HPC Certification Program

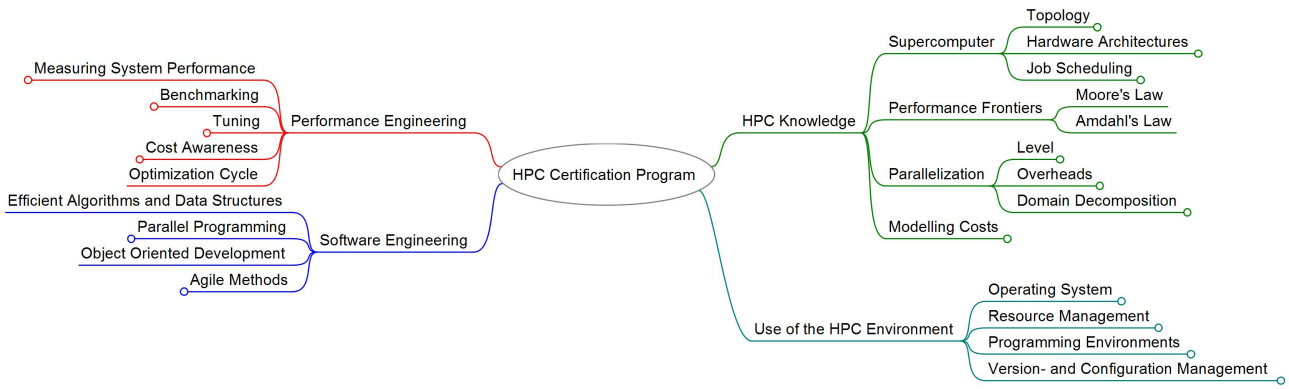
Contact:

HHCC Team
helpdesk.hhcc@uni-hamburg.de

www.hhcc.uni-hamburg.de

HPC Knowledge and Competences

The Hamburg HPC Competence Center (HHCC) will serve as an open-for-all education platform for HPC knowledge and competences. For that purpose we will establish a HPC Certification Program (we named it “HPC-Führerschein” in German) by providing basic and advanced HPC skills as online content. In the course of the project, we plan to bundle teaching material required to master the various certification levels and organize standardized online examinations for participants to acquire the certificates. This way a user can gain those custom-tailored HPC-skills which are required for the HPC environment he would like to use or the parallel application he would like to speed up. A further benefit exists for the compute centers: a certified user, able to exploit the full potential of a HPC system and being aware of utilizing the expensive HPC resources appropriately, will reduce their operating costs.
The online examinations to gain the HPC certificates will be multiple-choice tests. For each skill and level, a pool of questions will be developed, of which a subset is selected for each individual examination. Once the test is completed, the system will automatically assess the results and create a PDF with the certificate. At the beginning, we will manually approve the test results.
We are currently working on the classification of the HPC competences and have initially identified four major topics for the HPC Certification Program as “HPC Knowledge”, “Use of the HPC Environment”, “Performance Engineering”, and “Software Engineering”.



Tree of the Top Level Competences

The tree is the basis to easily create different views of the content. As an example, the table below shows how the content can be categorized to enable the learner to master a certain skill level. In the example used for the table the skills are based on one another. For example, the HPC knowledge provided to be able to develop a parallel program requires the knowledge of both lower levels.

The current project planning schedules the development of the HPC Certification Program by November 2017. In addition, we plan to start creating the workshop material in July 2017.

Skill Levels	HPC Knowledge	Use of the HPC Environment	Performance Engineering	Software Engineering
Run Parallel Programs	Shared Memory and Distributed Systems, Job Scheduling, File Systems, Network Bandwidth and Latency, Moore's Law, Amdahl's Law	Linux Command Line, Shell Scripts, Environment Selection (e.g. via modules load ...), Workload Manager	Measuring System Performance, Benchmarking (using 1, 2, 4, 8, 16, ... cores), Tuning via Runtime Options (e.g. for MPI and OpenMP)	Automated Testing
Build Parallel Programs (e.g. via Open Source Packages)	SMP-, NUMA-, GPU-, Many Core-Architectures, Hybrid Approaches (e.g. CPU + GPU), Domain Decomposition, Load Balancing	Programming Environments (Compilers, Libraries, Linker, ...)	Package Options, Optimized Libraries, Process Mapping to Nodes, CPU Pinning, Compiler Options, Profile Guided Optimization	Computational Complexity, Portability for Job Scripts
Develop Parallel Programs	Pipelining, Vectorization, CPU-, Cache-, Memory-, I/O-, Communication-Bounds, Overheads for Communication, Synchronization, and Redundant Computations, Multi Level Approaches (e.g. OpenMP + MPI)	Programming Environments (Debugger, IDEs), Version- and Configuration Management-Tools	Profiling, Detecting Performance Bottlenecks, Tuning via Reprogramming (e.g. using Functional Units (Fused-Multiply-Add)) Vectorization, SIMD, GPUs, More Efficient Algorithms	Test-Driven Development, Object Oriented Development, Communication Pattern, Blocking and Non-Blocking I/O, Domain Decomposition Pattern

Content Categorization for Three Skill Levels

Collaboration

We welcome your comments on the analysis and classification of HPC competences and their value for scientists or any other input for the HPC Certification Program.
Feel free to write to `helpdesk.hhcc@uni-hamburg.de`.

You can also subscribe to our mailinglist to get all news about the HPC Certification Program under www.hhcc.uni-hamburg.de → Certification → subscribe to our mailinglist.

Performance Conscious HPC (PeCoH)

This effort is part of the joint PeCoH project, in which we focus on raising the user awareness for performance engineering. In April 2017 the three Hamburg compute centers involved in PeCoH, German Climate Computing Center (DKRZ), Regional Computing Center at the Universität Hamburg (RRZ), and Computer Center at the Technische Universität Hamburg (TUHH RZ) started the Hamburg HPC Competence Center (HHCC) as a virtual institution and central contact point for their HPC users.

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