



The **High Performance Computing Group at Erlangen Regional Computing Center (HPC@RRZE)** is looking for a

## Master thesis student for the development of performance models for distributed-memory parallel programs

The thesis will be supervised by the HPC group at Erlangen Regional Computing Center, which is led by Prof. Dr. Gerhard Wellein (Department of Computer Science, FAU).

### Tasks

Our group has considerable expertise in analytic performance modeling. An analytic model is a simplified description of the interaction between a program code and the hardware. This description leads to a prediction of runtime or performance, and it can also be used to identify bottlenecks and promising optimization opportunities. The most widely known model of this sort is the Roofline model. In our group we have developed the Execution-Cache-Memory (ECM) model, which can yield more accurate predictions than Roofline in many cases. Both are applicable to the node level only. We are looking to expand this modeling approach towards distributed-memory parallel programs running on supercomputers.

This is a research project. The student will start with simple “toy programs” that show a predictable and reproducible behavior in order to study the interplay of communication overhead and node-level performance bottlenecks in MPI and hybrid MPI+OpenMP programs. The goal is to develop insight into typical patterns that emerge in highly parallel programs and to discover the reason why naïve modeling approaches tend to be rather inaccurate. The work will not require the development of a tool or of a lot of new code but rather a well-structured approach to performance experiments that stands up to scientific scrutiny.

### Required prior knowledge

- Student of (computational) engineering or computer science
- Profound knowledge of code parallelization with MPI and OpenMP (as taught, e.g., in the lecture “Programming Techniques for Supercomputers” and several other lectures)
- Profound knowledge of the Roofline model and how to apply it for predictive modeling
- Profound knowledge of C or C++ and at least one modern scripting language
- Must be able to work efficiently with the Linux OS
- Very good German or/and English language skills
- Interest in conducting well-documented and reproducible experiments as a prerequisite for scientific analysis

**Please direct any inquiries or applications to**

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