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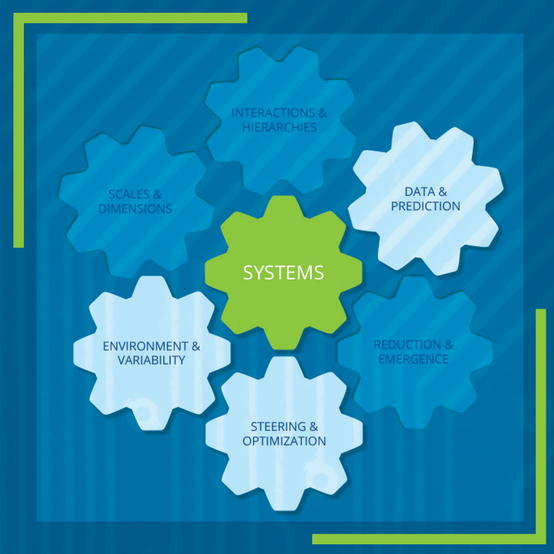
Matter under Extreme Conditions

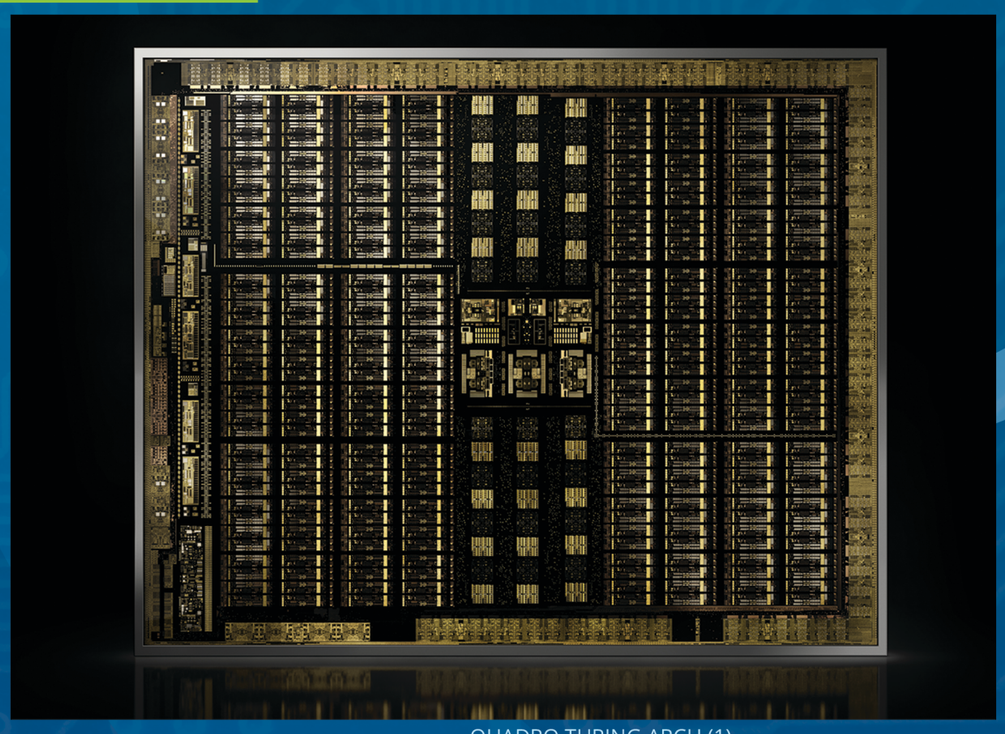
CASUS
CENTER FOR ADVANCED SYSTEMS UNDERSTANDING



THE ROAD TO EXASCALE

GOAL

Exascale is the next big step in the field of high-performance computing. However, the hardware configurations of supercomputers around the world are becoming increasingly heterogeneous. Programmers have to take into account varying processor architectures (x86, ARM, RISC-V, ...) as well as different accelerator types (multicore CPUs, GPUs, FPGAs, ...) and the accompanying tools. Our goal is a portable stack of C++ libraries and tools. Together they shall form an ecosystem which abstracts away the differences between hardware configurations without sacrificing performance.



QUADRO TURING ARCH (1)

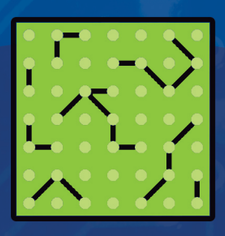
CHALLENGES

The main challenge is to find a way to easily express the problem in a way that is as abstract and user-friendly as possible. These expressions then need to be transformed into increasingly hardware-aware algorithms and data structures as they are passed down the software stack to the lower levels. Additionally, we need to provide performance analysis of the individual layers both at runtime and after a program execution.

JUWELS CLUSTER (2)

METHOD

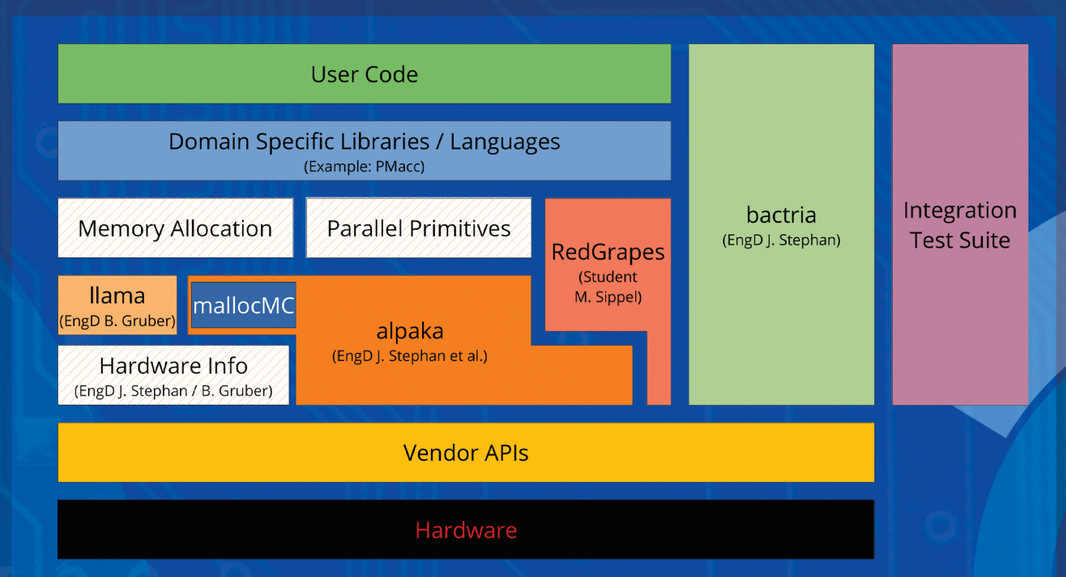
Our work uses classical approaches found in high-performance computing, a newly designed API for performance analysis and (prospectively) set theory methods.



BIG DATA

SIMULATIONS

HIGH-PERFORMANCE COMPUTING (HPC)



FUTURE APPLICATION

Our work will provide scientists from various fields of research with an Exascale-ready and user-friendly ecosystem which they can easily use for developing portable high-performance applications. In addition, our performance analysis API will enable users to gain in-depth knowledge about their programs' behaviour - both offline and in real time.

CROSS-DISCIPLINARY

Our work is not restricted to a specific field of science. The results will be applicable across science disciplines which rely on Exascale supercomputing.