CSCE 5218 & 4930 – Deep Learning

Course Information & Syllabus (Spring 2022)

https://hengfan2010.github.io/teaching/22S-5218_4930/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 3:30-5:30 pm, online (preferred, zoom link on Canvas) or in office, or by appointment
- **Lecture Time:** Tuesday/Thursday 1:00-2:20 pm, NTDP B142

- **TA:** Simon Tandi
  E-mail: TBD; Office: TBD
  Office hours: TBD

- **Grader:** Syed Araib Karim
  E-mail: TBD; Office: TBD
  Office hours: TBD

Recommended 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

In addition to the textbook, 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 homework and projects.

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**)**

- Class participation and homework assignment 25%
- Paper review 20%
- Course project 40%
- Final exam 15%

Homework: There will be three or four homework assignments through the semester (most of them are programming exercises).

- You are expected to do homework assignments by yourselves. Even if you discuss them with your classmates, you should turn in your own. Do NOT share your code!
- Each assignment will specify the material to be turned in. All the programming assignments require using Python for implementation on Colab (Colab provides free GPU resources to complete your assignments. To use Colab, you need to have your Google account. A useful tutorial to use Colab is here: https://colab.research.google.com/github/cs231n/cs231n.github.io/blob/master/python-colab.ipynb).

- Assignments are due before class on the due date (the due date will be indicated in the assignment). Assignments must be turned in electrically using Canvas. A late penalty of 10% will be applied to all late assignments for up to 3 calendar days. ***NO credit will be given after 3 days***.

Paper review: A list of papers will be suggested during the course of the semester. Every student is required to select 15 papers for review (a review example will be provided on the course website and Canvas).

Course project: After few weeks into the course, you will select among a number of collaborative projects (related to deep learning) suggested by the instructor, but the students are free to suggest, especially if they relate 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 three 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. Special cases caused by COVID can be found below in "COVID Information".

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.

COVID Information

Face Coverings: UNT encourages everyone to wear a face covering when indoors, regardless of vaccination status, to protect yourself and others from COVID infection, as recommended by current CDC guidelines. Face covering guidelines could change based on community health conditions.

Attendance: Students are expected to attend class meetings regularly and to abide by the attendance policy established for the course. It is important that you communicate with the professor and the instructional team prior to being absent, so you, the professor, and the instructional team can discuss and mitigate the impact of the absence on your attainment of course learning goals. Please inform the professor and instructional team if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community.

If you are experiencing any symptoms of COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.

Course Materials for Remote Instruction: Remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID- 19. Students will need access to a [webcam and microphone – faculty member to include what other basic equipment is needed] to participate in fully remote portions of the class. Additional required classroom materials for remote learning include: [list specific software, supplies, equipment or system requirements needed for the course]. Information on how to be successful in a remote learning environment can be found at https://online.unt.edu/learn.

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.