ECE 4730/6730: Digital Computer Design
Section 01
FALL 2021

MEETING TIME: TTh 3:30-4:45 p.m.

MEETING LOCATION: Riggs 226

INSTRUCTOR: Walt Ligon, walt@clemson.edu, Riggs 300D, 864-650-1224

OFFICE HOURS AND PROCEDURES: In my office, one student at a time, masks required, students waiting should stay social distanced in outer hall.

COURSE MODALITY: **IN-PERSON SYNCHRONOUS** (Traditional)

COURSE DESCRIPTION: Introduces parallel computer architectures and their programming. Includes an introduction to MPI and OpenMP and a number of engineering problems, including numerical simulations. Introduces scalability analysis.

COURSE PREREQUISITES: ECE 3220 or ECE 3290, each with a C or better.

STUDENT LEARNING OUTCOMES:

- Students should be able to write working parallel programs with MPI
- Students should be able to write working parallel programs with OpenMP
- Students should be able to code important numerical parallel algorithms involving vectors, matrices, linear systems, etc.
- Students should be able to code important non-numerical parallel algorithms involving graphs, game trees, sorts etc.
- Students should be able to perform performance analysis of parallel algorithms run on typical parallel machines including speedup, efficiency, and isoefficiency in order to evaluate the applicability of parallelism to the given task
- Students should be able to recognize and discuss general architecture features of parallel machines including processor and network design.

REQUIRED MATERIALS

- Required Text: *Parallel Programming in C with MPI and OpenMP*
       By: Michael J. Quinn,
       McGraw Hill ISBN: 0-07-282256-2

Laptop with Linux or a suitable alternative approved by the instructor with gcc, mpi and related gnu tools.

Some means of storing working files on an SD card or USB stick in order to transfer course files and back them up.

TOPICAL OUTLINE:

Motivation and History (Quinn chapter 1)

Architectures (Quinn chapter 2)

Parallel Computing (notes 1)

Message Passing, MPI (Quinn chapter 4, notes 2)

Collective Communication (notes 3)

MPI-IO (notes 4, notes 5)

Parallel Program Design (Quinn chapter 3)

The Sieve of Eratosthenes (Quinn chapter 5)

Floyd's Algorithm (Quinn chapter 6)

Performance Analysis (Quinn chapter 7)

Matrix Vector Multiplication (Quinn chapter 8)

Monte Carlo Methods (Quinn chapter 10)

Matrix Multiplication (Quinn chapter 11)

Solving Systems of Linear Equations (Quinn chapter 12)

Finite Difference Methods (Quinn chapter 13) ** optional

Sorting (Quinn chapter 14) ** optional

Fast Fourier Transform (Quinn chapter 15) ** optional

Combinatorial Search (Quinn chapter 16) ** optional

Shared Memory Programming (Quinn chapter 17)

Combining MPI and OpenMP (Quinn chapter 18)

CLASS CANCELLATION POLICY: Class is cancelled if the instructor is more than 15 minutes late to class.

GRADING POLICY:

- Exams: Given using Canvas and Respondus LockDown Browser.
  - MidtermExam:20%
  - FinalExam:20% (not cumulative)
- Projects: 60% (3 or 4, relative weight to be determined)
- Students are required to complete **ALL** projects on time and submit all code to receive a passing grade in the course. NO EXCEPTIONS!!!!
- Grades of A, B, C, D, and F will be given for 4730. Grades of A, B, C, F will be given for 6730. The instructor guarantees an A for a combined score of 90-100, a B for 80-89, and a C for 70-79 *BUT* might adjust the ranges in the student's favor based on grade distributions. 4730 and 6730 grades will be treated separately. Students in 6730 will have additional requirements on the projects comprising at least 10% additional work in accordance with university policy.
- A grade of I (incomplete) will only be given if a student must complete a project after the semester has ended and only by prior arrangement with the instructor. A suitable explanation will be required. Missing grades, quizzes, and projects will be treated as 0 points.

ATTENDANCE POLICY:

1. Class lectures will be held using the University's Zoom server under the instructor's account. Links to these meetings will be provided via Canvas and should also come by email/
2. Online attendance is mandatory. The Zoom session will record which accounts are present and I will call on students occasionally to verify their actual presence.
3. I give in-class quizzes or other graded activities. If you are not present for these, you will get a zero on them, they cannot be made up.
4. Tests can only be made up by prior arrangement. This means you must contact me, explain the proposed absence, and have it approved by me in writing, otherwise you will get a zero for the test. I might excuse an emergency situation provided it was dire and documented, do no approach me with silly excuses (I might charge that 0 for double points!).
5. In the event of a class cancellation on a test day, the instructor tests will be given at the next available period that is not also canceled.
6. Students must use the Notification of Absence module in Canvas or email to inform the instructor of unavoidable or planned student student absences.

STUDENTS are expected to communicate via Canvas and/or email, you should check these daily for announcements and/or assignments. As they are also required to attend lectures announcements may also be made during class.

ACCESSIBILITY STATEMENT: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: http://www.clemson.edu/campus-life/campus-services/sds/.

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a. Ensure you are signed up for emergency alerts (https://www.getrave.com/login/clemson)
b. Download the Rave Guardian app to your phone (https://www.clemson.edu/cusafety/cupd/rave-guardian/)
c. Learn what you can do to prepare yourself in the event of an active threat (http://www.clemson.edu/cusafety/EmergencyManagement/)

ACADEMIC INTEGRITY: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the *Undergraduate Announcements* and in the *Graduate School Policy Handbook*.

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MODIFICATION STATEMENT: The instructor reserves the right to modify any aspect of the syllabus, including but not limited to the above schedule, policies, procedures, and assignments, at any time during the semester in the event of extenuating circumstances, by mutual agreement, and/or to ensure better student learning. This includes but is not limited to COVID-related situations.

This version was last modified 8/13/2021.

TESTING and HOMEWORK PROCEDURES: All homework will be turned in electronically via Canvas. Alert the instructor is an assignment is not working for you. In some cases you may need to scan hand-written work to turn it in. All planned tests and quizzes are planned to be given online via Canvas/LockDown Browser. The student is expect be familiar with these before turn-ins and/or tests. If you have a problem with Canvas contact the help desk and/or the instructor.