CEng 783 Deep Learning

Department of Computer Engineering @ METU – Fall 2020

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Lectures: Tuesdays 09:40-12:30.

Web: `http://bit.do/783-20201`[1] and `https://odtuclass.metu.edu.tr/`.

Description: This course aims to teach the fundamentals of deep learning. We will study the three major types of deep neural networks, namely, Multi-layer Perceptrons, Convolutional Neural Networks, and Recurrent Neural Networks, and take an in-depth look at their use in various machine learning problems such as supervised learning, unsupervised learning, generative modeling, and reinforcement learning. We will also explore the most recent developments in the field and state of the art applications of deep neural networks in computer vision and natural language processing. Weekly tentative schedule is as follows.

Date		Topic	Activities
1	Oct 13	Course logistics. High-level introduction to deep learning.	Hw1 given Oct 14
2	Oct 20	Machine learning background and basics. *An overview of supervised learning*	Hw1 due Oct 21
3	Oct 27	Artificial neurons. Multi-layer Perceptrons *Biological neuron, artificial neuron, Perceptron, Multilayer Perceptrons, Activation Functions, Loss Functions, Backpropagation, Stochastic Gradient Descent, Momentum*	
4	Nov 3	Convolutional neural networks (CNNs) *Convolutional neural networks, Convolution, Connectivity types, Pooling, AlexNet, Data augmentation, Dropout, Batch and group norm.*	
5	Nov 10	Convolutional neural networks *More loss functions, Initialization, Implementing backpropagation in a modular way, Adaptive learning rate methods, Deconvolution*	
6	Nov 17	Applications of CNNs	
7	Nov 24	Recurrent neural networks (RNNs) *Recurrent neural networks, Backpropagation through time, Long short-term memory networks, Gated recurrent units, Encoder-decoder architectures*	Hw2 given Nov 24
8	Dec 1	Applications of RNNs	
9	Dec 8	Deep generative models *Boltzmann machines, Deep belief networks, Generative Adversarial Networks, Variational autoencoders*	Hw2 due Dec 8
10	Dec 15	Deep reinforcement learning (RL) *Intro to RL, Deep Q-Learning, Deep policy gradient, Applications of RL*	
11	Dec 22	Misc. topics *Non-local neural networks, Transformers, Graph Neural Networks, Neural architecture search*	Written exam
12	Dec 29	Discussion on latest trends, limitations, open issues. Deep hierarchies in human vision	
13	Jan 5	Paper presentations & discussions	
14	Jan 12	Paper presentations & discussions	

Textbook: There is no official textbook for the class. We will follow the state of the art mainly with papers and by using parts of the "Deep Learning" book by Goodfellow et al., which is available online.

Grading: Homework assignments 45%; Written exam 35%; Paper presentation 15%; Participation 5%

Prerequisities: Foundational knowledge in machine learning, calculus, linear algebra. Proficiency in Python.

[1] Full url: `http://user.ceng.metu.edu.tr/~emre/Fall2020-DeepLearning.html`