CS 540 – High Performance Computing
Spring 2017
Course Syllabus

Instructor: Prof. Rene German (german@chapman.edu)
Time and Place: TTh 4:00 - 5:15pm LLB B16
Office Hours: Mon/Wed. 10am-12pm **and by appointment, Becket Building 211**

Overview: This course covers the basic concepts and techniques needed for problem solving using parallel computing. It will introduce the students to high-performance computer architectures, their taxonomies, and performance issues. The design and analysis of parallel algorithms will be covered. Techniques for data and workload partitioning for parallel execution will be discussed. It will also introduce parallel programming models and contemporary parallel programming techniques including message passing and shared memory. Cluster, grid, GPU and cloud computing will also be introduced.

Prerequisites: CS 510 is a strict prerequisite for the course.

Units: CS 540 is a 3 unit course.

Required Text: *The CUDA Handbook: A Comprehensive Guide to GPU Programming*, by Nicholas Wilt. Addison-Wesley Professional, 2013.

Course materials: All course materials will be made available via the course site on Blackboard when possible. Blackboard will also be used for submitting assignments, viewing grades, etc.

Homework, Exams, and Grading (subject to change):
Homework will consist of programming assignments (i.e. mini projects) to reinforce material covered in lecture, and must be submitted electronically. All programs must be written in C/Cuda C++/pyCuda unless otherwise specified.

Deadlines, Grace Periods, and Policy on Late Work

All work must be submitted prior to the deadline.

A short grace period past the deadline permits late submission without penalty. Late submissions after the grace period are subject to penalties as explained in the next paragraph.

Late submissions beyond the grace period can be arranged but scores are downgraded depending on the delay. Reduction of 10% is applied to every day for which the submission has been delayed beyond the grace period. For a late submission, students must come to the instructor's office, preferably during office hours.

Major Topics Covered

- Parallel computing overview
- Computing in Unix and C
- Shared memory computing with OpenMP [multicore and GPU]
- Performance
- Message passing computing with MPI
- GPU processing with CUDA
- Data-intensive computing with Hadoop

Performance Evaluation

There will also be the usual midterm and final, which must be taken on the dates specified. In the case of a well-documented, unavoidable conflict, I will do my best to accommodate you.

Mini-project assignments will count for 30% of the course grade, the midterm for 30%, and the final for 40%.

Attendance

Students are expected to attend classes.

Note: To receive a passing grade in the course you must receive a passing grade (>60%) in every component (assignments, quizzes, exams) of the course.

Collaboration Policy:
You have much to learn from your colleagues, and so I encourage you to discuss and study course material together. It is also permissible for students to work in groups of *at most* 2 when completing programming assignments, unless otherwise specified. However, all work you submit for this course must be your own. More specifically, you may not present source code or programs copied from the Internet, other texts, other students, etc as your own work. Of course, you are free to use whatever *reference* materials you like, but please cite them in a README turned in with your assignments. I assume you are familiar with Chapman's policy on academic misconduct…any incidents of academic misconduct will be dealt with severely in accordance with this policy.

Course Learning Objectives:

1. Students will understand parallel computing architectures and parallel programming models
2. Students will be able to develop parallel applications using message passing, shared memory, GPGPU, and cloud computing techniques
3. Students will understand how to measure, analyze, and improve parallel performance

Program Learning Objectives:

1. Graduates will be able to apply the principles of computational science to scientific problems. Students will develop critical thinking, end to end problem-solving, and data analysis skills. With these skills, they will be able to: collect, process and analyze data; prioritize different potential solutions to a problem; and use advanced mathematics and computing to solve scientific problems.
2. Graduates will be able to apply principles of computer technology and computer science to scientific problems. In particular, they will be able to: use advanced high performance computer architectures including clusters and supercomputers. Create programs to manipulate and analyze data on HPC systems; construct solutions to scientific problems using advanced parallel algorithms and data structures; and analyze the performance of algorithms.

Equity and Diversity:
Chapman University is committed to ensuring equality and valuing diversity. Students and professors are reminded to show respect at all times as outlined in Chapman's Harassment and Discrimination Policy: http://tinyurl.com/CUHarassment-Discrimination. Any violations of this policy should be discussed with the professor, the Dean of Students and/or otherwise reported in accordance with this policy.

Chapman University's Academic Integrity Policy*:*
"Chapman University is a community of scholars that emphasizes the mutual responsibility of all members to seek knowledge honestly and in good faith. Students are responsible for doing their own work and academic dishonesty of any kind will be subject to sanction by the instructor/administrator and referral to the university Academic Integrity Committee, which may impose additional sanctions including expulsion. Please see the full description of Chapman University's policy on Academic Integrity at www.chapman.edu/academics/academicintegrity/index.aspx."

Chapman University's Students with Disabilities Policy
"In compliance with ADA guidelines, students who have any condition, either permanent or temporary, that might affect their ability to perform in this class are encouraged to contact the Disability Services Office. If you will need to utilize your approved accommodations in this class, please follow the proper notification procedure for informing your professor(s). This notification process must occur more than a week before any accommodation can be utilized. Please contact Disability Services at (714) 516–4520 or visit www.chapman.edu/students/student-health-services/disability-services if you have questions regarding this procedure or for information or to make an appointment to discuss and/or request potential accommodations based on documentation of your disability. Once formal approval of your need for an accommodation has been granted, you are encouraged to talk with your professor(s) about your accommodation options. The granting of any accommodation will not be retroactive and cannot jeopardize the academic standards or integrity of the course."