Math 596, Fall 2016

High Performance Computing For Applied Mathematics

Instructor: Dr. Bo-Wen Shen

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COURSE INFORMATION

Class Days: TTh.
Class Times: 12:30-13:45
Class Location: GMCS-422

Dr. Bo-Wen Shen:
Office Hours Times (and by appointment): 15:30-17:00
Office Hours Location: GMCS 596

Course Overview

Course Contents:

- Symbolic computing for applied mathematics (e.g., derivatives and integrals for multivariate functions);
- Programming languages (e.g., Python*);
- Numerical packages (e.g., Lapack) for applied mathematics (e.g., linear algebra, differential equations);
- Multi-tasking on Unix systems using Python* (e.g., Raspberry PI and a new cluster running Ubuntu);
- High performance computing and parallel computing using Python*;
- *During the lectures, discussions will be made mainly using Python. Examples for parallel computing using various languages will be provided and briefly introduced. For homework, students may choose their preferred computing language(s) such as C/C++, Fortran, Java and high-level script languages (e.g., Python, Matlab, R, or Julia).

Student Learning Outcomes:

1. Applying various high-performance computing skills to solving scientific problems accurately and efficiently (e.g., reducing time to solutions);
2. Learning plotting (matplotlib) and visualization (e.g., paraview) packages for data analysis;
3. Building up the concept of cloud computing for Big data analysis through parallel computing (optional);
4. Understanding the potential role of high-performance computing in advanced courses (such as PDEs, advanced parallel computing with compiled languages, cloud computing and/or Big data sciences).

Relation to Other Courses: Students may further take advanced courses such as numerical analysis, partial differential equations (PDEs), computational PDEs, applied Fourier transform, advanced calculus, scientific computing and advanced scientific computing etc.

Enrollment Information

Prerequisites: Math 252 (multivariable calculus) with minimum grade of C. Knowledge of linear algebra and differential equations (e.g., Math337) or consent of instructor. Understanding and knowledge in one of the following programing languages such as C/C++, Fortran, Java, Python, Matlab, R, or Julia. Students with special requests may take this course subject to approval by the instructor of the course.

Course Materials

- Langtangen, H. P., 2016: A Primer on Scientific Programming with Python. Springer-Verlag Berlin Heidelberg. 914pp.
- Hager G. and G. Wellein, 2010: Introduction to High Performance Computing for Scientists and Engineers. CRC Press.
- A Python Introduction to Parallel Programming with MPI: http://materials.jeremybejarano.com/MPIwithPython/index.html

References

- Dowd T., K. and C. Severance, 1998: High-performance computing. O'Reilly. 446pp.