Introduction to HPC2N, Kebnekaise and High Performance Computing

Mirko Myllykoski
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and others at HPC2N

Department of Computing Science and HPC2N
Umeå University

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UMEÅ UNIVERSITY

HPC2N

HPC2N (HPC2N at a glance)

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- Involved in several **projects and collaborations**
  - EGI, PRACE, EISCAT, eSSENCE, NOSEG, SNIC Science Cloud, NLAFET, ...

HPC2N (training and other services)

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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 support at HPC2N** (create a ticket, tier-3 and tier-4 tickets are forwarded to suitable application experts)

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
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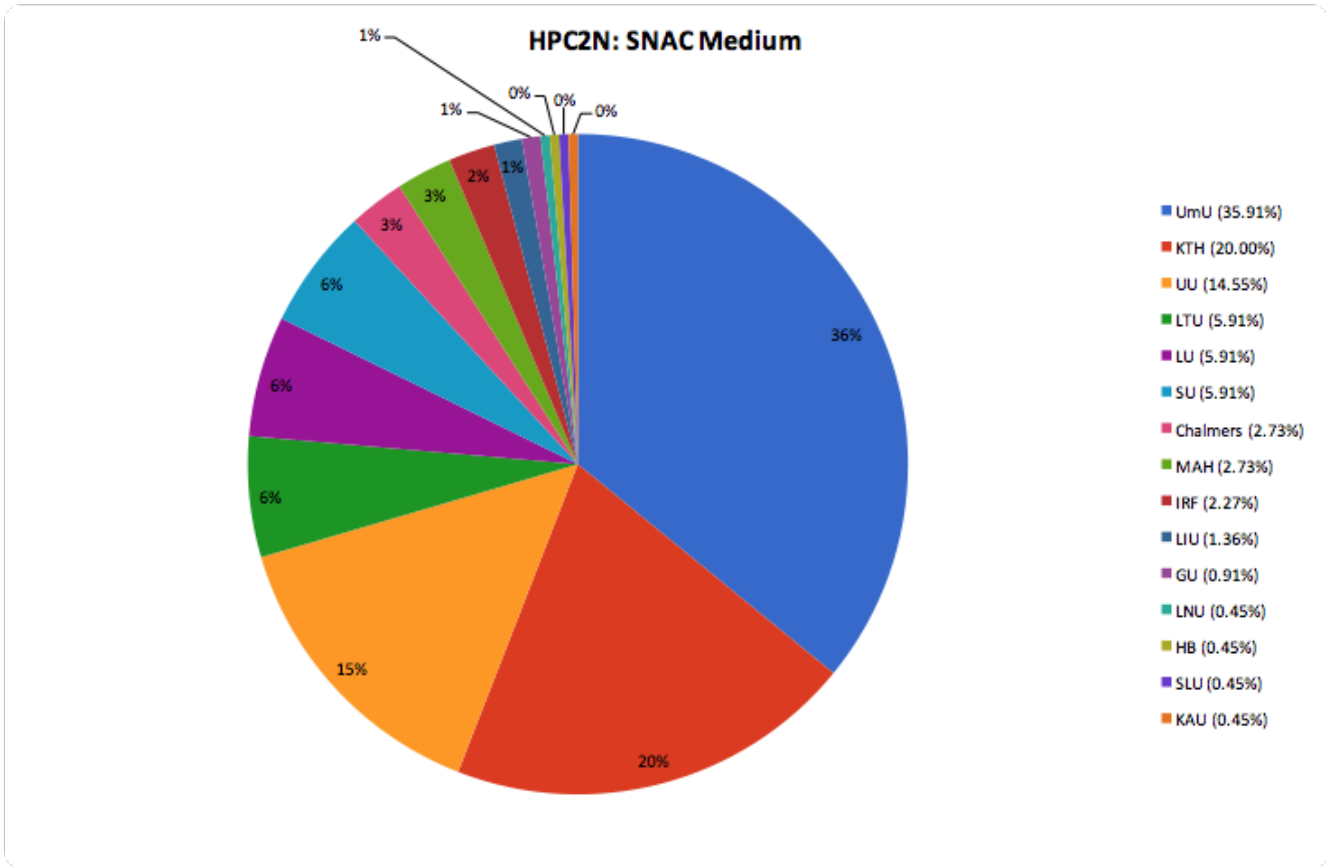
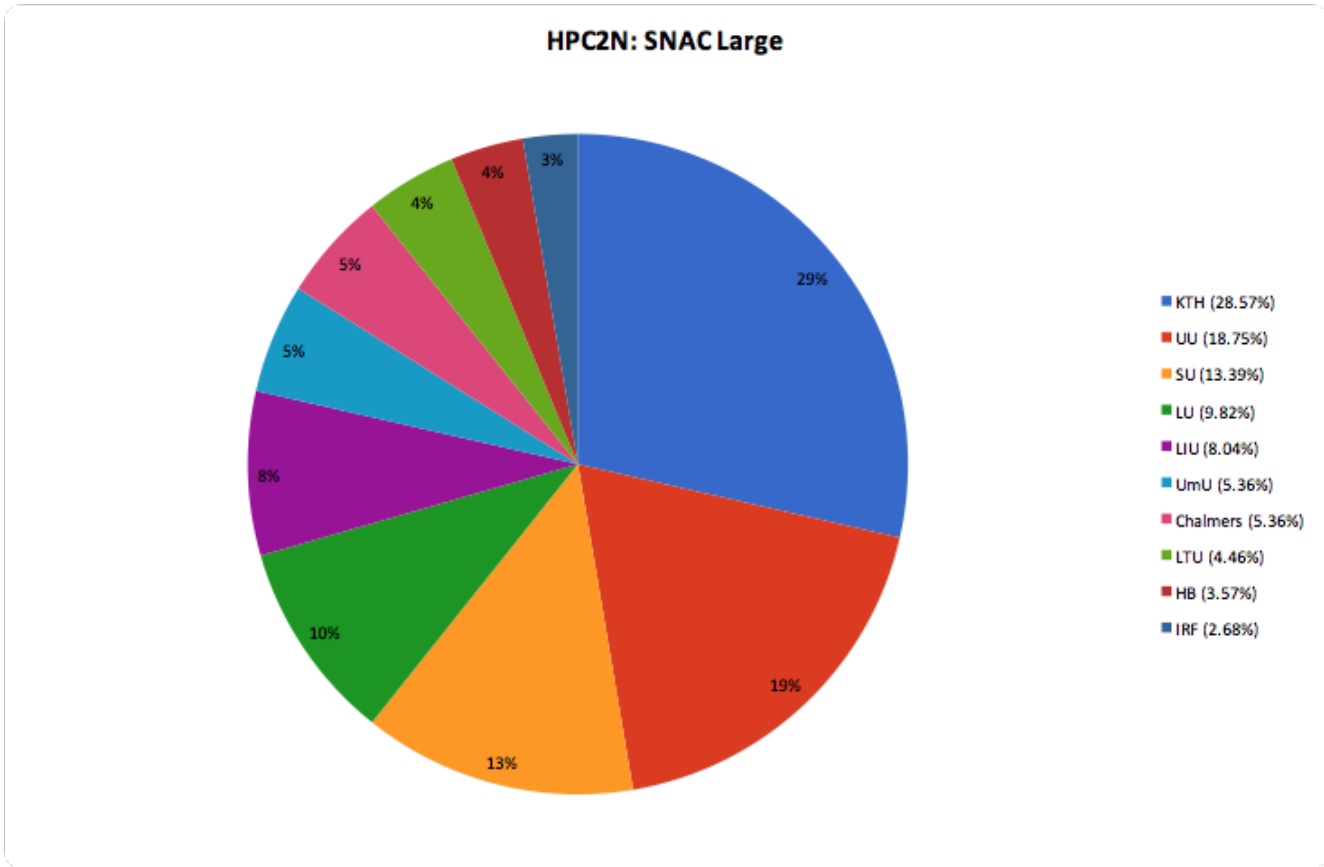
HPC2N (medium users by university)



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

HPC2N (large users by university)



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- In 2018, Kebnekaise was **extended** with
  - 52 Intel Xeon Gold 6132 (Skylake) nodes, as well as
  - 10 NVidian V100 (Volta) GPU nodes

Kebnekaise (compute nodes)

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KNL	36	Intel **Xeon Phi** 7250 (Knight's Landing), 68 cores, 192 GB, 16 GB MCDRAM, FDR Infiniband

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GPU-volta	10	Intel Xeon Gold 6132, 2 x 14 cores, 192 GB, EDR Infiniband, **2 x NVidia V100**, 2 x 5120 CUDA cores, 2 x 16 GB VRAM, **2 x 640 Tensor cores**

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  - 86% of Peak performance

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  - Per node local scratch space
    - about 170GB, SSD, only during the lifetime of the batch job

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/

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- **Solve large problems**
  - When does a problem become large enough for HPC?
  - Are there other reasons for using HPC resources?

High Performance Computing (large problems)

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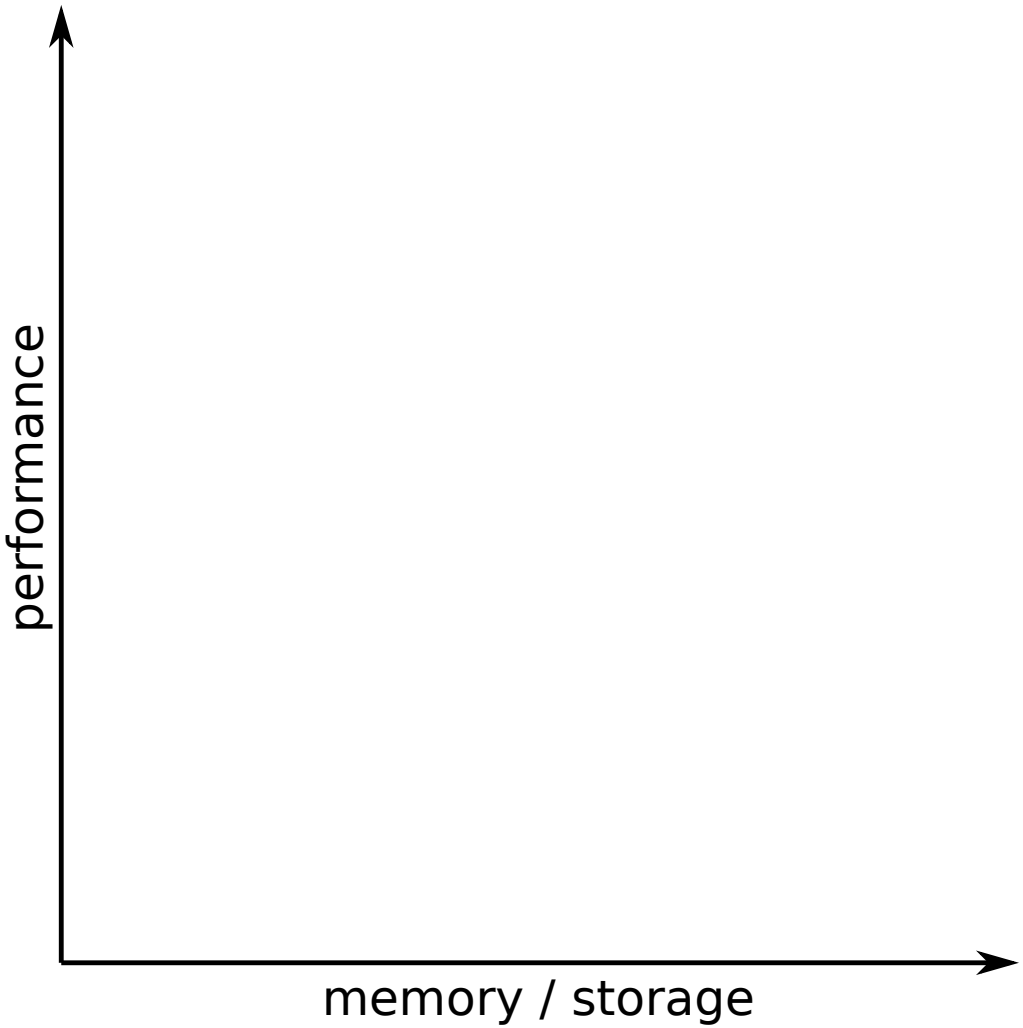
- The latter by **adding more memory / storage**
  - More memory per node (including large memory nodes), more nodes, ...
  - Large storage solutions, ...

High Performance Computing (what counts as HPC)



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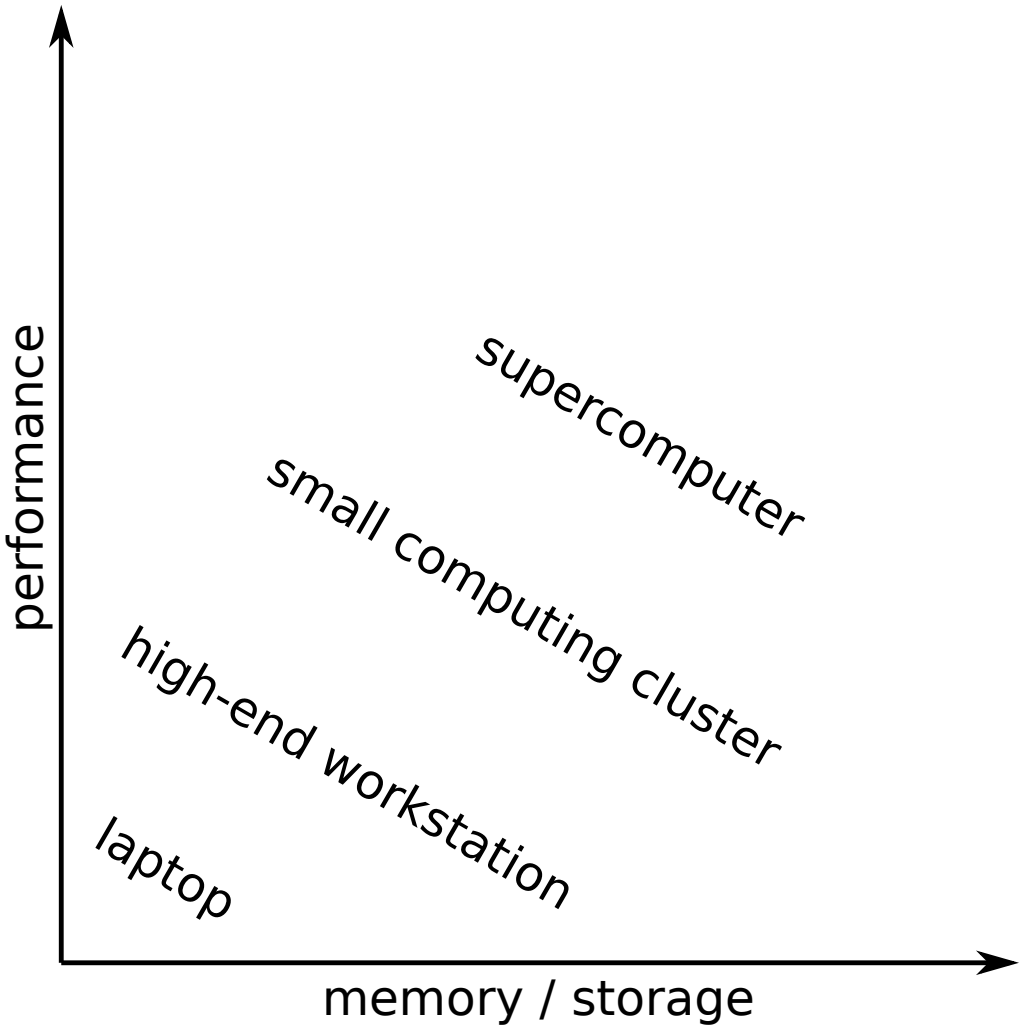

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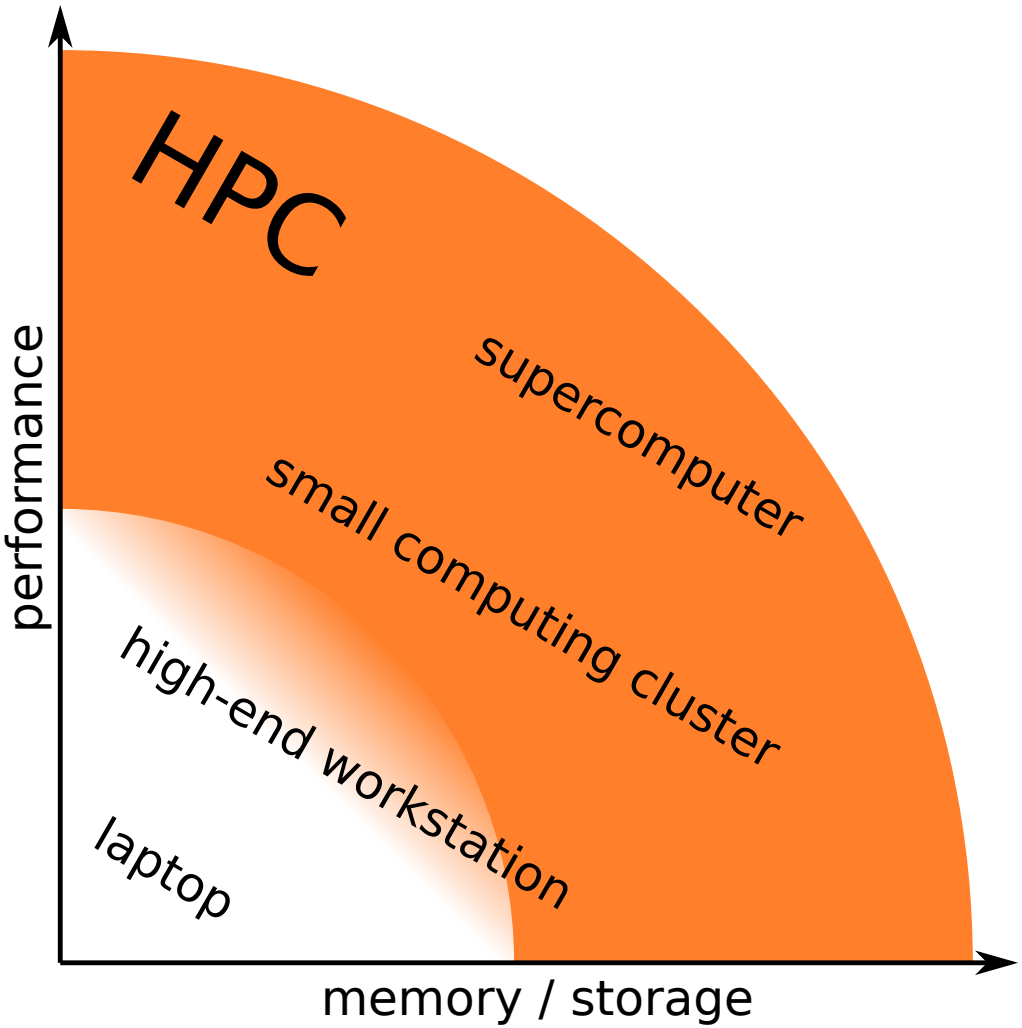

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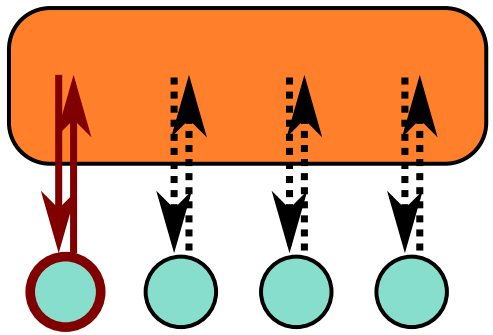

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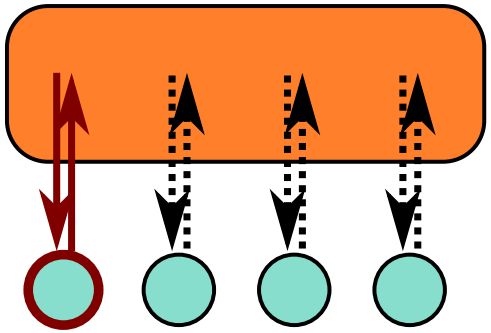

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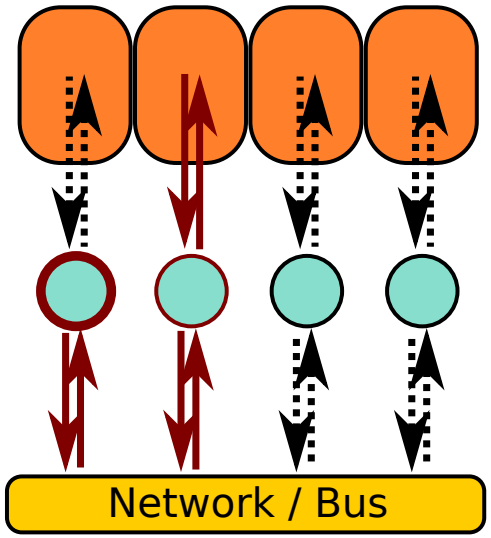
  - Distributed memory: Multiple **distinct** memory spaces.



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

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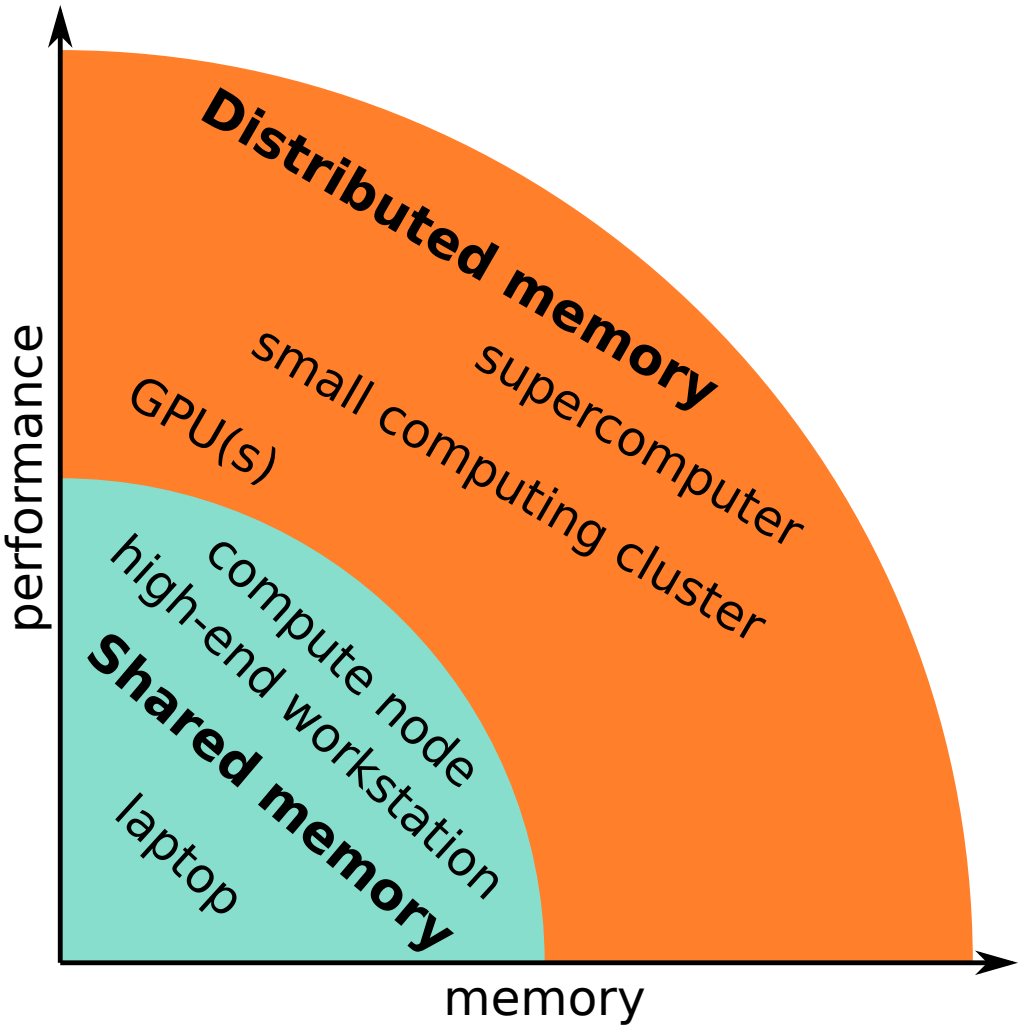

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     - **Data distribution and communication**

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- The programming model changes when we aim for extra performance and/or memory:
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  2. Multi-core: Vectorized Matlab, pthreads, **OpenMP**
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  3. Distributed memory: **MPI**, ...
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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, ...
  - Load correct toolchain etc
  - Allocate correct number of **cores and GPUs**, configure software to use correct number of **cores and GPUs**, ...

End (questions?)

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