Introduction to HPC2N, Kebnekaise and HPC

Birgitte Brydsö,
Pedro Ojeda May, and others at HPC2N

HPC2N
Umeå University

19. January 2022

HPC2N (HPC2N at a glance)

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- A part of **Swedish National Infrastructure for Computing (SNIC)**

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- 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 by **Swedish Research Council (VR)**, **SNIC** and various **partners**

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

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- Paolo Bientinesi, 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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[1] https://www.snic.se/support/dedicated-user-support/

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- Contact through regular support or dedicated support form[1]
  - If you have a specific problem/question and/or need consultation (up to 100 h)

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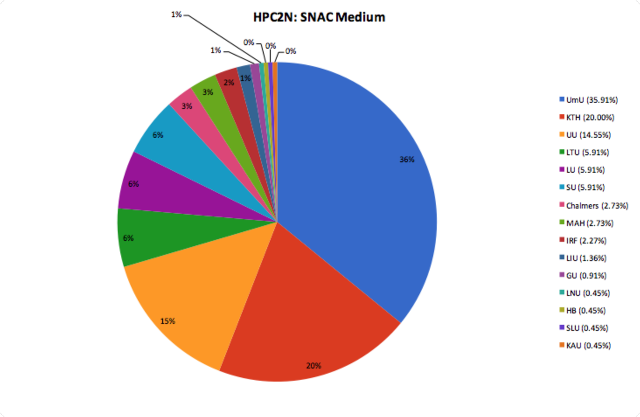
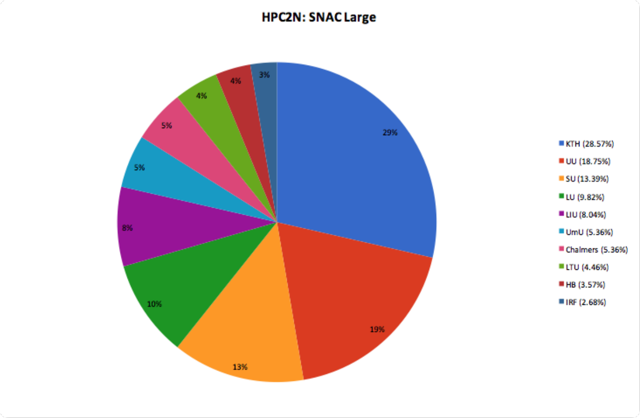
  - **Chemistry**
  - Computing science
  - Engineering
  - **Materials science**
  - Mathematics and statistics
  - **Physics including space physics**
  - Deep learning and artificial intelligence (several new projects)

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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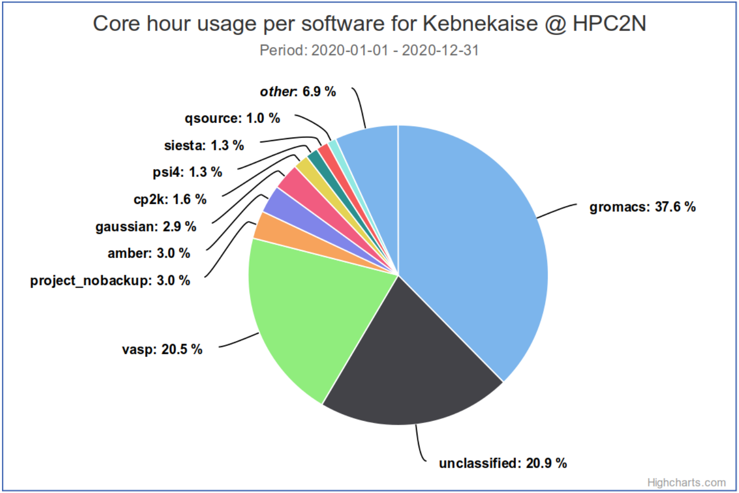
HPC2N (users by software)



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- Opened up for general availability on November 7, 2016
- 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**

Kebnekaise (in numbers)

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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 in to 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."[2]

[2] 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

[3] 728 trillion (billion)
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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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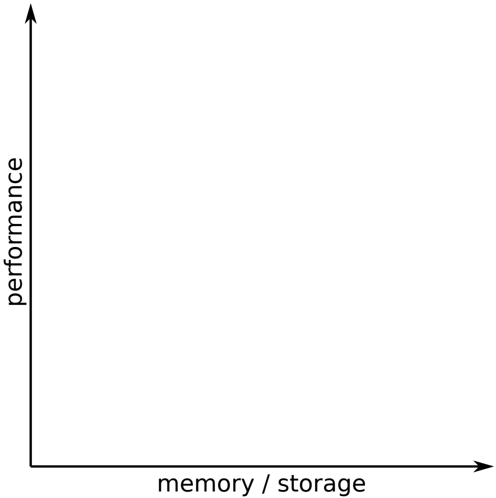
- The latter by **adding more memory / storage**
  - More memory per node (including large memory nodes), more nodes, ...
  - Large storage solutions, ...

High Performance Computing (what counts as HPC)



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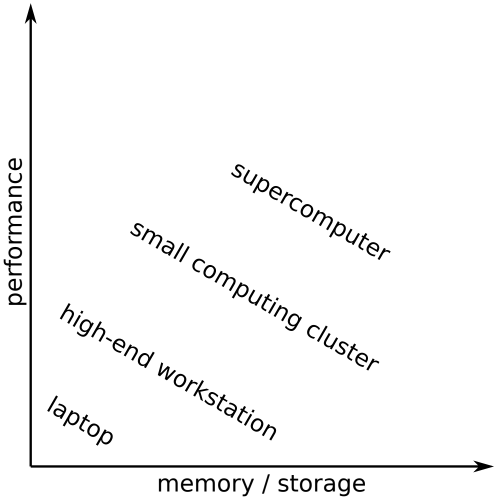

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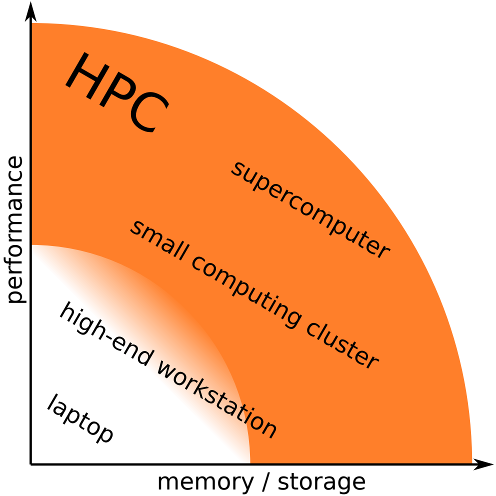

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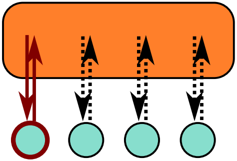

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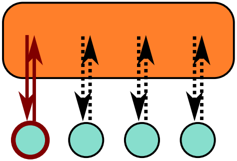

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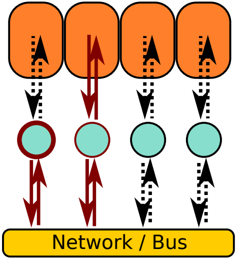
  - Distributed memory: Multiple **distinct** memory spaces.



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

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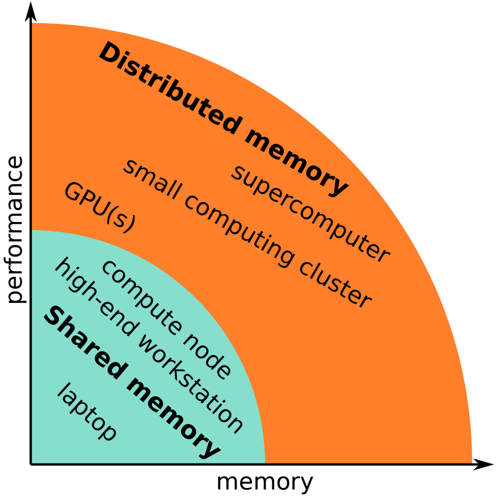

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  3. Distributed memory: **MPI**, ...
     - Multiple streams of operations
     - Work distribution, coordination (synchronization, etc), ...

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- The programming model changes when we aim for extra performance and/or memory:
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     - Single stream of operations
  2. Multi-core: Vectorized Matlab, pthreads, **OpenMP**
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  - **Data distribution across memory spaces and movement**

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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?)

Questions?