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HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES
fbi
FACHBEREICH INFORMATIK

Modulbeschreibung

High Performance Computing

Module numbers:	41.5078 [PVL 41.5079; Module 41.50780]
Language:	english
Study programme:	Dualer Master 2021 - Katalog AS: Anwendungs- und systemorientierte Module Master 2021 - Katalog AS: Anwendungs- und systemorientierte Module Dualer Master 2013 - Katalog AS: Anwendungs- und systemorientierte Module Master 2013 - Katalog AS: Anwendungs- und systemorientierte Module MN Data Science 2022/2016 - Katalog DS-I: Data Science - Informatik
Type of course:	V+P = Lecture+Practical
Weekly hours:	2+2
Credit Points:	6
Exam:	written exam
PVL (e.g. Practical):	graded
PVL percentage:	33%
Required knowledge:	Programming experience (e.g. C, C++, Python, Go, Rust, etc.).
Learning objectives:	Students are able to first plan, then build and then analyze the performance of High Performance Computing (HPC) systems. More precisely, they are able to: • analyze problems and algorithms to discover inherent parallelism, • find the appropriate granularity for a given problem, i.e. choose between fine-grained and coarser grained implementations, • use shared memory (multithreaded), message passing and hybrid approaches, • use, and choose between, currently available tools (programming languages, libraries, etc.), • apply best practice design patterns and methods, • measure and analyze the performance and scalability of HPC implementations.
Content:	• Performance - Where it is needed, why it is needed, how to measure and analyze it. • Models of parallel computation • theoretical models such as PRAM and Dataflow Graphs • architectural models e.g. SIMD, MIMD, SPMD • Methods and patterns for parallel system design • The shared memory paradigm, both explicitly with multi-threaded programming and with compiler assistance via OpenMP. • The message passing paradigm with MPI and/or modern MOM approaches (e.g. ZeroMQ). • Heterogeneous Hardware approaches, particularly with GPUs (Graphics Processing Units), using various techniques, e.g. OpenCL or OpenACC.
Literature:	Main Text • T. G. Mattson, B. A. Sanders & B. L. Massingill, Patterns for Parallel Programming, Addison-Wesley (Pearson Education), 2005. Also helpful: • Clay Breshears, The Art of Concurrency, O Reilly Media Inc, 2009. • Ian Foster, Designing and Building Parallel Programs, Addison-Wesley Publishing, 1995. Cf. http://www.mcs.anl.gov/~itf/dbpp/ • Brendan Gregg, Systems Performance: Enterprise and the Cloud, 2nd Edition, Pearson, 2020.
Responsibility:	Ronald Moore
Professional competencies:	• formal, algorithmic, mathematical competencies: medium • analytical, design and implementation competencies: high • technological competencies: high • capability for scientific work: medium
Interdisciplinary competencies:	• project related competencies: low • interdisciplinary expertise: basic technical and natural scientific competence • social and self-competencies: ability to work in a team, analytical competence, deciding competence, competence of knowledge acquisition, presentational, documentary, teaching and mentoring competence, fluency