Introduction to HPC2N, Kebnekaise and HPC

Birgitte Brydsö,
Pedro Ojeda May, and others at HPC2N

HPC2N
Umeå University

21. September 2023

UMEÅ UNIVERSITY

HPC2N

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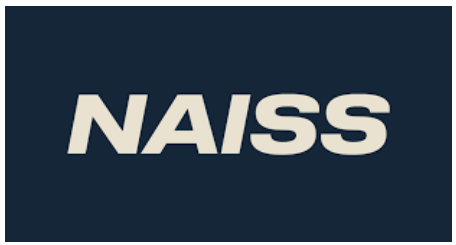
- A part of **National Academic Infrastructure for Supercomputing in Sweden (NAISS)**



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  - Application Experts (AEs)
- International network for **research and development**

HPC2N (partners)

HPC2N has five **partners**:

- Luleå University of Technology
- Mid Sweden University
- Swedish Institute of Space Physics
- Swedish University of Agricultural Sciences (SLU)
- Umeå University

HPC2N (funding)

- Funded mainly by **Umeå University**, with contributions from the **other HPC2N partners**

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- Involved in several **projects and collaborations**
  - DDLS, EGI, EISCAT, eSSENCE, NOSEG, Swedish Science Cloud, ...

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  - Introduction to HPC2N and Kebnekaise
  - Parallel programming and tools (e.g., OpenMP, MPI, debugging, performance analyzers, Matlab, R, MD simulation, Deep Learning, GPU, . . .)

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- Workshops and seminars

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Management

- Paolo Bientinesi, director
- Björn Torkelsson, deputy director
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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 (NeIC, Tier1)
- **Lars Viklund**

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- Contact through regular support
  - If you have a specific problem/question and/or need consultation (up to 100 h)

HPC2N (users by discipline)

- Users from several scientific disciplines:
  - Biosciences and medicine
  - Chemistry
  - Computing science
  - Engineering
  - Materials science
  - Mathematics and statistics
  - Physics including space physics
  - Deep learning and artificial intelligence

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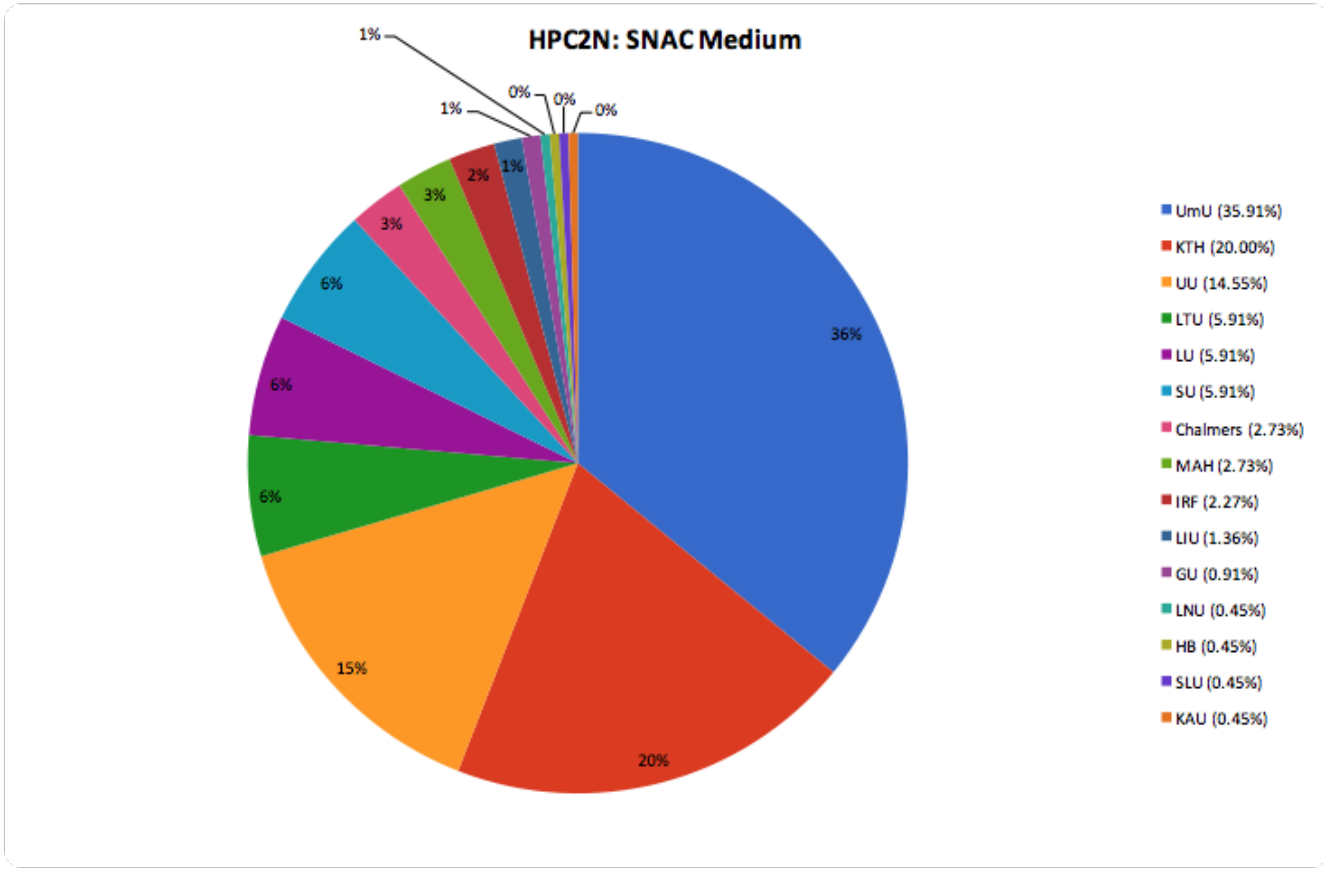
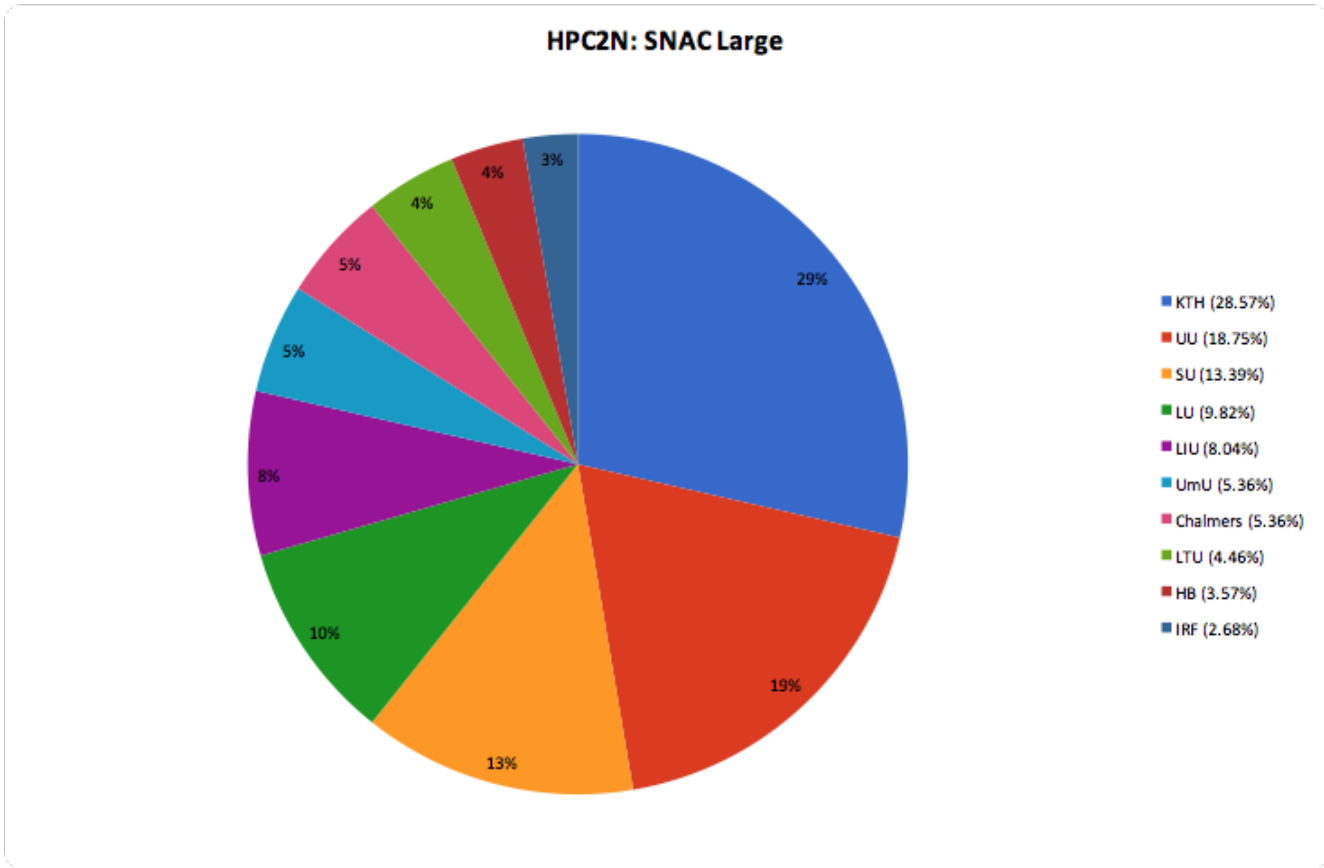
  - Computing science
  - Engineering
  - **Materials science**
  - Mathematics and statistics
  - **Physics including space physics**
  - Deep learning and artificial intelligence (several new projects)

HPC2N (medium users by university)



Projects with allocations at HPC2N: 2014-01-01 to 2016-05-30

HPC2N (large users by university)



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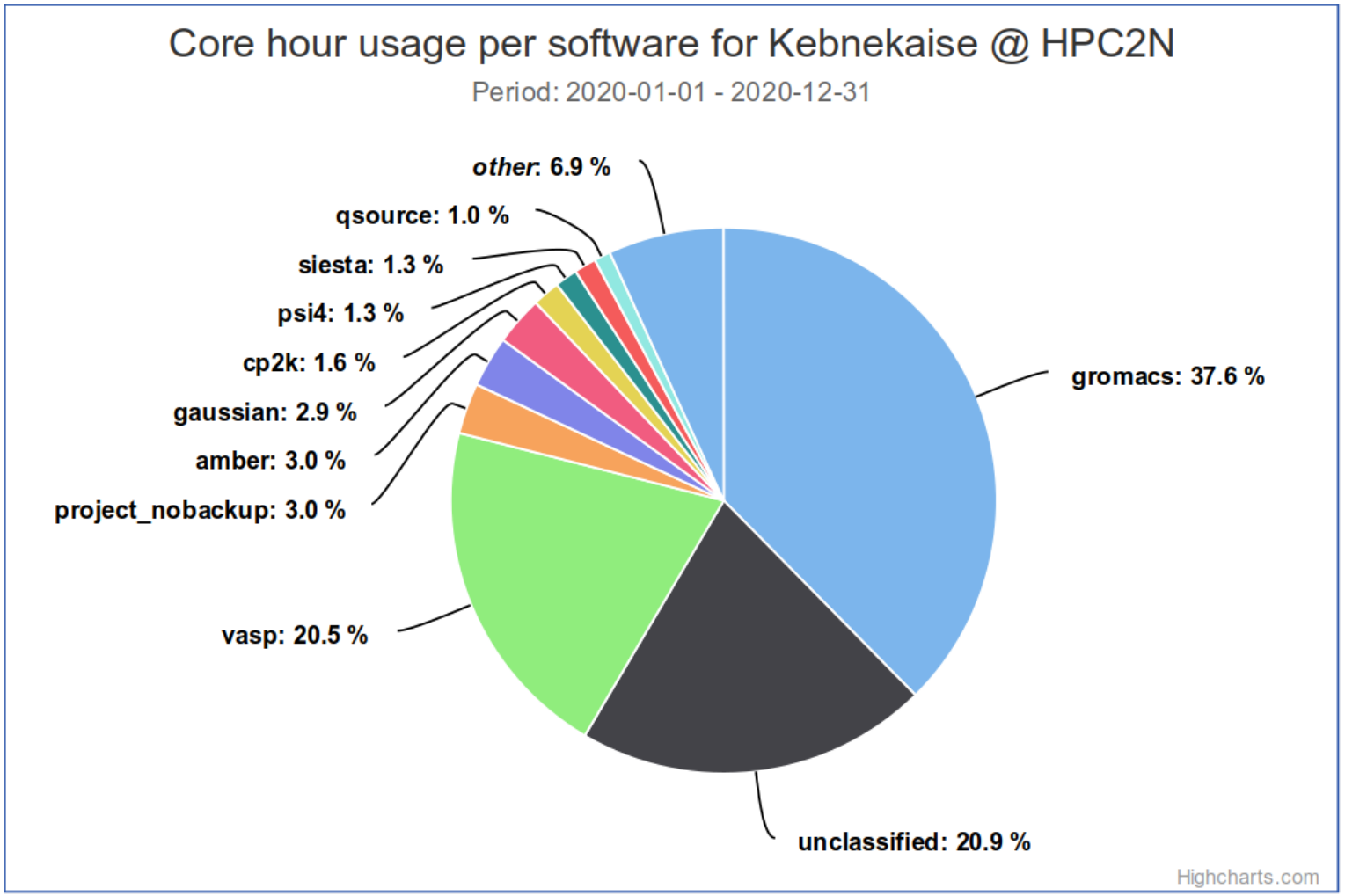
HPC2N (users by software)



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- In 2023, Kebnekaise was **extended** with
  - 2 dual NVIDIA A100 GPU nodes
  - one many-core AMD Zen3 CPU node

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Name	#	Description
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Large Memory	20	Intel Xeon E7-8860v4, **4 x 18 cores**, **3072 GB**, EDR Infiniband

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2 x A100	2	AMD Zen3 (AMD EPYC 7413), 2 x 24 cores, 512 GB, EDR Infiniband, **2 x NVidia A100**, 2 x 6912 CUDA cores, **2 x 432 Tensor cores**

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- **629 TFlops/s** Linpack (all parts, except expansion)
  - 86% of Peak performance

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  - Tape Storage
    - Backup
    - **Long term storage**

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

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/

High Performance Computing (opening the definition)

- **Aggregating computing power**
  - 602 nodes in 15 racks totalling 19288 cores
  - Compared to 4 cores in a modern laptop

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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)

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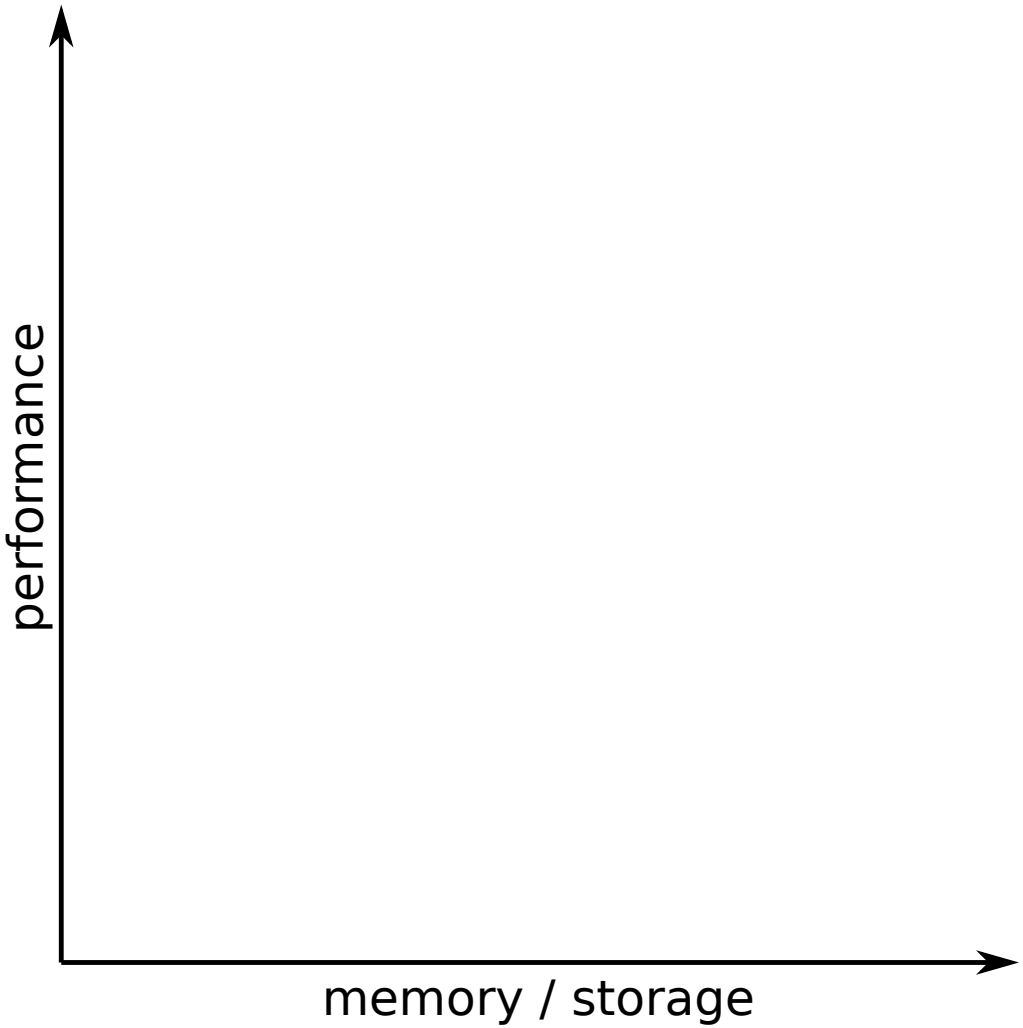
- The latter by **adding more memory / storage**
  - More memory per node (including large memory nodes), more nodes, ...
  - Large storage solutions, ...

High Performance Computing (what counts as HPC)



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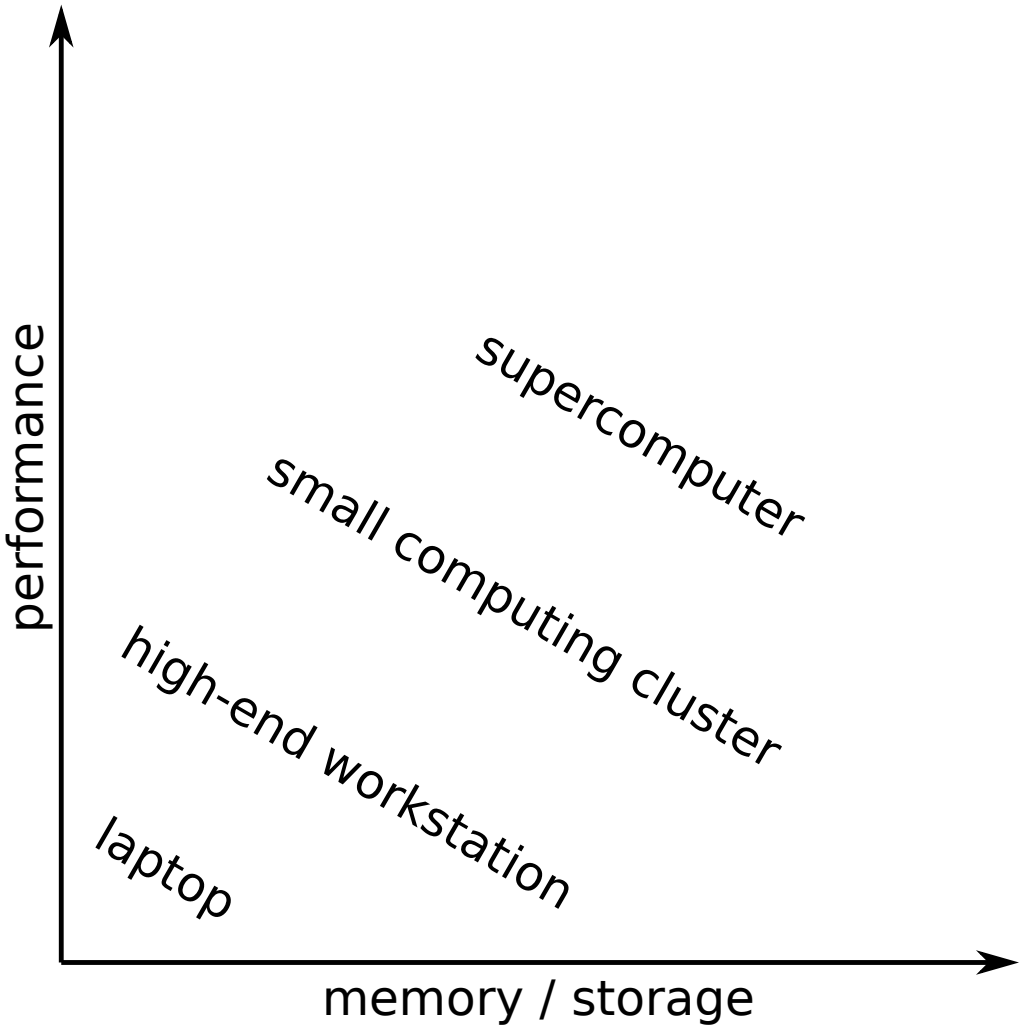

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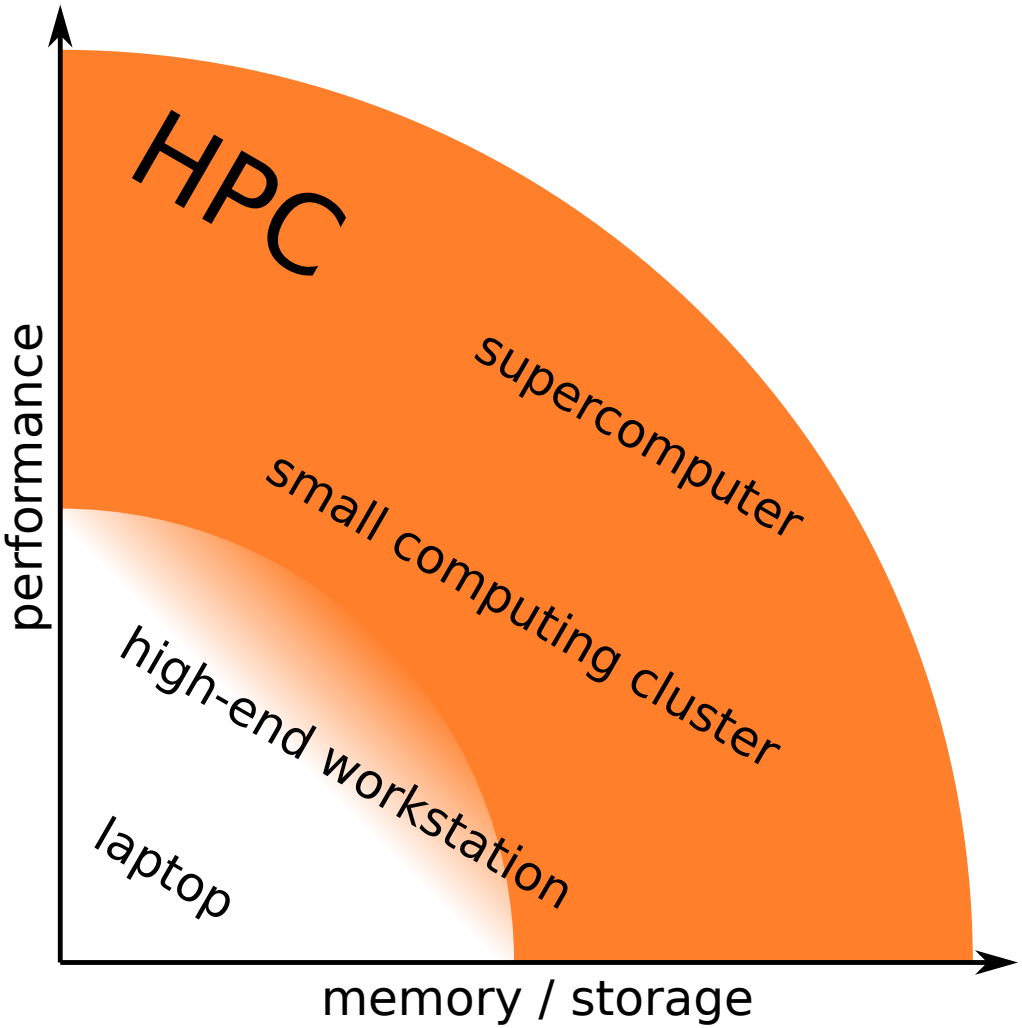

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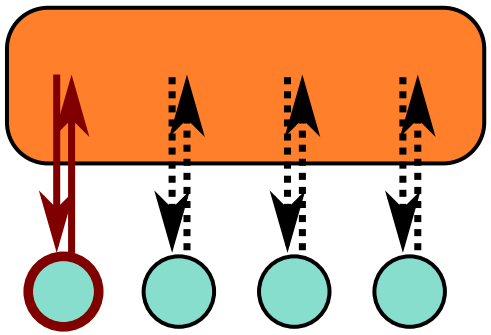

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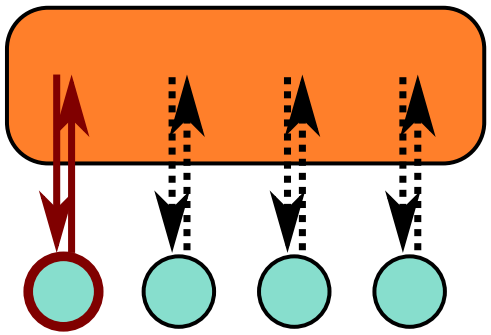

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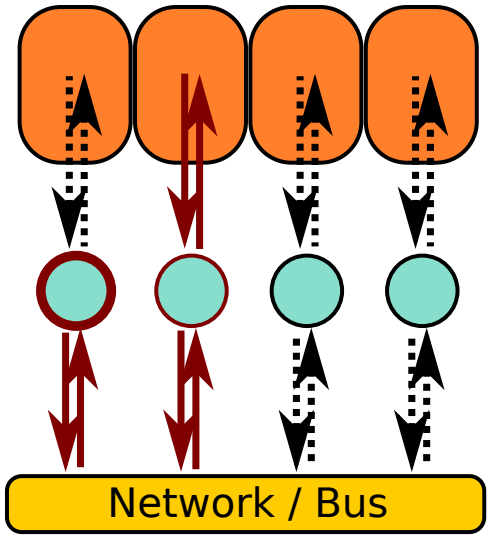
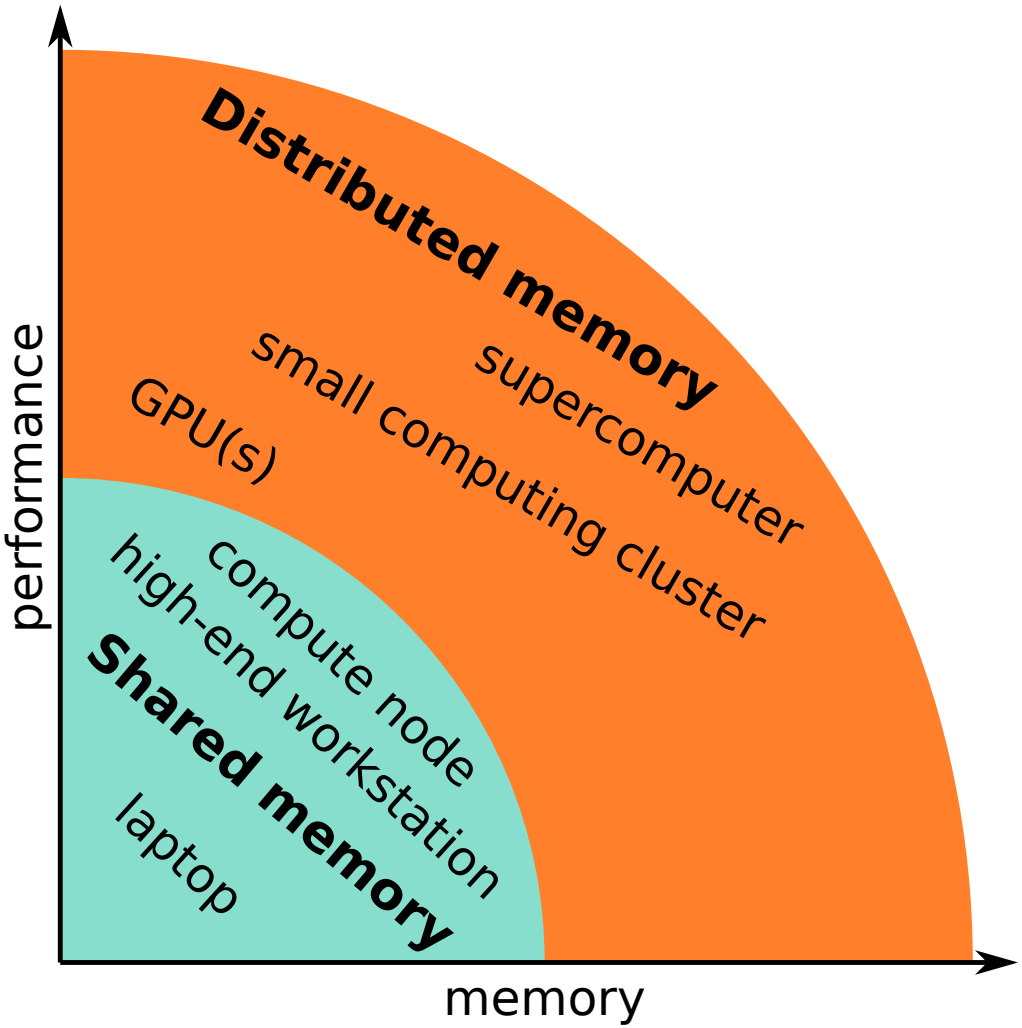
  - Distributed memory: Multiple **distinct** memory spaces.



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

High Performance Computing (memory models)



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  - **Data distribution across memory spaces and movement**

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- GPUs: MAGMA, TensorFlow, ...
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  - Allocate correct number of **cores and GPUs**, configure software to use correct number of **cores and GPUs**, ...

End (questions?)

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