Course Syllabus
High Performance Computing I
CE620/CSE547/MAE609/MTH667/PHY515
Fall 2014

M. D. Jones, Ph.D.

1 Brief Overview

This course will introduce students to High Performance Computing (HPC) in the context of Computational Science and Engineering (CSEG), and will focus on parallel programming in both basic (a few processing cores, e.g., in a typical multi-core computer) and advanced (thousands of processing elements, e.g., in the most advanced distributed computing systems) usage. We will also cover HPC architectures, operating environments, compilers, performance tuning, and libraries, all in the context of their relevance to scientific computing. Students who enroll in this course should have a working knowledge of at least one standard high-level programming language (e.g. `Fortran`, `C`, or `C++`).

2 Text & Other Course Materials

Online Text *Introduction to High-Performance Scientific Computing* by Victor Eijkhout with Edmond Chow and Robert van de Geijn, available online (also contains a link to where you can purchase a paperback version) at:
`http://www.tacc.utexas.edu/~eijkhout/istc/istc.html`

Online Resources: I will be posting a wide variety of reading materials on the course web site in addition to the class notes.

Computing: Students will use the HPC facilities at UB's Center for Computational Research (CCR) for parallel programming-related course work.

3 Grades

Final grades will be based primarily on class projects (40%), and homework assignments (the lowest homework score will be neglected and the remaining used for 40% of the final grade). A midterm exam will account for the remainder (20%) of the final grade.

4 Homework & Projects

Homework and project assignments will be given throughout the course, and will be due on the assigned date. Late submissions will not be accepted.

5 Exams

There will be a short midterm exam, tentatively scheduled for in-class in the latter half of the semester.

6 Lectures

Lectures are scheduled for Tuesday/Thursday from 0930-1050 in 146 Park Hall on the North Campus. I will archive as much of the lecture material as possible on the course website at `ublearns.buffalo.edu`.

7 Topics Covered

The goal is to give you a solid background in harnessing cutting-edge high-performance computing techniques to solve novel problems in your field (be it Physics, Chemistry, Engineering, Mathematics, etc.). To that end, we will cover the following topics:

- HPC Historical Development, Processors & Networks, Languages
- Code Management (Makefiles, CVS, Subversion)
- Debugging, Performance Tuning
- Parallel Programming Landscape, particularly MPI and OpenMP
- Sorting, Optimization
- Numerical Methods for Partial Differential Equations
- Fast Fourier, Monte Carlo, and Particle (N-body) Methods

and roughly the schedule will break down as follows, with the matching material from Eijkhout's book:

Week 1	08/26,08/28	Parallel computing background	Eijkhout, Ch. 1
Week 2	09/02,09/04	CCR Cluster Computing	Eijkhout, Ch. 2, App. 18-19
Week 3	09/09,09/11	CCR Cluster Computing, APIs	Eijkhout, Ch. 2, App. 18-19
Week 4	09/16,09/18	MPI, OpenMP	Eijkhout, Ch. 2, App. 18-19
Week 5	09/23,09/25	Fortran, Debugging	Eijkhout, Ch. 2, App. 25-27
Week 6	09/30,10/02	Scripting, Make	Eijkhout, Ch. 2, App. 18,20
Week 7	10/07,10/09	Floating Point, Eclipse IDE	Eijkhout, Ch. 3
Week 8	10/14,10/16	Profiling, Linear Algebra	Eijkhout, Ch. 5-6, App. 23.2
Week 9	10/21,10/23	PDEs	Eijkhout, Ch. 4, App. 23.1
Week 10	10/28,10/30	Parallel I/O, GPUs	Eijkhout, App. 22, Ch. 2.9
Week 11	11/04,11/06	Midterm review, Midterm	
Week 12	11/11,11/13	Nbody Methods, Monte Carlo Methods	Eijkhout, Ch. 7, 11
Week 13	11/18, 11/20	SC14 (no class)	
Week 14	11/25	Fourier Methods	Eijkhout, Ch. 7.3
Week 15	12/02,12/04	Sorting, Optimization	Eijkhout, Ch. 8

Note that `MATLAB in parallel` training will be offered separately, currently scheduled for 9/25/14 1300-1500 in Jarvis 223. There will also be a general `MATLAB` training session by Mathworks on 9/18/14 1330-1600 in Furnas 206.

8 Contact Information

EMail:	`jonesm@ccr.buffalo.edu`
Office:	B1-110, CoEBLS (701 S. Ellicott)
Phone:	881-8958
Office Hours:	Tuesday after class (1100-1200) in 107 Bell Hall or by appointment (we can easily meet outside the regular office hour)

9 Standard Disclaimer

This syllabus is subject to change at the discretion of the instructor.