ECE 4730/6730: Digital Computer Design
Section 01
FALL 2023

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

MEETING LOCATION: Riggs 223

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

OFFICE HOURS AND PROCEDURES: Due to my back condition my availability on campus is limited. Most questions or concerns can be handled via email, so please first email me with your concern and I will answer it. If it is question with a program, attach a complete copy of your code and the error message issued (if there is one). If we cannot seem to work things our this way we can set up a meeting.

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
- This text is out of print, but used copies are usually available as well as paperback and ebook versions.
- 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. Attendance is mandatory.
2. 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.
3. 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 not approach me with silly excuses (I might charge that 0 for double points!).
4. 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.
5. Students must use the Notification of Absence module in Canvas or email to inform the instructor of unavoidable or planned student absences.

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 8/22/2023.

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.