

# CEng 501 Deep Learning

Department of Computer Engineering @ METU – Fall 2021

**Instructor:** Emre Akbas; Office B-208; emre@ceng.metu.edu.tr; Office hours by appointment.

**Lectures:** Friday 09:40-12:30 @ BMB5 & Zoom.

**Web:** [https://dar.vin/501-F21<sup>1</sup>](https://dar.vin/501-F21<sup>1</sup) 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 22	Course logistics. High-level introduction to deep learning.	Hw1 given Oct 22
2	Oct 29	Republic Day (National Holiday) – no class.	Hw1 due Oct 31
3	Nov 5	Machine learning background and basics. <i>An overview of supervised learning</i>	
4	Nov 12	Artificial neurons. Multi-layer Perceptrons <i>Biological neuron, artificial neuron, Perceptron, Multilayer Perceptrons, Activation Functions, Loss Functions, Backpropagation, Stochastic Gradient Descent, Momentum</i>	
5	Nov 19	Convolutional neural networks (CNNs) <i>Convolutional neural networks, Convolution, Connectivity types, Pooling, AlexNet, Data augmentation, Dropout, Batch and group norm.</i>	
6	Nov 26	Convolutional neural networks <i>More loss functions, Initialization, Implementing backpropagation in a modular way, Adaptive learning rate methods, Deconvolution</i>	Hw2 given Nov 26
7	Dec 3	Applications of CNNs	Hw2 due Dec 5
8	Dec 10	Recurrent neural networks (RNNs) <i>Recurrent neural networks, Backpropagation through time, Long short-term memory networks, Gated recurrent units, Encoder-decoder architectures</i>	Hw3 given Dec 10
9	Dec 17	Applications of RNNs	Hw3 due Dec 19
10	Dec 24	Deep generative models <i>Boltzmann machines, Deep belief networks, Auto-encoders, Variational autoencoders, Generative Adversarial Networks</i>	
11	Dec 31	Deep reinforcement learning (RL) <i>Intro to RL, Deep Q-Learning, Deep policy gradient, Applications of RL</i>	<del>Exam</del>
12	Jan 7	Misc. topics (latest trends, limitations, open issues, etc.) <i>Double descent, Dynamic Filter Networks, Non-local neural networks, Transformers, Graph Neural Networks, Neural architecture search</i>	Exam
13	Jan 14	Paper presentations & discussions	
14	Jan 21	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%

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

<sup>1</sup>Full url: <http://user.ceng.metu.edu.tr/~emre/Fall12021-DeepLearning.html>