

Introduction to High Performance Computation

COSC6365

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This course provides an introduction to High-Performance Computation (HPC), an essential tool in many sciences, engineering and increasingly also in medicine, the humanities, and the entertainment industry. HPC today implies parallel computation and in many cases employs high-performance networking technologies. In HPC there is a great emphasis on achieving high efficiency in resource utilization for applications, something that often requires a good understanding of the application, the processor, node and platform architecture, and compilers, operating systems and programming tools.

This course focuses on the architecture of scalable computing environments and algorithms for scientific and engineering problem solving in such environments. The course is suitable for scientists and engineers with computationally demanding problems, and computer scientists and applied mathematicians with an interest in techniques for efficient use of platforms suitable for large scale computations.

The course gives an overview of high performance computer architectures, scalable environments and Grid computation. Parallel programming paradigms will be covered, with an emphasis on MPI, possibly OpenMP as well depending on student background. Basic algorithms for matrix operations, the solution of linear systems of equations, sorting, the Fast Fourier Transform and other common operations will be taught.

Reducing the need for data motion through proper data allocation and management of the data motion is critical for performance. User level techniques for managing memory hierarchies will be discussed, and tools for performance analysis will be covered briefly.

Scalable platforms will be used for homework and projects.