

MIT Sloan School of Management
15.773: Hands-on Deep Learning – Spring 2024

Course Syllabus

Instructors: Vivek Farias, Rama Ramakrishnan

Description

Deep Learning is the engine behind all the **Predictive** and **Generative AI** advances that we see around us today. Starting from around 2010, this single algorithmic strategy has beaten incumbents and broken records in multiple areas: speed recognition, image recognition, natural language processing and so on. Deep Learning is considered by many to be a general-purpose technology - like electricity and the Internet - whose impact will be pervasive and profound, and it is well on its way to revolutionizing many fields, from business to the sciences.

This course will unpack Deep Learning, developing its building blocks from scratch. The emphasis will be on developing a deep, hands-on understanding of how to build models to solve complex problems involving the processing of unstructured inputs (e.g., how do we detect if a driver is falling asleep?) and the generation of unstructured outputs (e.g., how do we summarize the content of a customer-service call transcript?)

You will learn the basics of deep neural networks - layers and activations - and how to set up and train them. You will learn about special-purpose networks that have been invented in the field of Computer Vision to process images and videos (convolutional networks) and networks that have been invented in the field of Natural Language Processing to process text and sequences (Transformers). **You will learn how Large Language Models (LLMs) like GPT-4 are built and how to adapt LLMs to specific business applications.** You will roll up our sleeves and write Python programs (using the powerful Tensorflow/Keras Deep Learning software framework) to create deep learning models and train them on real-world datasets.

Throughout the course, we will examine in detail how Deep Learning is being applied to a range of opportunities and problem areas. The class will place an emphasis on connecting this fascinating new technology to sources of business value.

This course is an approved elective for MBAn and the Business Analytics Certificate.

Pre-requisites

- Familiarity with Python at [this](#) level
- Familiarity with fundamental machine learning concepts (such as training/validation/testing, overfitting/underfitting, and regularization).
 - If you have taken 15.071/15.072 (or will be taking it concurrently) OR if you have other relevant coursework or work experience, you should be fine.
 - If you aren't sure if you have the necessary background, email the instructors.

Grading

Your course grade will be based on 2 homework assignments, a final project, and class participation:

Class participation	10%
Homework assignments (25% x 2)	50%
Final project	40%

Course Textbook

[Deep Learning with Python](#) by Francois Chollet, Second Edition, October 2021.

Professors

	Vivek Farias	Rama Ramakrishnan
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Lectures

Section	Professor	TA	Location	Day/Time
A	Ramakrishnan	Evan Yao (evanyao@mit.edu)	E62-276	MW 8:30-10:00
B	Farias	Gabriel Afriat (afriatg@mit.edu)	E62-250	MW 10:00-11:30

SCHEDULE (subject to change)

Mon	05 Feb	Introduction to Neural Networks and Deep Learning (motivation, smart representations, layers, activations, architectures); Training Deep NNs (loss functions, gradient descent, regularization)	
Wed	07 Feb	Training Deep NNs (continued); Introduction to Keras/Tensorflow (tensors, functional API, training, evaluation); Application to tabular data	
Mon	12 Feb	Deep Learning for Computer Vision – Building Convolutional Neural Networks from scratch	HW Assignment #1 posted
Wed	14 Feb	Deep Learning for Computer Vision – Transfer Learning and Fine-tuning; Introduction to HuggingFace	
Mon	19 Feb	<i>HOLIDAY (President's Day)</i>	
Tue	20 Feb	Deep Learning for Natural Language – The Basics (Tokenization, N-grams, Bag-of-Words)	HW Assignment #1 due
Wed	21 Feb	Deep Learning for Natural Language – Embeddings	HW Assignment #2 posted
Mon	26 Feb	Deep Learning for Natural Language – Transformers	Project Proposal Due
Wed	28 Feb	Deep Learning for Natural Language – Transformers, Self-Supervised Learning	
Mon	04 Mar	Generative AI - Large Language Models (LLMs) and Retrieval Augmented Generation (RAG)	HW Assignment #2 due
Wed	06 Mar	Generative AI – Adapting LLMs with Parameter-Efficient Fine-Tuning	
Mon	11 Mar	Generative AI – Text-to-Image Models	Projects due
Wed	13 Mar	Project Presentations	

Recitations

Location and times: TBD

Teams

Students are required to form teams of 4 that will stay fixed for the duration of the class. Cross-sectional teams are not allowed since teams will be presenting their projects in their respective sections.

We ask that students form teams via Canvas within the first two weeks of class. Use the "People" link on Canvas and navigate to the "Project Groups" tab.

Projects

A major deliverable for the course is a final project. You will submit a 1-page proposal for your final project in the fourth week of class. The proposal will clearly describe the problem (both from a business and technical perspective), the dataset, and your proposed approach(es).

We encourage teams to assemble/curate their own dataset. If that proves to be infeasible given the time constraints of a half-semester class, you are welcome to use publicly available datasets. To that end, the following resources may be helpful:

- [Kaggle Datasets](#)
- [Google Dataset Search](#)
- [Huggingface Datasets](#)

Teams that do bring their own dataset to the project will get *extra* credit 😊.

All project submissions must be made available under the MIT license (<https://tldrlegal.com/license/mit-license#fulltext>) and posted to Github.