

## Mth 410/510: High-Performance Computing

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**Office Hours:** 10:30-11:30 MW. Also by appointment.

**Class Time and Location:** MWR 09:00-09:50, NH 385

**Final Examination:** Tuesday Dec 08, 08:00-09:50, in class.

**Course web site:** Syllabus, class assignments, and other information about the course will be available on the web site: <http://www.mth.pdx.edu/~daescu/hpc.html>

Students are responsible for checking this site on a regular basis.

**Course Description:** This course provides the fundamentals of high performance computing (HPC) in applied mathematics and a hands-on experience in implementing numerical algorithms on distributed memory systems. Basic theory and concepts of parallel programming will be introduced and applied to design HPC algorithms using the message passing interface (MPI) libraries. Access to a modern Linux cluster equipped with Intel quad-core Xeon-dual processor computing nodes<sup>1</sup> will facilitate the implementation of algorithms and analysis of their numerical efficiency. After successful completion of the course, students will be able to design parallel algorithms related to a variety of research areas and to assess the performance of their implementation.

**Topics:** Overview of parallel computing architectures, design of parallel algorithms for distributed memory systems using MPI, performance analysis. Design and implementation of parallel numerical algorithms selected from: quadrature methods for numerical integration, matrix operations, solution to linear systems using Gaussian elimination and iterative methods, red-black Gauss-Seidel, numerical solution to partial differential equations, operator splitting and domain decomposition methods, Fast Fourier Transform. Examples and case studies of computationally intensive problems in applied sciences.

**Recommended Prerequisites:** Knowledge of linear algebra (Mth 261), Numerical Calculus (Mth 451/551 sequence) and a high-level programming language such as Fortran, C, Matlab.

**Textbook:** PARALLEL PROGRAMMING WITH MPI, by P.S. Pacheco. Morgan Kaufmann Publishers, 1997.

**Grading Policy:** The final grade will be based on homework assignments (60%) and a final project (40%). Homework assignments will be given once every couple of weeks. Each student is required to complete a final project involving the use of parallel numerical algorithms. The final project can be done individually or in teams of two. A report must be submitted prior to the final exam date and an oral presentation will take place during the last week of the term. In assigning final course grades, plus/minus grading will be used. Main criteria for evaluating your work will be: correctness, completeness, and *clarity* of the work presentation.

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<sup>1</sup>Funding to purchase the computing resources was provided by 2006 Intel Faculty Fellowship Program