The **Erlangen National High Performance Computing Center** (NHR@FAU) is looking for a

Master thesis student for

Performance Analysis of the SPEChpc 2021 Benchmark Suite

The thesis will be supervised by and conducted in the Research division at NHR@FAU, led by Prof. Dr. Harald Köstler.

Description

SPEChpc is a collection of parallel benchmark programs from science and engineering that are representative of high performance computing (HPC) workloads and are portable across CPU and accelerators, along with certain fair comparative performance metrics. Application benchmarking is a crucial activity on supercomputers, since it provides a realistic measure of the capability of such systems for real-world application programs. However, benchmarking is more than just measuring execution time, performance, and scalability: It is about getting thorough insight into how these numbers come about. To do this, a meticulous measurement strategy and a rigorous scientific process is required.
In this thesis you will develop a thorough understanding of the SPEChpc benchmark suite via careful benchmarking and performance analysis on massively parallel computers. You will identify the prevalent performance bottlenecks in the different SPEChpc benchmarks and develop suggestions for performance improvement. These skills will be invaluable if you strive for a career with any significant HPC component.

Within the master thesis, the focus will be in the following areas:

- Getting familiar with the benchmarks from the SPEChpc suite with a focus on MPI and hybrid MPI/OpenMP versions
- Definition of a sustainable benchmarking strategy (selection of problem sizes, parallelism, compiler/library environment, performance metrics,…)
- Running the benchmarks on NHR@FAU's 5-Petaflop Top500-class "Fritz" supercomputer
- Identification of computational and execution bottlenecks for each benchmark using performance models and state-of-the-art performance analysis tools
- Identification and implementation of performance optimization opportunities

Working on these topics, you will have the chance to work with **state-of-the-art supercomputing technology** in a scientific environment. We foster **scientific thinking** and proper **data presentation skills**.

Required skills

- Profound knowledge of C/C++ and/or Fortran
- Knowledge of high-performance parallel computer architecture and of code parallelization with MPI and OpenMP (as taught, e.g., in the lecture "Programming Techniques for Supercomputers")
- Knowledge of basic performance modeling strategies (e.g., Roofline)
- Excellent communication skills in English and/or German

Please direct any inquiries or applications to

Jan Laukemann <jan.laukemann@fau.de>
Georg Hager <georg.hager@fau.de>
Gerhard Wellein <gerhard.wellein@fau.de>