University of North Texas
CSCE5218/CSCE4930, Spring 2021
Deep Learning

Meetings	Wednesday 5:30–8:20pm, NTDP B142
	(and remote via Zoom, see link on Canvas)
Instructor	Dr. Eduardo Blanco, `eduardo.blanco@unt.edu`
	Office Hours: Thursday 4:00-6:00pm (Zoom link on Canvas)
TA	TBD

Textbook

This class does not have a required textbook and we will not follow closely any textbook. The instructor will provide the required reading materials as we cover topics. Here are a few good textbooks:

- Eugene Charniak, 2019. *Introduction to deep learning*. The MIT Press.
- Aston Zhang and Zachary C. Lipton and Mu Li and Alexander J. Smola. 2020. *Dive into Deep Learning*. `https://d2l.ai`.
- Ian Goodfellow, Yoshua Bengio, Aaron Courville, and Yoshua Bengio. 2016. *Deep learning*. The MIT press.

Course Contents

Hands-on introduction to deep learning emphasizing application using GPU-accelerated hardware to train multilayer machine learning models directly on raw input signals. Discusses the foundations of feedforward networks, convolutional neural networks, and recurrent networks. Using real datasets and popular deep learning tools (e.g., Tensorflow, Keras), students create systems to make inferences from rich and varied raw data including speech, video, and other signals. Topics include:

- Machine learning primer and introduction to deep learning
- The Perceptron
- Backpropagation, auto-differentiation, and tensors
- Convolutional Neural Networks (CNNs)
- Recurrent Neural Networks (RNNs)
- Building models: regularization, optimization and hyperparameter tuning
- Evaluation
- Transfer Learning
- Autoencoders and Generative Adversarial Networks
- Ethics: fairness, accountability, transparency, and biases

You are expected to check `https://unt.instructure.com/` often for course material, homework assignments, and grades.

This class uses (and adapts) materials (homeworks, slides, etc.) from the following courses:

- CS 5781 Machine Learning Engineering, by Sasha Rush at Cornell Tech (Fall 2020).
- DS4440 Practical Neural Networks, by Byron Wallace at Northeastern University (Fall 2020).

Additional pointers will be provided during the lectures.

Communication Expectations

You are encouraged to ask questions in class or during office hours. The best way to contact the course staff (instructor and TA) is via email. You will fine contact information on Canvas. You can expect an email reply within one business day.

Prerequisites

You should be familiar with Data Structures and Algorithms. You should also be able to program in Python by yourself (or learn quickly).

We will use GitHub and standard software development practices in this class. You do not need to be familiar with them, but you must be ready to learn them.

Grading

You will be graded as follows:

Homework 1, MiniTorch Fundamentals	10
Homework 2, MiniTorch Auto-differentiation	15
Homework 3, MiniTorch Tensors	15
Homework 4, CNNs	15
Homework 5, RNNs	15
Project, proposal	2
Project, follow-up	3
Project, implementation and report	20
Paper readings and discussions	5

You will have 5 "grace days" (self-granted extensions) which you can use to give yourself extra time without penalty for homework assignments. Grace days cannot be used for the project. As a rule, late submissions will not be accepted (after using the grace days).

Schedule (tentative and subject to change)

Week	Lecture Content	Assignment
1	Syllabus and logistics, ML primer, introduction to DL	
2	The perceptron, MiniTorch preliminaries	HW1 out
3	MiniTorch, Fundamentals: property testing, modules, visualization	HW1 due, HW2 out
4	MiniTorch, Auto-Differentiation: derivatives, tracking variables, autodifferentiation, backpropagation	
5	MiniTorch, Auto-Differentiation: derivatives, tracking variables, autodifferentiation, backpropagation	HW2 due, HW3 out
6	MiniTorch, Tensors: Operators, Tensor Variables, Broadcasting	
7	MiniTorch, Tensors: Operators, Tensor Variables, Broadcasting	HW3 due
8	Convolutional Neural Networks; applications in vision and natural language processing; discussion of project ideas	HW4 out
9	Recurrent Neural Networks: vanilla RNN, GRU, LSTM, attention, sequence2sequence; discussion of project ideas	HW4 due, HW5 out
10	Building models: model regularization, model optimization, hyperparameter tuning; discussion of project ideas	HW5 due
11	Evaluation: accuracy; precision, recall and F-measure; adversarial attacks; see readings below (will update on Canvas)	Project (proposal) due
12	Project follow-up, project advice and discussion	
13	Transfer learning; see readings below (will update on Canvas)	
14	Advanced Topics, e.g., autoencoders and generative Adversarial Networks	
15	Ethics and Bias: fairness, accountability, transparency, and biases; see readings below (will update on Canvas)	Project (implementation and report) due

- Most assignments will be due on Fridays

- Most assignments will be out on Wednesdays

Several lectures with include paper discussions. Some examples (all open access):

- Evaluation

  - Ribeiro, Marco Túlio, Tongshuang Wu, Carlos Guestrin and Sameer Singh. *Beyond Accuracy: Behavioral Testing of NLP models with CheckList.* ACL (2020).
  - Dodge, Jesse, Suchin Gururangan, D. Card, Roy Schwartz and Noah A. Smith. *Show Your Work: Improved Reporting of Experimental Results.* EMNLP (2019).

- Transfer Learning

  - Razavian, A., Hossein Azizpour, J. Sullivan and S. Carlsson. *CNN Features Off-the-Shelf: An Astounding Baseline for Recognition.* 2014 IEEE Conference on Computer Vision and Pattern Recognition Workshops (2014).
  - Pasunuru, Ramakanth and Mohit Bansal. *Multi-Task Video Captioning with Video and Entailment Generation.* ACL (2017).

- Ethics and Bias

  - Strubell, Emma, Ananya Ganesh and A. McCallum. *Energy and Policy Considerations for Deep Learning in NLP.* ACL (2019).
  - Merullo, Jack, Luke Yeh, Abram Handler, Alvin Grissom, Brendan T. O'Connor and Mohit Iyyer. *Investigating Sports Commentator Bias within a Large Corpus of American Football Broadcasts.* EMNLP (2019).
  - Rudinger, Rachel, Chandler May and Benjamin Van Durme. *Social Bias in Elicited Natural Language Inferences.* EthNLP@EACL (2017).

Statement on Face Covering

Face coverings are required in all UNT facilities. Students are expected to wear face coverings during this class. If you are unable to wear a face covering due to a disability, please contact the Office of Disability Access to request an accommodation. UNT face covering requirements are subject to change due to community health guidelines. Any changes will be communicated via the instructor.

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 topics discussed in class will have associated homework. Students may discuss homework problems and approaches with each other, but must work on their solutions individually unless otherwise stated in the assignment. Students may not copy homework from any source, including other students or the internet.

ADA Policy

UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one's specific course needs. Students may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website: `https://disability.unt.edu/`.

Prohibition of Discrimination, Harassment, and Retaliation (Policy 16.004)

The University of North Texas (UNT) prohibits discrimination and harassment because of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law in its application and admission processes; educational programs and activities; employment policies, procedures, and processes; and university facilities. The University takes active measures to prevent such conduct and investigates and takes remedial action when appropriate.

Religious Observance

In accordance with state law, a Student absent due to the observance of a religious holiday may take examinations or complete assignments scheduled for the days missed, including those missed for travel, within a reasonable time after the absence. Students should notify the instructor in each course of the date of the anticipated absence as early in the semester as possible. Only holidays or holy days observed by a religion whose place of worship is exempt from property taxation under Section 11.20 of the Tax Code may be included. A student who is excused under this provision may not be penalized for the absence, but the instructor may appropriately respond if the student fails satisfactorily to complete the assignment or examination. (`http://policy.unt.edu/policy/15-2-5`).

Student Support Services

Mental Health

UNT provides mental health resources to students to help ensure there are numerous outlets to turn to that wholeheartedly care for and are there for students in need, regardless of the nature of an issue or its severity. Listed below are several resources on campus that can support your academic success and mental well-being:

- Student Health and Wellness Center: `https://studentaffairs.unt.edu/student-health-and-wellness-center`

- Counseling and Testing Services: `https://studentaffairs.unt.edu/counseling-and-testing-services`

- UNT Care Team: `https://studentaffairs.unt.edu/care`

- UNT Psychiatric Services: `https://studentaffairs.unt.edu/student-health-and-wellness-center/services/psychiatry`

- Individual Counseling: `https://studentaffairs.unt.edu/counseling-and-testing-services/services/individual-counseling`