CS 415/615: Parallel Computing
3 credits (Lecture 3 + Lab 0)
Spring 2020

Last Modified: 1/17/2020

Instructor: Dr. Frederick C Harris, Jr.
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- Office: SEM 240A
- Office hours: T,R: 11:00am-11:50am

Class webpage: https://www.cse.unr.edu/~fredh/class/415/current/415.php

Teaching Assistant:
- TBD

Lectures:
- Tuesday, Thursday: 9:00am-10:15am, DMS 102

Labs: *none*

Important Notes and Dates:
- **Final Exam:** Tuesday May 12 7:30am-9:30am
- **Holidays:** T Mar 17, R Mar 19 (Spring Break)

Required Textbooks:
- *none*

Supplemental Books:
- *Parallel Programming* (2nd Ed.) by Wilkinson and Allen—Prentice Hall.
- *Parallel Programming with MPI* by Peter Pacheco—Morgan Kaufman

Course Description:
   Catalog:
   Parallel Algorithms and Architectures. Taxonomy of systems, SIMD, MIMD, systolic arrays. Parallel languages and programming paradigms. Applications using a multiple processor parallel network.

Prerequisites:
   Courses:
- CS 302 (Data Structures) with a C or better (C- does not meet this criteria).
- Math 182 (Calculus II)

Topics:
- a good working knowledge of data structures. You will need to know how to implement these data structures in C or C++.
- This course will also draw on knowledge of 2D and 3D geometry of vectors and coordinate systems, and on the use of matrix algebra for coordinate transformations.

Requirement or Elective:
- This course is a technical elective for the BS CSE Program.

Course Objective:
Students will demonstrate an understanding of concepts, algorithms, and design principles underlying parallel computing, develop algorithm design and implementation skills, and gain practical experience in programming large scale parallel machines

Student Learning Outcomes (SLO's) and Course Outcomes:
- The course outcomes are skills and abilities students should have acquired by the end of the course. These outcomes determine how the general CSE Student Learning Outcomes apply specifically to this course. All CSE Student Learning Outcomes are listed in the next subsection and those relevant to this course are identified in the following Table.

CSE Student Learning Outcomes	Course Outcomes	Assessment Methods/Metrics
1	Students demonstrate they can define and apply parallel computing to a variety of applications in Mathematics and Engineering.	Explain the usage of parallel computing and write a program that uses parallel computing.
2	Students will have an ability to assess a problem presented to them, design a solution, and test their implementation.	Design and write a parallel program to solve specific problems.

Undergraduate Student Learning Outcomes:

Our graduates will have an ability to:
1. Identify, formulate, analyze, and solve complex computing or engineering problems by applying principles of computing, engineering, science, and mathematics.
2. Design, implement, and evaluate a computing or engineering solution to meet a given set of requirements, with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively in a variety of professional contexts, with a range of audiences.

4. Recognize professional responsibilities and make informed judgments in engineering and computing practice based on legal and ethical principles, considering the impact of solutions in global, economic, environmental, and societal contexts.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline, creating a collaborative and inclusive environment, establishing goals, planning tasks, and meeting objectives.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.
7. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
8. Acquire and apply new knowledge as needed, using appropriate learning strategies.

CSE Graduate Student Learning Outcomes:
(a) An ability to apply engineering and computer science research and theory to advance the art, science, and practice of the discipline.
(b) An ability to design and conduct experiments as well as to analyze, interpret, apply, and disseminate the data.
(c) An understanding of research methodology.

Program Educational Objectives:
Within a few years of graduation our graduates will:
1. Be employed as computer science or computer engineering professionals beyond entry level positions or be making satisfactory progress in graduate programs.
2. Have peer-recognized expertise together with the ability to articulate that expertise as computer science or computer engineering professionals.
3. Demonstrate strong analytic, design, and implementation skills required to formulate and solve computer science or computer engineering problems in a professional or research environment.
4. Demonstrate that they can function, communicate, collaborate and continue to learn effectively as ethically and socially responsible computer science or computer engineering professionals.

Course Topics:
- Parallel Computers
- Message-Passing Computing
- Embarrassingly Parallel Computations
- Partitioning and Divide-and-Conquer Strategies
- Pipelined Computations
- Synchronous Computations
- Load Balancing and Termination Detection
- Programming with Shared Memory
- Distributed Shared Memory Systems and Programming
- Sorting Algorithms
- Numerical Algorithms
- Image Processing
- Searching and Optimization

Course Policies:
- Students are expected to attend, and be on time, for every class. This demonstrates professionalism and consideration for your fellow students and your Instructor. While the course does not have an attendance policy, students who miss class and/or are late for class may experience an impact on their grade by missing classroom activities and/or quizzes
- Students are expected to turn in all assigned materials in a timely manner.
- Students are expected to demonstrate professionalism and courtesy by either silencing or turning off all cell phones and/or other alarm or audible indicator devices

- The Instructors reserve the right to add to, and/or modify any of the above policies as needed to maintain an appropriate and effective educational atmosphere in the classroom and the laboratory. In the case that this occurs, all students will be notified in advance of implementation of the new and/or modified policy.

UNR Athletics:
- If you are involved with any *university-sponsored* athletic activities that will have an impact on your attendance, please provide your Instructor with a letter from your coach and/or the UNR Athletic Department as soon as possible, but no later than the end of the second week of classes. This should include the official schedule of your activities which will impact your attendance throughout the semester.

Absence due to religious holy day observance:
- If you intend to participate in a religious holiday that does not fall on state holidays or periods of class recess you need to notify me in writing (in advance) and no later than the end of the second week of classes.

University Class Absence Policy:
- https://www.unr.edu/administrative-manual/3000-3999-students/3020-class-absence-policy

Assignments, Examinations and Grading:
- All Formal Homework Assignments (Including exercises and Projects) and all Exams (Quizzes, Hour Exams, and the Final) are to be treated as individual and not collective efforts, **unless specified otherwise**. A severe penalty will be given to any assignment which indicates collusion or cheating. The usual penalty for cheating on project or an exam is failure in the course.

Homework Assignments:
- There will be a number of Homework Assignments. These consist of practice questions which are intended to assist the student in mastering the course content. Some of these assignments will be collected and graded, but you will be informed in advance when an assignment is to be handed in

Quizzes:
- There will be several announced and unannounced quizzes in lecture and online.

Exams:
- There will be two Midterm Exams. Both exams will be closed books, closed notes.
- Permissions to take exams on other dates than scheduled will not be given, except for extreme medical emergencies.
- All exams will take place in the regular classroom.

Programming Assignments:
- The Programming assignments require the solutions to problems using the computer. We will be using XSEDE computers this semester. You will be instructed how to submit your projects for grading.
- The Programming Assignments should be considered as "open-book, take-home tests".

Late Submission Policy:
- Projects will be collected at the start of the class session in which they are due. A programming assignment turned in after collection is done will be graded as late.
- The penalty for late assignments and projects will be as follows: $\max(10\%, n^2\%)$, where n is the number of school days.

Grading Structure:
- The final grade will be based on (Tentative, subject to change):

Section	415	615
Attendance/Participation/Homework	10%	5%
Quizzes	20%	20%
Projects	35%	35%
Midterm Exams	15%	15%
Final Exam	15%	15%
Presentation	5%	10%

- Letter grades will be based on a 10 point scale ([90, 100] = A, [80, 90) = B, ...)

Important Notes:
- I will be using a +/- grading system.
- Every project must be completed, working, and turned in. For each project that is not, the final grade in the course may be lowered.

Academic Standards Policy for Writing Code (CSE Dept)

A student may receive academic and disciplinary sanctions for cheating, plagiarism or other attempts to obtain or earn grades under false pretenses. In addition to University definitions of academic dishonesty, the following rules define plagiarism and cheating for students in computer science and engineering classes:

1. Sharing ideas with other students is fine, but you should write your own code. Never copy or read other students' code, including code from previous years. Cosmetic changes, such as rewriting comments, changing variable names, and so forth to disguise the fact that your work is copied from someone else, is easy to detect and not allowed.
2. It is your responsibility to keep your code private. Sharing your code in public is prohibited, and may result in zero credit for the assignment.
3. If you find some external code (such as an open-sourced project) that could be reused as part of your assignment, you should first contact the instructor to see whether it is fine to reuse it. If the instructor permits it, she/he may announce it to the entire class so that all students could use it. And if you decide to reuse the external code, you should clearly cite it in comments and keep the original copyright in your code, if applicable.
4. You should be prepared to explain any code you submit, including code copied/modified from external sources.
5. Every student will be asked to sign the following statement for every programming assignment: "This code is my own work. It was written without consulting a tutor or code written by other students."

Supplemental Instructions for 400-600 Courses:

- As stated previously, Projects will typically have an itemized list of topics where the undergraduates will have to do the first few (specific number identified on the project) and the graduate students have to do those plus a few more on the list (specific number again specified on the project). Those items that are not required and are completed will be graded as extra credit.
- Graduate Students are also to read two papers which discusses a facet of Parallel Computing. You will do a presentation in class for each paper similar to a conference presentation in our field. Your presentation will be 15 minutes in length followed by 5 minutes of question/answer.

UNIVERSITY POLICIES

Statement on Academic Dishonesty:
- "Cheating, plagiarism or otherwise obtaining grades under false pretenses constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include filing a final grade of "F"; reducing the student's final course grade one or two full grade points; awarding a failing mark on the coursework in question; or requiring the student to retake or resubmit the coursework. For more details, see the University of Nevada, Reno General Catalog." And UAM 6,502
- Your continued enrollment in this course implies that you have read it, and that you subscribe to the principles stated therein.

Statement of Disability Services:
- "Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations."
- **This course may leverage 3rd party web/multimedia content, if you experience any issues accessing this content, please notify your instructor.**

University Math Center (UMC):
- The University Math Center (UMC) is focused on helping students with mathematical and statistical concepts. While mathematics is used extensively in engineering, the UMC does not have the resources to help students with engineering courses. Engineering students are encouraged to use the UMC for help in their math classes, and they are welcome to use its computer lab and study area any time –regardless of course. However, UMC tutors cannot answer questions regarding engineering courses.

Statement on Audio and Video Recording:
- "Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."

Statement on Equal Opportunity and Title IX:
- The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit: The Equal Opportunity and Title IX page at https://www.unr.edu/equal-opportunity-title-ix