

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

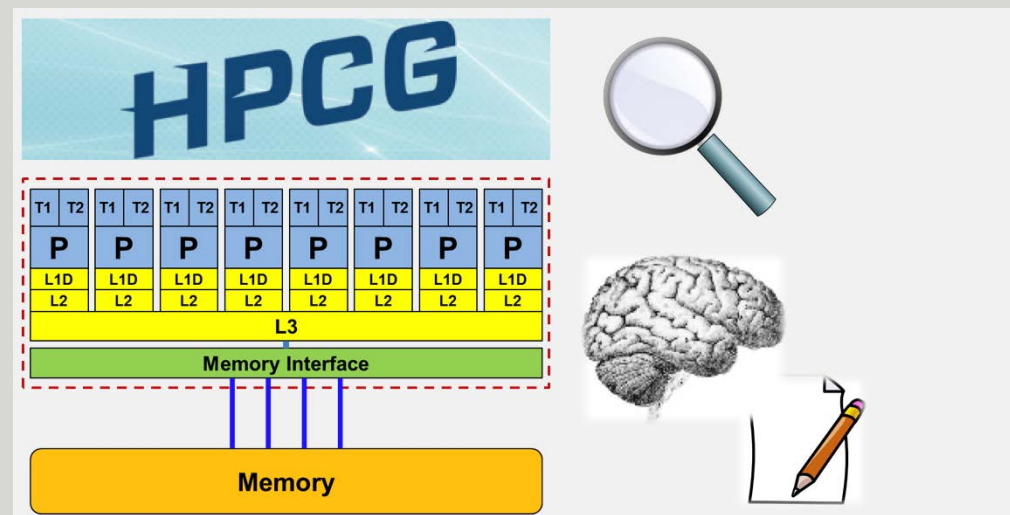
## Master thesis student for

# Unveiling the tricks and optimizations of HPCG benchmark using performance analysis

The thesis will be hosted and supervised by the research division at Erlangen National High Performance Computing Center (NHR@FAU), which is led by Prof. Dr. Gerhard Wellein (Department of Computer Science, FAU).

### Tasks

**HPCG (High Performance Conjugate Gradient)** is a benchmark used to rank the world's most powerful supercomputers (<https://www.hpcg-benchmark.org>). The benchmark solves a linear equation system using a multigrid preconditioned conjugate-gradient algorithm. There exist various implementations of the benchmark, each which uses certain tricks and optimizations that are mostly undisclosed. The aim of this thesis is to unveil these optimizations using a thorough performance analysis.



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

- Getting familiar with the HPCG benchmark and the numerics behind it
- Understanding the challenges posed by the benchmark and common strategies used to solve them
- Explore various implementations of the benchmark for CPUs and/or vector accelerators
- Performance analysis using data traffic analysis and simple roofline model
- Relate the performance model with measurements to explain plausible optimization strategies

### Required skills:

- Student of computational engineering or computer science
- Good understanding of roofline performance model
- Basic knowledge on numerical linear algebra
- Profound knowledge of C/C++ and the Linux OS
- Good knowledge of code parallelization with OpenMP
- And most important: interest and a detective mindset 😊

### Please direct any inquiries or applications to

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