



# **ECE 8930: Data Compression in High-performance Computing Section 001 FALL 2021**

**MEETING TIME:** TR 2:00-3:15 PM

**MEETING LOCATION:** Riggs 219

**INSTRUCTOR(s):** Dr. Jon C Calhoun; Riggs Hall 221-C; [jonccal@clermson.edu](mailto:jonccal@clermson.edu); 864-656-2646

**OFFICE HOURS AND PROCEDURES:** Thursday 3:30-4:30 PM Additional office hours must be arranged via email.

**COURSE MODALITY:** Traditional

**COURSE DESCRIPTION:** As the size of large-scale high-performance computing (HPC) systems and scientific instruments grow, so too does the volume of data generated. Production runs of large-scale applications and full streaming intensity of scientific instruments generate more data than can be analyzed and stored. Thus, data reduction is necessary to enable scientists and engineers to retain more data for analysis and archival. This course investigates both lossless and lossy data compression. We explore Huffman coding, dictionary based lossless techniques (e.g. Lempel-Ziv), quantization, transforms, truncation, decimation, and data sampling and their application in the HPC domain.

**COURSE PREREQUISITES:** ECE 4730 is recommended, but not required.

## **STUDENT LEARNING OUTCOMES:**

- Students will be able to describe the need for data compression in HPC
- Students will explore various use cases of data compression in HPC
- Students will compare and contrast different methods of lossless and lossy data compression
- Students will conduct a research project focused on improving the state-of-the-art in compression, improving the state-of-the-practice, or replicating/validating prior works

**REQUIRED MATERIALS:** Internet connected laptop with a webcam, microphone, and speakers/headphones.

**RECOMMENDED MATERIALS:** Introduction to Data Compression 5th Edition by Khalid Sayood Ph.D.  
ISBN-10: 0128094745. ISBN-13: 978-0128094747.

**TOPICAL OUTLINE:**

What is HPC and why is there a data volume issue?	1 week
Introduction to Information Theory	1 weeks
Lossless Techniques	5 weeks
Lossy Techniques	5 weeks
Reading/discussing recent publications	3 weeks

A per class outline is available on the course's Canvas page.

**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%]

Paper and Presentation Reviews:	15%
Paper Presentations:	25%
Discussion Participation:	10%
Project (Team based):	50%

*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. Attendance is mandatory. Note students who are attending in-person classes in traditional courses and are not approved to be online for all spring semester are expected to return to in-person attendance once cleared by the University. Students that must quarantine/isolate will

not suffer any grade penalties associated with their physical absence from in-person classes.  
Quarantining students should join via Zoom

2. Online attendance is mandatory for students approved to be online for all spring semester.
3. Use the Notification of Absence module in Canvas or email to inform the instructor of student absences.
4. 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.
5. 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. Please be familiar with the additional information on the Healthy Clemson website, such as the use of wipes for in-person classes. If an instructor does not have a face covering or refuses to wear an approved face covering without valid accommodation, students should notify the department chair. If a student does not have a face covering or refuses to wear an approved face covering without valid 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.
6. Specific COVID-19 related information for student absences:  
For a student who reports testing positive or is being asked to quarantine because of exposure to the virus, it will be up to the student to inform the instructor that they will be moving to online only instruction for at least the next two weeks. Students are directed to use the Notification of Absence form in Canvas to initiate this notification, which can be found under the "Help" button on the left navigation. (For courses where Canvas is not used, the direct link to the Notification of Absence form can be found through the Division of Student Affairs site.) Additional communication via email is encouraged; students should follow up with their instructor to develop a continued plan of study for each course. Students cannot be penalized in their grade for needing to move to online instruction.
7. Please note that the University may convert to a purely online mode at any time.

**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](mailto: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

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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>.

**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.

