Math 596, Fall 2016

High Performance Computing For

Applied Mathematics

Instructor: Dr. Bo-Wen Shen

email: sdsu.math596.shen@gmail.com

URL: http://bwshen.sdsu.edu

Course Overview

Course Descriptions:

In the era of Big Data, enabled by rapidly-changing technologies, effective learning of applied mathematics and high-performance computing is crucial for solving scientific problems accurately and efficiently. Math 596 provides the opportunity of learning modern computing and numerical technologies (e.g., computing languages, numerical packages/methods and parallel computing) and applying them to solving mathematical problems in engineering or science fields. Examples include simulations and visualizations of flows in 1D wave equation, 2D or 3D flows.

Course Contents:

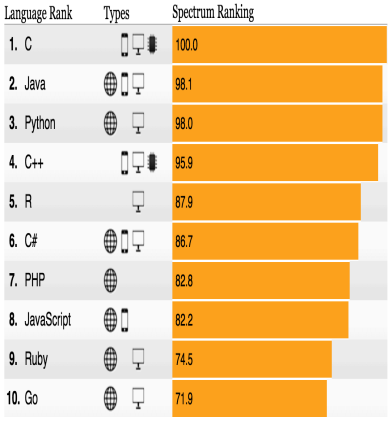
- Symbolic computing for applied mathematics (e.g., derivatives and integrals for multivariate functions);
- Programming languages (e.g., Python*);
- Numerical packages (e.g., Lapack) for applied mathematics (e.g., linear algebra, differential equations);
- Multi-tasking and multithreading using Python (e.g., Raspberry PI and a new cluster running Ubuntu);
- High performance computing and parallel computing using Python.
- *Examples in the Lectures will be discussed mainly using Python. Supplemental 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:

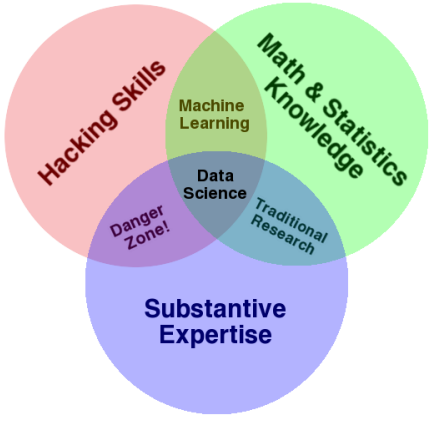
1. Applying various high-performance computing skills to solving scientific problems accurately and efficiently (e.g., reducing time to solutions);
2. Learning plotting (matplotlib) and visualization (e.g., paraview) packages for data analysis;
3. Building up the concept of cloud computing for Big data 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).

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: C/C++, Fortran, Java, Python, Matlab, R, or Julia.



The top Programming Languages 2016 (Diakopoulos and Cass, 2016). *Python is among the top computing languages.*



Drew Conway's Venn diagram of data science. *Effective learning of applied math and computing/hacking skills is crucial for obtaining solutions effectively and efficiently.*

Python Facts:

- Python is an open-source, high-level, OOP scripting languages;
- Python Is a widely used, general-purpose, interpreted language;
- Python is similar to MATLAB;
- Python is recommended by the Raspberry Pi Foundation.

Python is often used for

- symbolic computation,
- scientific computing and plotting,
- multi-tasking (i.e., fork),
- multi-threading,
- network programming (TCP/IP, IPC),
- MPI parallel computing,
- web development, and
- game programming.