Advanced Scientific Computing – ACMS40212 / 60212

Course Summary

This course covers fundamental material necessary for using high performance computing in science and engineering. There is a special emphasis on algorithm development, computer implementation, and the application of these methods to specific problems in science and engineering.

Prerequisites – ACMS 40390
Books –

1. **Discovering Modern C++: An Intensive Course for Scientists, Engineers, and Programmers**, by Peter Gottschling. 2016.
2. **Introduction to Parallel Computing**, by Grama, Gupta, Karypis, Kumar. Second edition, 2003.
3. Modern C++ Design
4. Structured Parallel Programming
5. Effective C++, and his others.

Time and place – M W F - 9:25A - 10:15A, Pasquerilla Center 102.
Instructor – Dani Brake. Office 146 Hayes-Healey. dbrake@nd.edu
Office hours – Mondays 12-1, Wednesdays 3-4, and by appointment. Subject to revision and suggestion.

Grade

Homework	500
Final project	500
Total	1000

Homework – Assigned periodically, and turned in by Sakai. Points scaled to 500. **No late submissions accepted.**

Final project – A term project, which will allow you to more deeply explore some facets of computing which interests you. Components will include a proposal, peer-reviewed drafts, final writeup, a final presentation, and the deliverable itself, including documentation, style, and functionality.

Letter grade – Will be assigned on the percentage of points you earned, out of the total available, with a scale no more stringent than the typical ND 90-80-70 scale, including canonical ± cutoffs.

Policies

Attendance – You are expected to attend every lecture. If you must miss a lecture, it is your responsibility to obtain notes from a reliable classmate.

Honor code – As a member of the Notre Dame community, I will not tolerate academic dishonesty. All components of this course are conducted under the Honor Code. You are encouraged to work together on the homework assignments and projects, but copying in any form or submitting work done by others as your own is a violation of the Honor Code.

Late work – **Late work is not accepted**, except for pre-arranged university excused absences.

Detailed and *Hopeful* Course Schedule

This will be tuned based on the first week of class, and student interests.

week	topic	chapters	notes
1	Intro. CRC usage. C++ refresher. Build systems. Memory and smart pointers.	Disc. 1.8	First meeting Jan 18
2	Templates. Generic programming.	Disc. 3	
3	Lambdas. Metaprogramming.	Disc. 3, 5	
4	Expression templates.	Disc. 5	
5	Catch up, reflection time		
6	Parallel computing patterns	Para. 3	
7	Message passing parallelism – MPI. Communicators & topology	Para. 4, 6	
8			
	Mar 11-19 – Spring Break		
9	Parallel algorithms for implementing direct and iterative methods for solving system of linear equations		
10	MPI		
11	Shared-memory parallelism – OpenMP	Para. 7	
12	OpenMP		
	easter break April 14-17		
13	Graph algorithms	Para. 10	
14	OpenACC	Online	
15	Other topics – non-OpenMP threading, etc		
	Final Time, Thursday, May 11, 8-10 am (as of 12/12/2016)		Presentations, Project due

If there are topics which you would like to cover in particular depth, or what you want to learn isn't on this topic list, please ask! You can help determine the focus of the class!