ISM 6930: Tech Foundation of AI (Fall 2023)

School of Information Systems and Management
USF Muma College of Business

Instructor: Tengteng Ma
Office Hour: Friday 2-3 pm, CIS 2056
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Lectures: Thursday 6:30 pm-9:15 pm, CIS 1045
Contact: **Piazza private message** (you can log into Piazza through Canvas)

- For technical questions, post the question on Piazza or ask the TA during labs or office hours.
- For other questions (e.g., ask for absence), send a private message via Piazza or talk to the instructor directly.

Textbooks

While we do not have any required textbook for the course, here are a few recommended books/online resources:

- Francois Chollet. Deep learning with Python. Manning Publications Co., 2017. (Available online.)
- S. Boyd and L. Vandenberghe. Introduction to Applied Linear Algebra. Cambridge University Press, 2018. (Available online.)
- Y. Nesterov. Introductory Lectures on Convex Optimization Book. Springer, 2013. (Available online.)
- D. S. Watkins. Fundamentals of Matrix Computations. John Wiley & Sons, 2004.
- I. Goodfellow, Y. Bengio, A. Courville, Y. Bengio. Deep learning. MIT press, 2016. (Available online.)
- M. Mohri, A. Rostamizadeh, and A. Talwalkar. Foundations of machine learning. MIT press, 2012.
- J. Friedman, T. Hastie, and R. Tibshirani. The elements of statistical learning. Springer series in statistics, 2001. (Available online.)

Course Description

Goal: This is a practical course; the students will be able to use DL methods for solving real-world ML, CV, and NLP problems. The students will also learn math and theories for understanding ML and DL.

Broadly, we will cover topics spanning deep learning and reinforcement learning. In particular, we will study popular deep learning architectures, their design choices, and how they are trained.

This will be motivated by business applications dealing with image and text data. Finally, we will look at online and reinforcement learning frameworks and their role in sequential decision-making settings such as retail.

The (tentative) list of topics we will cover in this course is:

- Deep learning basics
- Backpropagation and feed forward neural networks
- Convolutional networks (CNNs)
- Recurrent networks (RNNs) and Long short-term memory networks (LSTMs)
- Attention mechanism and transformers (BERT)
- Deep reinforcement learning (RL)

Prerequisite

This is an advanced deep-learning course, so students must be familiar with:

- Elementary linear algebra, e.g., matrix multiplication, eigenvalue decomposition, and matrix norms.
- Elementary calculus, e.g., convex function, differentiation of scalar functions, first derivative, and second derivative.
- Python programming (especially the Numpy library) and Jupyter Notebook.

Course Workload Expectations

This course is a fast-paced and challenging course! We assume you will allocate an average of at least 15-20 hours per week outside of lectures for study, assignment and project work. It is your responsibility to manage your workload such that you have enough time for this course. Please DO plan ahead.

Software

Any OS should be okay. You can use either Tensorflow or Pytorch as your framework. You are encouraged to set up a computing environment in your own computer if you have an accessible GPU. For lectures and labs, we will rely on Google Colab, especially the GPU/TPU to train our deep learning models.

Piazza

We will use the Piazza (you can log into this system through Canvas) for a discussion board and for posting updates. Participation on the discussion board counts towards your grade. A constructive, relevant, non-redundant post earns a Piazza point. Here are some examples:

- A question that elicits a substantive, correct answer. In other words, this cannot be a superficial question that you can easily find answers on Google. This also suggests that you should provide enough details in this question.
- A substantive, correct answer to another student's question.
- A substantive, correct refinement or clarification of another student's answer to a question.
- A correction to anything substantive that I get wrong.

Q&A policies on Piazza:

- Your questions posted on Piazza are usually answered within 24 hours, except on weekends and holidays.
- No anonymous questions will be answered by the teaching staff. If there is an anonymous post, I will ask the author to reveal the ID on the platform. This is because you are expected to form a connection with your classmates. You can also form groups with the help of Piazza.
- Debug: Since this is an advanced deep learning course, students are expected to be familiar with Python coding and know how to debug by themselves. If you show up saying, "my code is broken or I can't get the performance numbers, help", this counts as *negative participation in the class*. We do not expect the teaching staff to debug, or fix any problem, which is simply not feasible and does not help with educational objectives. The best way to go about getting help is to isolate exactly where the problem is. We will expect that you have created new tests to run that show when the code works and when is the point that the code fails (deterministically). Part of this is being able to identify where you think the problem is, what have you tried, and how isolated have you made the problem.
- Assignment-related questions posted on Piazza will only receive responses from the teaching staff within a 24-hour window prior to the due date. For example, if the assignment is due at 6:30 pm and you post a question at 10 am on the same day, the teaching staff will answer your question only after the deadline (i.e., after 6:30 pm). Consequently, it is advisable to plan ahead and refrain from depending on last-minute assistance from the teaching staff.

Assignments

There are tentatively 3 assignments across this semester. Assignments must be submitted on Canvas and are date-stamped when submitted. While you are allowed to submit your assignment late, you will receive a 20% grade penalty for every additional day after the deadline. As this is a generous late submission policy, penalties are strictly enforced, and I will NOT grant extensions. Please plan accordingly, and do not leave submission for the last minute. You are allowed to discuss the assignments with up to three classmates, but each assignment must represent your

own effort. If you discussed assignments with any other classmates, please also list their names in your submission (e.g., “This assignment submission was discussed with xx”).

Plagiarism Policy

I have seen plagiarism in my past years of experience teaching programming classes, and it seems that a few people will turn in assignments that are not their own. You should understand that it is very easy to detect copy & paste for programs, even when a program has been changed to cover where it comes from. Copying code from others, or letting others copy your code is a violation of student disciplinary policy and academic integrity at USF, and the penalty for such behavior follows related school policy. Copying answers from each other or from prior students of this class will be viewed as “plagiarism” and will earn you a zero grade on that assignment for the first offense, an F grade for the class for the second offense, and dismissal from the MS-BAIS program for the third offense.

Lab Sessions

There are tentatively 6-8 labs, which follow immediately after each lecture**.** Each lab session lasts 30-45 minutes. Within each lab, you need to finish some given tasks. Typical tasks are reviewing/practicing what we learned in lectures for that week. For some labs, you need to submit your code. **You are required to attend all the Lab sessions**.

Course project

Please refer to **Project_23fall.pdf** to find more details of project requirements.

Attendance

There might be some random attendance checks. I will deduct 10 points if you are absent for all checks. Failing to attend midterm or final project presentations will receive an “F” for the course except for extreme reasons.

Tentative Class Schedule (subject to change):

Week	Date	Topic	Pre-lecture reading	Due
1	08/24	Introduction to AI, machine learning basics +lab		
2	08/31	Neural Networks and	● Lecture2Note on Canvas	*Assignment*

		Backpropagation +lab	● Deep Learning with Python book: Section 2.4 ● Tutorial of backpropagation: https://www.youtube.com/watch?v=tIeHLnjs5U8&t=261s	*1 release*
3	09/07	CNN Basic (basic, batch normalization) +lab	Deep Learning with Python book: section 5.1, section 7.3.1	
4	09/14	CNN Advanced (training tricks, common architectures) +lab	Deep Learning with Python book: section 5.2 and 5.3.	Assignment 1 due Assignment 2 release
5	09/21	CNN Applications, RNN (LSTM, making RNN more effective) +lab		
6	09/28	RNN (Text generation and translation) +lab		Assignment 2 due Assignment 3 release
7	10/05	Attention, Self attention **Midterm presentation and feedback**		
8	10/12	Transformer, BERT		Assignment 3 due
9	10/19	Reinforcement Learning (1)		
10	10/26	Reinforcement Learning (2)		
11	11/02	**Final Presentation**		
12	11/09	No class		Final report and code submission due

Acknowledgments

Much of the structure of this course was derived from previous courses taught by Professors Shusen Wang and Theja Tulabandhula. I appreciate their help and permission to build on their good work.