

DEEP LEARNING

Objective:

1. To understand the fundamentals of deep learning and neural networks.
2. To apply CNNs, RNNs, and generative models to real-world problems.
3. To analyze optimization methods and training strategies for effective model design.
4. To be familiar with recent trends, deployment practices, and ethical aspects of deep learning.

Module I

Introduction to Deep Learning, Evolution, Bayesian Learning, Perceptron, Activation Functions Decision Surfaces, Linear Classifiers, SoftMax, SVM Hinge Loss, Gradient Descent, Optimization Basics

Module II

Introduction to Neural Network, Multilayer Perceptron, Back Propagation, Unsupervised Deep Learning: Autoencoders, Convolutional Neural Networks: Convolution, Pooling, Padding, Building Blocks; Transfer Learning, Feature Extraction, Domain Adaptation

Module III

Optimization Techniques: Batch Optimization, Momentum, RMSProp, Adam; Effective Training Strategies: Early Stopping, Dropout, Batch Normalization, Group Normalization; Sequence Models: Recurrent Neural Networks (RNN), LSTM, GRU; Applications of RNNs in NLP and Time Series; Evaluation Metrics for Classification and Detection, Recent Trends in Deep Learning Architectures

Module IV

Classical Supervised Tasks: Image Denoising, Semantic Segmentation, Object Detection; Generative Models: Variational Autoencoders (VAE), Generative Adversarial Networks (GAN); Attention Mechanisms & Transformers (introductory level), Generative Modeling with DL, Responsible AI & Ethics, Deployment of DL Models.

Course Outcomes:

1. CO1: Demonstrate knowledge fundamental concepts of deep learning, including neural architectures, activation functions, and optimization techniques.
2. CO2: Design and implement deep learning models such as MLPs, CNNs, and RNNs using modern frameworks.
3. CO3: Apply optimization strategies, regularization methods, and training techniques to improve model efficiency and accuracy.
4. CO4: Evaluate deep learning models using appropriate metrics and analyze their performance in real-world tasks like vision, NLP, and time-series.
5. CO5: Develop and deploy deep learning applications while considering responsible AI principles and ethical implications.

Books Recommended:

1. Deep Learning — Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016.

2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd Edition)
— Aurélien Geron, O'Reilly Media, 2022.