ECE 8560: PATTERN RECOGNITION

SYLLABUS SPRING-2023

Instructor

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Office Hours: Thursday 10:00am – 12:00pm

Class Location and Times

Day: Tuesday & Thursday
Location: Riggs Hall 223
Time: 5:00pm ~ 6:15pm
Information on modality: In-person / hybrid (Zoom: https://clemson.zoom.us/j/96781191548)

Recording of Classes:

This course will be delivered with traditional (section 001) and hybrid/blended (section 843) sessions. This course, or parts of this course, may be recorded for educational purposes. These recordings will be made available only to students enrolled in the course, instructor of record, and any teaching assistants assigned to the course. Classes will be recorded to enable all students to review material covered in synchronous classes. Please contact me if you have any concerns.

Books

(*Recommended but NOT Required*) Textbook: Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Prerequisites

No prerequisites for this course.

Description

This class is a graduate-level and research-oriented class. It will focus on the recent advances in the deep learning applications and research fields.

Learning Objectives / Outcomes

The objective is to make students competitive in the growing job markets and research activities of artificial intelligence and big data areas. There are four major components in this course. The first is basic deep

learning models, including feedforward neural networks, deep convolutional neural networks (VGG, ResNet, MobileNet, Yolo), recurrent neural networks (LSTM, GRU, etc.), transformer-based neural networks (e.g., BERT, ViT), autoencoder and representation, transfer learning, deep reinforcement learning (e.g., AlphaGo), generative adversarial networks (GANs), and their inference and training algorithms. The second part is different application fields of deep learning, including image classification, object detection, speech recognition, robotics, autodriving, automated control, medical systems, etc. The third part is effective accelerations and implementations of deep learning systems including GPU-based implementations, edge device implementations, dedicated hardware such as Google TPU or IBM TrueNorth, deep learning model quantization, model compression, and FFT-based computations. The last part is the security aspects of deep learning, i.e., how deep learning can enhance the security levels of cyber-physical systems and how to enhance the security level of deep learning systems themselves. This class requires programming in C++ and Python, and students will learn effective deep learning tools such as TensorFlow and PyTorch.

Topics covered

1. Introductions
2. Classification problem, basic machine learning models
3. Neural networks, deep convolutional neural networks (DCNN)
5. Python, PyTorch, and TensorFlow
6. Using GPU to accelerate learning and inference
7. Recurrent neural networks (RNN)
8. Transformer-based neural networks
9. Autoencoder, representation and transfer learning
10. Neural networks for computer vision and autodriving
11. Deep reinforcement learning
12. Generative adversarial networks (GAN)
13. Hardware acceleration of deep learning systems
14. Security in deep learning systems

Class schedule (tentative)

Index	Date of class	Plan
1	1/12/2023	Class
2	1/17/2023	Class
3	1/19/2023	Wei Niu from William & Mary will give research talk on *compiler-based software-hardware co-optimization of deep neural networks*.
4	1/24/2023	Geng Yuan from Northeastern University will give research talk on *neuromorphic computing and efficient deep neural network algorithms.*
5	1/26/2023	Class
6	1/31/2023	Class
7	2/2/2023	Class
8	2/7/2023	Class

9	2/9/2023	Class
10	2/14/2023	Class
11	2/16/2023	Class. Homework 1 assign.
12	2/21/2023	Class
13	2/23/2023	Class. Homework 1 due.
14	2/28/2023	Class
15	3/2/2023	Class
16	3/7/2023	Class
17	3/9/2023	Class. Homework 2 assign.
18	3/14/2023	Class
19	3/16/2023	Class. Homework 2 due.
20	3/21/2023	Spring break, no class.
21	3/23/2023	Spring break, no class.
22	3/28/2023	Final project proposal.
23	3/30/2023	Final project proposal.
24	4/4/2023	Class
25	4/6/2023	Class. Homework 3 assign.
26	4/11/2023	Class
27	4/13/2023	Class. Homework 3 due.
28	4/18/2023	Final project presentation.
29	4/20/2023	Final project presentation.
30	4/25/2023	Final project presentation.
31	4/27/2023	Final project presentation.
32	5/2/2023	Exam week. No class.
33	5/4/2023	Exam week. No class.

Grading policy

Final Project: 45%
Homework and Projects: 45%
Quizzes: 10%
Extra Points: up to 3%

Grading System:

90 ~ 100 = As
80 ~ 89 = Bs
70 ~ 79 = Cs
60 ~ 69 = D
Below 60 = F

Grading Policy

Homework assignments are to be submitted through Canvas website or hand to the instructor on the assignment due date. Assignments submitted after the due date will be deducted 10 points for each day late.

Exams

All exams must be taken at the scheduled time unless a previous arrangement (with a good reason) has been made with the instructor

Absences

You are expected to attend each class punctually and remain for the entire class period. You need to inform the instructor in advance if you expect to miss a class or leave the course before the end of the semester. If you miss class your absence will be excused by the instructor only if a doctor's certificate or other evidence is submitted. You remain to be responsible for the work associated with the class you missed, even if your absence has a valid reason. There will be a number of unannounced popup quizzes during the semester.

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. All infractions of academic dishonesty by undergraduates must be reported to Undergraduate Studies for resolution through that office. In cases of plagiarism instructors may use the Plagiarism Resolution Form. See the Undergraduate Academic Integrity Policy website for additional information and the current catalogue for the policy. For graduate students, see the current Graduate School Handbook for all policies and procedures.

Accessibility

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 this 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, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen, if at all possible, but there could be a significant wait due to scheduled appointments. Students who have accommodations are strongly encouraged to request, obtain and send these to their instructors through the AIM portal 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 at the Student Accessibility website. Other information is at the university's Accessibility Portal.

The Clemson University Title IX Statement Regarding Non-Discrimination

The Clemson University 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. This Title IX policy is located on the Campus Life website. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 223 Brackett Hall, 864-656-0620. Remember, email is not a fully secured method of communication and should not be used to discuss Title IX issues.

Clemson University aspires to create a diverse community that welcomes people of different races, cultures, ages, genders, sexual orientation, religions, socioeconomic levels, political perspectives, abilities, opinions, values and experiences.

Emergency Preparation

Emergency procedures have been posted in all buildings and on all elevators. Students should be reminded to review these procedures for their own safety. All students and employees should be familiar with guidelines from the Clemson University Police Department. Visit here for information about safety.

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:

Ensure you are signed up for emergency alerts

Download the Rave Guardian app to your phone (https://www.clemson.edu/cusafety/cupd/rave-guardian/)

Learn what you can do to prepare yourself in the event of an active threat (http://www.clemson.edu/cusafety/EmergencyManagement/)