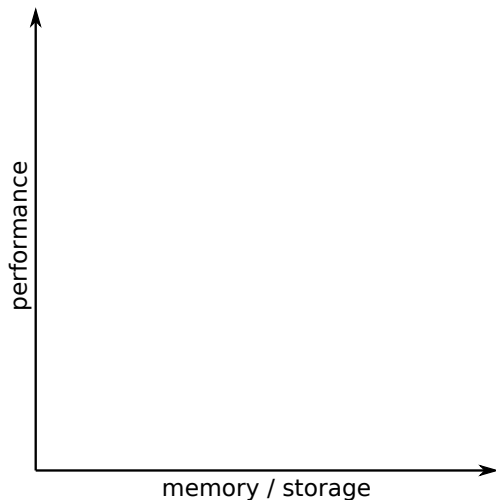
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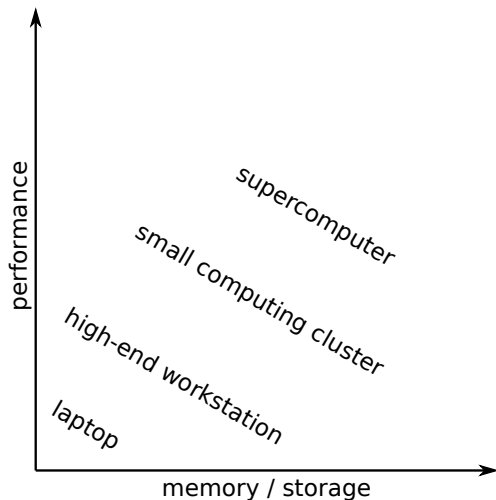
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- The latter by **adding more memory / storage**
 - More memory per node (including large memory nodes), more nodes, ...
 - Kebnekaise: 128GB - 192GB, 512GB, 3TB
 - Large storage solutions, ...

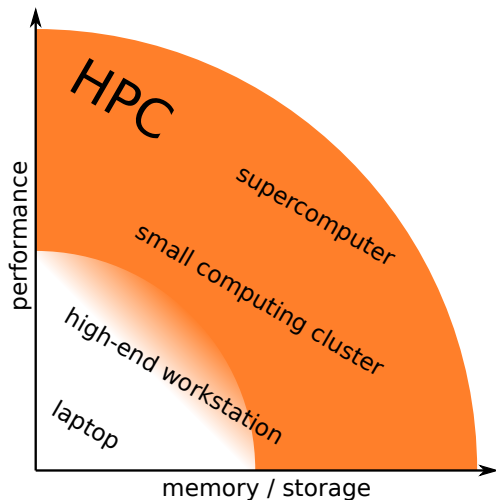
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 - Software is **pre-configured and ready-to-use**

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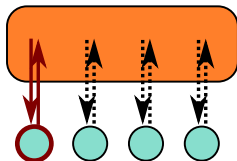
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- **Support and documentation**

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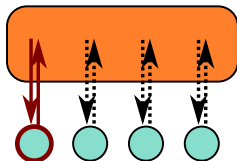
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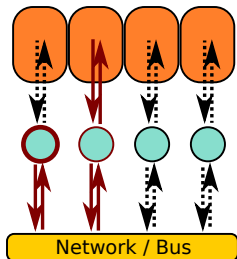
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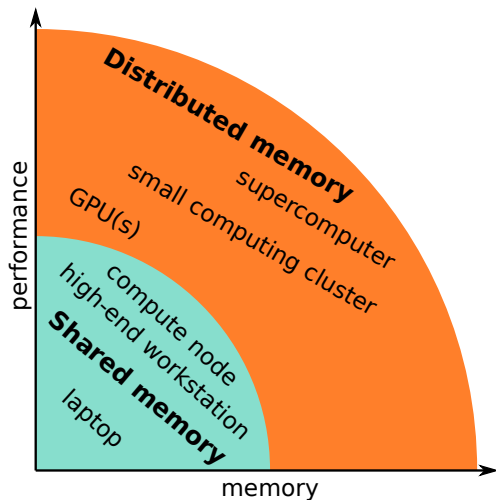
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- **Distributed memory**: Multiple **distinct** memory spaces.



- Everyone has direct access **only to the local data**
- Requires **communication**

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 - Multiple streams of operations
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 - **Data distribution and communication**

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- The programming model changes when we aim for extra performance and/or memory:
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 - Allocate correct number of **nodes and cores**, configure software to use correct number of **nodes and cores**, ...
 - Data distribution, storage, ...
- **GPUs:** MAGMA, TensorFlow, ...
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 - Allocate correct number of **cores and GPUs**, configure software to use correct number of **cores and GPUs**, ...

Questions?