



METU - Department of Computer Engineering
CENG 501 – Deep Learning
2025-2026 Spring



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, BMB4

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%
Assignments, Project	45%

Tentative Schedule:

Week & Date		Topic
1	16 Feb	Course Overview; A Quick Review of Deep Learning Fundamentals [History of Artificial Neuron Models, Perceptron Learning, Gradient Descent, Multi-layer Perceptrons, Backpropagation, Convergence, Overfitting, ...]
2	23 Feb	A Quick Review of Deep Learning Fundamentals [History of Artificial Neuron Models, Perceptron Learning, Gradient Descent, Multi-layer Perceptrons, Backpropagation, Convergence, Overfitting, ...]
3	2 Mar	Convolutional Neural Networks [Operations in CNNs, Types of Convolution, Popular CNN Architectures]
4	9 Mar	Recurrent Neural Networks [Vanilla RNNs and Long Short Term Memory Networks]
5	16 Mar	Self-Attention and Transformers [Types of attention, Self-attention, Encoder and Decoder Transformers]
6	23 Mar	Large-Language Models [Generative Pretraining, BERT, GPT-1, GPT-2, GPT-3, Instruct-GPT]
7	30 Mar	Large-Language Models [Using Pretrained LLMs, Retrieval Augmented Generation, Efficient Finetuning]
8	6 April	Vision Models [Vision Transformers, Swin Transformers, Fast/Faster ViTs, Pretraining]
9	13 Apr	Vision-Language Models [Well-known Models such as CLIP, BLIP, Flamingo]
10	20 Apr	Generative Models [Autoregressive Models, Variational AEs, Flow Models]
11	27 Apr	Generative Models [Energy-based Models, Diffusion Models]
12	4 May	Self-Supervised Learning [Contrastive Learning, SimCLR, MoCo, BYOL, SimSiam, VICReg]
13	11 May	Self-Supervised Learning [Contrastive Learning, SimCLR, MoCo, BYOL, SimSiam, VICReg]
14	18 May	Reinforcement Learning [Problem Setting, Value Networks, Policy Networks, Actor-Critic Networks]
15	25 May	Sacrifice Bayram Break
16	1 June	An Overview of Current Challenges