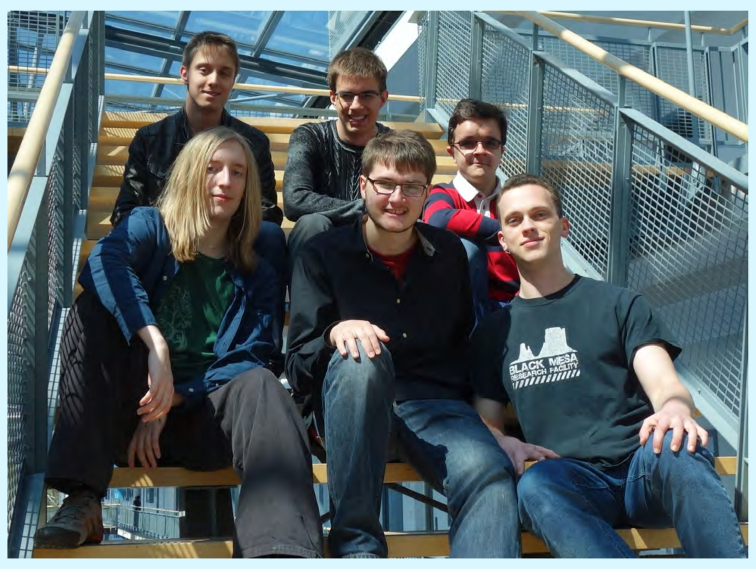
TUM PhiClub at SCC16

PhiClub at TUM

Our Team has a very competitve background with some team members taking part in competitions such as the North West European Regional Contest (NWERC) in programming, Tyrolean region athletics contests, or the physics Olympiads.



From left to right, Stefan Haas, David Schneller, Svilen Stefanov, Sharru Moeller, Maximilan Hornung, Jan Schuchardt

Taking a look at these competitions shows not only our dedication, but also our diverse set of skills. Some specialize in programming and the more practical aspects, others in the physicalities and theoretical aspects. Another team member also has some background in designing.

In addition we are a truely European team that does not only include German participants, but also members from Austria, Bulgaria, Denmark and Switzerland.

Technical University of Munich

The Technical University of Munich (TUM) is one of Europe's top universities. It is committed to excellence in research and teaching, interdisciplinary education and the active promotion of promising young scientists. The university also forges strong links with companies and scientific institutions across the world. Moreover, TUM regularly ranks among the best European universities in international rankings.

The Department of Informatics at TUM has a very close collaboration with the Leibniz Supercomputing Centre (LRZ). Hosting two of the fastest supercomputers on campus, researchers and students have excellent access to compute resources. Additionally, LRZ and TUM offer a great variety of training courses to prepare graduate and undergraduate students for modern supercomputers.

Hardware

PhiClub Cluster

7x Intel Xeon Phi 7290	72 cores @ 1.5GHz	1,715 Watt
DDR4 RAM	96GB	252 Watt
1x IntelR SSD DC S3500 Series	340GB	35 Watt
1x Intel Xeon Phi 7290	72 cores @ 1.5GHz	245 Watt
DDR4 RAM	192GB	72 Watt
2x IntelR SSD DC S3500 Series	2x 340GB	10 Watt
IIntelR Omni-Path Edge Switch 100 and Host Adapters		255 Watt
CommodityGigE switch		30 Watt
2x coolant system Koolance ERM-3K3U		180 Watt
	Total:	2814 Watt

Why choose this architecture?

This year's release of Intel's "Knights Landing" processors meant a significant leap forward in many different areas of supercomputing. The new processor is very energy efficient but still much more flexible than competitive hardware (e.g. GPUs). Keeping the system flexible enough and still getting the most performance per Watt is one of the challenges of the SCC.

Despite the low power consumption (TDP of 245 Watt), a single Xeon Phi can reach a theoretical peak performance of 3.45 TFLOPS due to the 72 cores and 512 bit vector instructions. Thus, our system should also be competitive in the Linpack benchmark.

As we will be facing at least two memory-intensive applications, ParaView and ParConnect, memory is of great importance. In addition to supporting up to 384GB of "far" memory per node, all Knights Landing processors include 16 GB of integrated MCDRAM, with a speed up-to 500 GB/s.

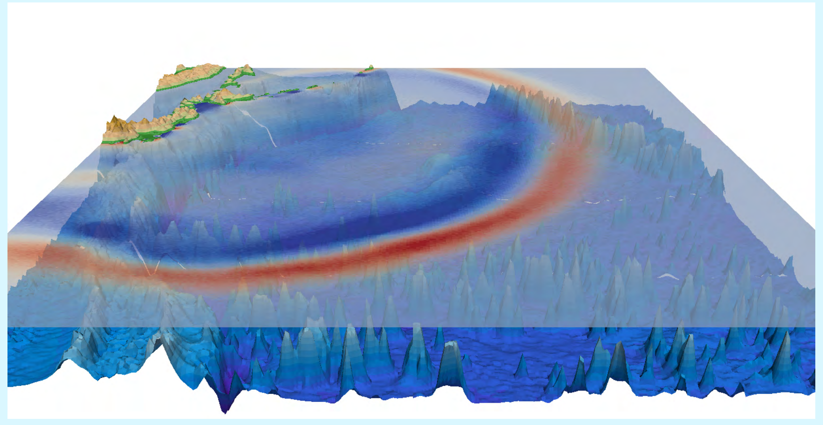
We choose Linux as an operating system since it is most used in HPC environments. As a compiler and MPI library we use the latest Intel tool stack (with GCC as fallback) as it is optimized for Knights Landing. To automatically schedule our jobs and avoid oversubscription, we use SLURM.

Preparation

At the beginning of our preparation phase ever team member had to choose at least two topics in which to specialize. These topics included of course the competition applications, but also things like scheduling or presentation.

The team members then prepared for their respective topics each, gaining highly specialized knowledge at first. However, for every topic the members had to give a talk transfering knowledge and preparing us for the team interview.

Furthermore, the Department of Informatics at TUM has many different lectures for HPC. At Bachelor level there are different seminars and practical courses, e.g. Tsunami Simulation or HPC algorithms and applications. Team members attended these programs to gain more knowledge in HPC.



ParaView visualization of of the 2011 Tohoku tsunami simulated with the Shallow Water Teaching code from the Tsunami lab course

In addition, our team met weekly to dicuss progress, problems or concerns both among the team members and our supervisors. These sessions usually took about two hours with some exception as for example a nine hour session one week prior to the competition.

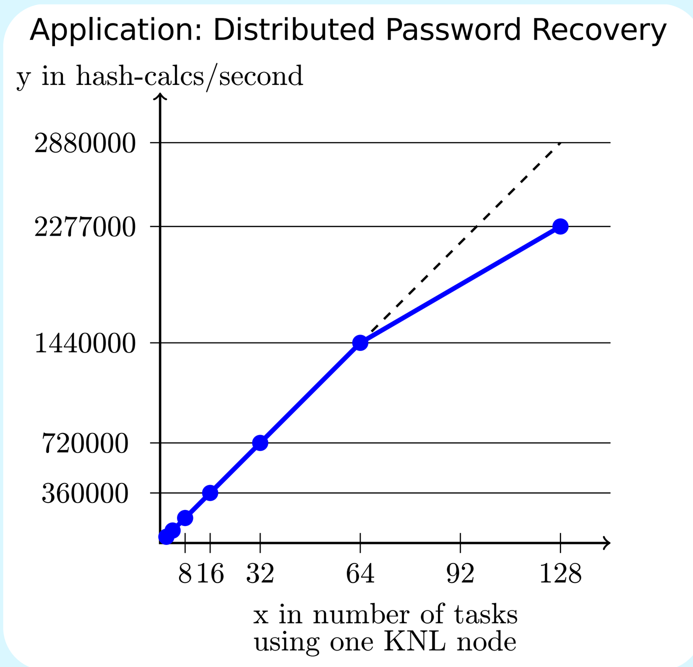
Strategy in Running and Optimizing the Applications

Optimizing applications differs from one to another. However, steps we did for every application included fine tuning parameters. How many cores, tasks and nodes do we use for a given input? Which compilers and libraries do we use for any given problem?

Further optimization was code specific in nature and optimized accordingly. For example, for the Distributed Password Recovery task a lot of freedom was granted. Choosing the optimal program and algorithm we went through several steps of evaluation between programs and approaches. We decided that John the ripper scales best and can crack many hashes very quickly. If a hash takes too long, it will be dropped and later on be cracked by either another algorithm or with another dictionary. This way we can crack many easy ones very fast and the hard ones later on.

When the competition starts, we will start with ParConnect. It already has clear instructions since we need to reproduce the results from the SC paper. In the mean time the rest of the team can focus on classifying their input data and choosing the any parameters accordingly.

We have prepared a script to distribute the password hashes of the password into small work packages in order to backfill empty nodes. Thus, we can fully utilize the cluster at any given time.



In order to measure power consumption, we did stress tests on our cluster. With Linpack our energy consumption was maximal and just below the power limit. To be prepared for the unexpected, we can dynamically reduce cpu-clock frequency in order to to reduce power consumption.

Why we will win

Even with our very competitive background in computer science and various other subjects, we always stay humorous, but also dedicated to our task. We laugh when something blows up and still keep on going. Keeping ourselves cool is key, and we completely share this mindset. But maybe more importantly we have our rules.

1. You do talk about PHIClub.
2. You do talk about PHIClub.
3. If the cluster combusts, the PHI is over (at least for us).
4. Only 3120 Watts to the PHIs.
5. 272 threads per PHI.
6. We PHI without GPUs and FPGAs.
7. The PHI goes on for 48h, no (second) longer, no shorter.
8. If this is your first night at PHIclub, you have to stay awake.