CSCI 176: PARALLEL PROCESSING
Spring 2017

COURSE SYLLABUS

Course Description (*revised from catalog)***:**
Characteristics and classification of parallel computer systems. Parallel computation/programming models and related issues. Study of parallel algorithms, program development, performance analysis. Shared memory and massage passing parallel programming on multicore and clustered systems. Other HPC methodologies will be covered depending upon time.

Prerequisites: CSCI 113 (Intro. Computer Organization),
CSCI 144 (Intro. Operating Systems)

Units: 3

Lectures: T, Th 2:00 pm – 3:15 pm, McF 208

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Office hours: M, T 3:30 – 5:00 pm
Th 3:30 – 4:30 pm, or by appointment
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Required Textbook:
- Peter Pacheco, *An Introduction to Parallel Programming,* Morgan Kaufmann, 2011 (ISBN: 978-0-12-374260-5)

Reference books:
- Tomas Rauber & Gudula Runger, *Parallel Programming – for Multicore and Cluster Systems,* 2nd Edition, Springer, 2013 (ISBN: 978-3-642-37800-3)
- Gerassimos Barlas, *Multicore and GPU Programming: An Integrated Approach*, Morgan Kaufmann, 2015 (ISBN: 978-0-12-417137-4)

Course Goals and Expected Learning Outcomes:
This course provides computer science undergraduate students essential knowledge in parallel computing/processing. At the completion of this course students will be able to:

1) demonstrate an understanding of parallel computation models/systems and related issues;
2) demonstrate an understanding of communication/synchronization among parallel computation modules;
3) develop/implement parallel algorithms and problem solving methodologies;
4) write parallel programs for target parallel computer systems.

Assignments:
There will be frequent problem solving and programming assignments during the semester. Programming assignments cover the following paradigms: Unix pipe, Pthread, Java Threads, OpenMP, MPI, etc. All work must be done individually. Violating this will result in an assignment grade of zero and possible academic dishonesty penalties. Assignments are due at the beginning of the class on the due date. No late assignments are acceptable.

Term project and report:
Each student is required to find a real-world problem, which needs high-performance computation, and design/implement the parallel solution by using either message-passing or shared-memory parallel programming, as well as other methodologies, e.g., GPU, FPGA, etc.

The problem to be attacked should be serious enough for developing parallel/high-performance solution. Each student is required to present the project work at the end of semester and submit a comprehensive report.

Evaluation:

Midterm-1 25%, date will be announced in advance
Midterm-2 25%, date will be announced in advance
Final exam 30%, May 18 (Th), 3;30 pm – 5:30 pm
Assignments and term project 20%

Grading scale: [100%, 90%] A, (90%, 80%] B, (80%, 70%] C, (70%, 60%] D, otherwise F
Note: no make-up exams, except emergency cases verified with official documents

Participation:

Attending classes is very important. It is not guaranteed that a student can succeed in this course without attending classes regularly.

University Policies:

Students with Disabilities

Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the Henry Madden Library, Room 1202 (278-2811).

Honor Code

"Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities." You should:

a) understand or seek clarification about expectations for academic integrity in this course (including no cheating, plagiarism and inappropriate collaboration)
b) neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.
c) take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Instructors may require students to sign a statement at the end of all exams and assignments that "I have done my own work and have neither given nor received unauthorized assistance on this work." If you are going to use this statement, include it here.

Cheating and Plagiarism

"Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Computers

"At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a

modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior

"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live . . . Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

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Tentative course schedule (subject to change with prior notice)

Class	Date	Topics	Reading
week1	1/17, 19	Parallel computing/processing concepts, issues	Ch1 & reference materials
week2	1/24, 26	Parallel systems/architectures	Ch2 & ref. book Ch2
week3	1/31, 2/2	Parallel systems/architectures more	Ch2 & ref. book Ch2
week4	2/7, 9	Vector and SIMD processing	Ch2 & ref. book Ch2
week5	2/14, 16	Interconnection Networks and routing	Ch2 & ref. book Ch2
week6	2/21, 23	Parallel computation/programming models, issues	Ch2 & ref. book Ch3
week7	2/28, 3/2	Memory consistency models, cache coherence	ref. book Ch2
week8	3/7, 9	Shared-memory programming with Pthread/Java Thread	Ch4 & ref. book Ch6
week9	3/14, 16	Shared-memory programming with OpenMP	Ch5 & ref. book Ch6
week10	3/21, 23	Message-passing programming with MPI	Ch3 & ref. book Ch5
week11	3/28, 30	Parallel algorithms and performance analysis	Ch6 & ref. book Ch8
week12	4/4, 6	Parallel algorithms and performance analysis more	Ch6 & ref. book Ch8
week13	4/18, 20	Other HPC techniques, GPGPU with CUDA	ref. book Ch7
week14	4/25, 27	Student project discussion and presentations	
week15	5/2, 4	Student project presentations	
week16	5/9	Review and summary	