ECE 4990: CI: High-performance Cluster Computing
Section 005
Spring 2021

MEETING TIME: Ad-Hoc see canvas

MEETING LOCATION: Ad-Hoc see canvas

INSTRUCTOR(s): Dr. Jon C Calhoun; Riggs Hall 221-C; jonccal@clemson.edu; 864-656-2646

OFFICE HOURS AND PROCEDURES: Tuesday 11 a.m. -12 p.m. Additional office hours must be arranged via email. See canvas for the Zoom link used for office hours.

COURSE MODALITY: HYBRID

COURSE DESCRIPTION: Parallel computing is often a topic covered until the senior year for undergrads. Moreover, large-scale computing is becoming fundamental tool to researchers in many fields of science and engineering. This CI is dedicated to opening parallel computing to all levels of undergrads in relevant fields of computational science and engineering. Through this CI, we explore how high-performance computing (HPC) systems are constructed, what it takes to program parallel applications, how to run parallel applications on an HPC system, and how to optimize applications. This CI is intended to introduce undergraduate students to parallel computing early in their undergraduate experience. Skills and knowledge gained though hands on activities, research, and trainings will prepare students for undergraduate research, provide skills to help students stand out and succeed in graduate school, and provide students an opportunity to test their skills against teams from all over the world at the annual Supercomputing Conference's Student Cluster Competition.

The CI is broken down into 2 semesters:
- During the Spring semester students will explore the area of parallel and cluster computing. This exploration provides the needed foundations for hands on exploration/research. In addition, the Spring semester will be used as a local competition to select the best students to compete in the Supercomputing's Student Cluster Competition (http://www.studentclustercompetition.us/).
- During the Fall semester, selected students from Spring train to compete at the Student Cluster Competition. The competition involves running real world scientific workloads to accomplish several tasks including benchmarking the team's cluster's performance and replicating computational and scientific results from a paper published at the conference the prior year. The problem domain changes from year to year (e.g. genetics, chemistry, aerospace, geophysics, hydrology, cosmology). The changing problem areas allows easier exposure to undergraduates from other STEM disciplines.

COURSE PREREQUISITES: None.

Updated: December 2021

STUDENT LEARNING OUTCOMES:

Typical Spring Semester:
- Learn about clusters and large-scale system design.
    - Students will conduct their own research on different aspects of system design (e.g. network, computing, storage, memory)
    - Students will write a report on their finding and give a presentation to other CI members
- Learn about programming models:
    - Students will conduct their own research on different programming models, program optimizations, and performance (e.g. MPI, vectorization, GPUs, tasking). Students will write a report on their finding and give a presentation to other CI members
- Students will attend relevant workshops offered by CCIT
- Students will write and modify HPC applications based on acquired knowledge
- Design and select system configuration (software, possible hardware upgrades)
- Students will submit an application to compete at the Supercomputing Conference's Student Cluster Competition
- Students will write summary report over what they learned and its potential impacts on their careers and society

Typical Fall Semester:
- Students will attend relevant workshops offered by CCIT
- Students will explore, run, and optimize applications used during the competition
- Students will explore the competition's problem area (e.g., genetics, chemistry, aerospace, geophysics, hydrology, cosmology) to learn more about the science they are going to be verifying and replicating during the competition. This may include guest speakers from those departments
- Students will compete at the Supercomputing Conference's Student Cluster Competition
- Students will write summary report over what they learned and its potential impacts on their careers and society

REQUIRED MATERIALS: Textbook: None. Internet connected laptop with a webcam, microphone, and speakers/headphones.

CLASS CANCELLATION POLICY: Class is cancelled if the instructor is more than 15 minutes late to class and there is no email message or Canvas post explaining otherwise.

COURSE MANAGEMENT SYSTEM: Canvas will be used to make class announcements, turn in assignments, and provide students access to additional course materials (e.g. PowerPoint slides, assignments, gradebook, papers discussed).

GRADING POLICY: Scale. A: [90%, 100%]; B: [80%, 90%); C: [70%, 80%); D: [60%, 70%); F: [0%, 60%)

Application Summary on Palmetto:	10%
Building Pi/Jetson Cluster	25%
Submit SCC Application:	60%
End of Semester Summary:	5%

See the lecture slides and Canvas assignments for more details about each category.

LATE ASSIGNMENTS: Late assignments will have 1 letter grade deducted for each day that they are late. Examples of excused absences include a death in the immediate family or personal conditions requiring hospitalization or emergency treatment. Personal illnesses such as colds, general fatigue, or general sickness are not typically excused. If you are unsure if your situation will be excused, contact the professor in a professional manner prior to or as soon as possible after the missed assignment.

EMAIL POLICY: To receive a response, emails must be sent from your Clemson University email address to the professor's @clemson.edu email and must include the course number in the subject line. The professor will respond within 24-hours during weekdays unless on travel.

ATTENDANCE POLICY:

1. This course is a hybrid class. The university will assign students a day of the week they are to come this class; on other days, they must attend online.
2. Physical attendance on days students are to come physically is not required by strongly encouraged to provide extra opportunities for office hours and one-on-one help with class exercises.
3. If students are not physically in attendance, it is required that they connect online. If there are technical issues preventing a student attending, the student should inform the professor at their earliest convenience.
4. In the event class is canceled, check Canvas for any schedule modifications. Assignments turned in through Canvas will not be pushed back unless noted by the professor. Exams will be rescheduled for the next class period.
5. Email the professor to inform him of expected absences.
6. To maintain physical distancing, individuals arriving first to the classroom should sit farthest from the door. Similarly, at the conclusion of class, students closest to the door should leave first.
7. While on campus, face coverings are required in all buildings and classrooms. Face coverings are also required in outdoor spaces where physical distance cannot be guaranteed. If a student does not have a face covering or refuses to wear an approved face covering without valid documented accommodation, the instructor will ask the student to leave the academic space and may report the student's actions to the Office of Community & Ethical Standards as a violation of the Student Code of Conduct. If the student's actions disrupt the class to the extent that an immediate response is needed, the instructor may call the Clemson University Police Department at 656-2222.
8. Please note that the University may convert to a purely online mode at any time.

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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/.

TITLE IX STATEMENT: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

SAFE CAMPUS: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

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*.

COPYRIGHT STATEMENT: Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: https://clemson.libguides.com/copyright.

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MODIFICATION STATEMENT: The professor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations.