CSCE 5218 – Deep Learning

Course Information & Syllabus (Spring 2023)

https://hengfan2010.github.io/teaching/23S-5218/index.htm

Basic Course Information

- **Instructor:** Dr. Heng Fan
- **E-mail:** heng.fan@unt.edu
- **Office:** Discovery Park F284
- **Phone:** 940-565-3209
- **Office Hours:** Thursday 2:30-4:00 pm
- **Lecture Time:** Tuesday/Thursday 1:00-2:20 pm, NTDP B217

- **TA:** Xiaoqiong Liu
  E-mail: xiaoqiongliu@my.unt.edu
  Office: F289
  Office hours: Monday/Thursday 11:50-12:50 pm

Textbooks

We will have required readings from the following textbook:

- **Deep Learning**, by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 2016. online version

Besides, the following textbooks are useful as additional references:

- **Dive into Deep Learning**, by Aston Zhang, Zack C. Lipton, Mu Li, and Alex J. Smola, 2019. online version
- **Neural Networks and Deep Learning**, by Michael Nielsen, 2019. online version
- **Introduction to Deep Learning**, by Eugene Charniak, 2019. link

In addition to the textbooks, extra reading materials will be provided as we cover topics. Check out the course website regularly for updated reading materials.

Prerequisites

The students are required to master basic knowledge about calculus, linear algebra, (Python) programming, and algorithm implementation. Machine learning background is beneficial for this course.

Programming language/framework:

We will use Python, NumPy/SciPy, and PyTorch for this course.

Course Description

This course aims to cover the basics of modern deep neural networks. In specific, the first part will introduce the fundamental concepts in neural networks including network architecture, activation function, loss, optimization, etc. Then, the second part will describe specific types of deep neural networks such as convolutional neural networks (CNNs), recurrent neural networks (RNNs) and attention-based Transformer, as well as their applications in computer vision and natural language processing. In the final part we will briefly discuss some recent advanced topics in deep learning such as graph neural networks, unsupervised representation learning, deep reinforcement learning, generative adversarial networks (GANs), etc. In this course, hands-on practice of implementing deep learning algorithms (in Python) will be provided.

Tentative topics of this course include:

- Review of machine learning
- Basic concepts in neural networks
- Loss, optimization, and training of deep neural networks
- Convolutional neural networks (CNNs)
- Recurrent neural networks (RNNs)
- Transformer
- Applications of deep neural networks
- Graph neural networks
- Unsupervised representation learning
- Deep reinforcement learning
- Generative adversarial networks (GANs)

Detailed class schedule of this course can be found on the course website.

Learning outcomes: Students in this course will learn basic concepts in deep neural network and different neural network types such as convolutional neural networks (CNNs), recurrent neural network (RNNs), and Transformer. The goals including the following:

- Learn the basic concepts and tools that underlie all modern deep neural networks
- Be able to select a suitable model architecture to process different types of data
- Grow hands-on experience implementing deep neural network models for computer vision, natural language processing, robotic applications, etc.
- Team up and implement an existing research paper or algorithm

Grading (tentative)

- Attendance 5%
- Paper review 30%
- Course project 50%
    - Project proposal: 15%
    - Final report: 25%
    - Presentation: 10%
- Final exam 15%

Paper review: A list of papers will be suggested during the semester. Every student is required to select 20 papers (one or two per week) for review (a review example will be provided on the course website).

Course project: After a few weeks into the course, you will select among several collaborative projects (the project must be related to deep learning) suggested by the instructor, but the students are free to suggest, especially if they are related to their current research. The project is important to improve the hands-on skill of implementing the deep models. A small team of at most two members can work on a project together (each team member will receive the same grade for the project; it is up to the team members to divide the work fairly). For the project, each team requires to include:

- *Project proposal*: On the indicated due date, each team needs to submit the proposal that consists of abstract, introduction, related work, potential solution, datasets and metrics for experiments, and reference.
- *Final report*: On the indicated due date, each team needs to submit a final report which is similar to a research paper. Besides all the components in the proposal, the details of the proposed approach, implementation, and experimental analysis and results should be included in the final report.
- *Project presentation*: All teams need to present the project in class.

The project proposal and final report need to be submitted on Canvas on the indicated due date. More details of the project will be announced during the semester.

Final exam: There will be a final exam for this course. The final exam must be taken in class unless otherwise specified in advance. The final exam will be on TBD.

Attendance: Attendance may be checked on randomly selected days. You are responsible for any missed material and completing all work by the assigned due dates. You should notify the instructor of your absence as soon as possible.

Late submission: Late submissions will **not** be accepted. It is your responsibility to submit any required submission on time. There will be no exceptions.

Grading Scale (based on 100 points**)**

90-100 = A

80-89 = B

70-79 = C

60-69 = D

below 60 = F

No exceptions will be made.

UNT Policies

Academic Integrity and Consequences: According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University.

Most lectures in class will have homework assignments. Students may discuss the homework problems and approaches with each other but must work on their solutions individually unless otherwise stated in the assignment. Students must not copy homework from any source, including other students or the internet. No collaboration is allowed in quizzes and exams.

Acceptable Student Behavior: Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Center for Student Rights and Responsibilities to consider whether the student's conduct violated the Code of Student Conduct. The university's expectations for student conduct apply to all instructional forums, including university and electronic classroom, labs, discussion groups, field trips, etc.

Americans with Disabilities Act: We cooperate with the Office of Disability Accommodation to make reasonable accommodations for qualified students (cf. Americans with Disabilities Act and Section 504, Rehabilitation Act) with disabilities. If you have not registered with ODA, we encourage you to do so. If you have a disability for which you require accommodation, please discuss your needs with the instructor or submit a written Accommodation Request on or before the fourth-class day.

Disclaimer

Note, this syllabus is to serve as a guide and may be subject to changes. For up-to-date information, assignments, and class material, students are recommended to check out course website or Canvas regularly. This syllabus may be updated to reflect changes. The updated version will be available in the course website and on Canvas.