



METU - Department of Computer Engineering  
**CENG 501 – Deep Learning**  
**2024-2025 Fall**



**Web:** <https://user.ceng.metu.edu.tr/~skalkan/DL/>

**Emailing List:** METU Class page of the course.

**Instructor:** Sinan Kalkan, skalkan@metu.edu.tr (Office hours: by appointment)

**Lectures:** Wednesdays, 9:40-11:30, BMB2

**Credits:** METU: 3 Theoretical, 0 Laboratory; ECTS: 8.0

**Description:** This course assumes that the student has taken already a course on the fundamentals of deep learning and is familiar with conventional models such as Multi-Layer Perceptrons, Convolutional Neural Networks, Recurrent Neural Networks and Long-Short Term Memory Networks. After a review of these models, the course will cover self-attention & transformers, large-language models, vision-language models, generative models, self-supervised learning and reinforcement learning in detail.

**Textbook:** We will mainly follow the papers. However, the following might be handy:

- Y. Bengio, I. Goodfellow and A. Courville, “Deep Learning”, MIT Press, 2016.
- A. Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly, 2017.
- Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.

**Grading:**

Quizzes (approx. 10)	20%
Final Exam	35%
Project	45%

**Tentative Schedule:**

Week & Date		Topic
1	2 Oct	<b>Course Overview; A Quick Review of Deep Learning Fundamentals</b> [History of Artificial Neuron Models, Perceptron Learning, Gradient Descent, Multi-layer Perceptrons, Backpropagation, Convergence, Overfitting, Capacity]
2	9 Oct	<b>A Quick Review of Deep Learning Fundamentals</b> [History of Artificial Neuron Models, Perceptron Learning, Gradient Descent, Multi-layer Perceptrons, Backpropagation, Convergence, Overfitting, Capacity]
3	16 Oct	<b>Convolutional Neural Networks</b> [Operations in CNNs, Types of Convolution, Popular CNN Architectures]
4	23 Oct	<b>Recurrent Neural Networks</b> [Vanilla RNNs and Long Short Term Memory Networks]
5	30 Oct	<b>Self-Attention and Transformers</b> [Types of attention, Self-attention, Encoder and Decoder Transformers]
6	6 Nov	<b>Large-Language Models</b> [Generative Pretraining, BERT, GPT-1, GPT-2, GPT-3, Instruct-GPT]
7	13 Nov	<b>Large-Language Models</b> [Using Pretrained LLMs, Retrieval Augmented Generation, Efficient Finetuning]
8	20 Nov	<b>Vision Models</b> [Vision Transformers, Swin Transformers, Fast/Faster ViTs, Pretraining]
9	27 Nov	<b>Vision-Language Models</b> [Well-known Models such as CLIP, BLIP, Flamingo]
10	4 Dec	<b>Generative Models</b> [Autoregressive Models, Variational AEs, Flow Models]
11	11 Dec	<b>Generative Models</b> [Energy-based Models, Diffusion Models]
12	18 Dec	<b>Self-Supervised Learning</b> [Contrastive Learning, SimCLR, MoCo, BYOL, SimSiam, VICReg]
13	25 Dec	<b>Self-Supervised Learning</b> [Contrastive Learning, SimCLR, MoCo, BYOL, SimSiam, VICReg]
14	1 Jan	<b>Reinforcement Learning</b> [Problem Setting, Value Networks, Policy Networks, Actor-Critic Networks]