

Machine Learning

L-T-P-C : 3-1-0-4

Course Objectives:

1. To have a clear understanding of supervised learning, unsupervised learning, and dimensionality reduction techniques.
2. Students should be able to design and implement the above mentioned learning solutions for respective learning problems.
3. Students should know how to evaluate a learning technique.

Course Outcomes:

1. Ability to build a classifier for the given labeled data.
2. Ability to employ a clustering method for the given unlabeled data.
3. Ability to do dimension reduction for the given data.

Prerequisites:

Probability Theory, Linear Algebra, Basics of Calculus, Data Structures and Fundamental Algorithms.

Syllabus

Module	Lectures
Module1	Introduction to machine learning (ML). Various learning paradigms. Introduction to supervised learning. Introduction to the Bayes classifier.
	Bayesian decision theory. Various cases, especially with the Normal (Gaussian) density – discriminants, etc.
	Maximum-likelihood and Bayesian parameter estimation.
	Nonparametric techniques – Parzen Windows, K-nearest neighbor classification.
Module2	Linear discriminants – Perceptron
	Multilayer neural networks – Error backpropagation. Introduction to Convolutional Neural Networks.
	Support Vector Machines (SVMs) and other kernel methods – SMO algorithm for learning.
	Regression – linear models – extension to nonlinear models.

Module3	Unsupervised learning – clustering, mixture models and EM.
	Dimension reduction techniques – PCA, SVD.
	Introduction to semi-supervised learning: Semi-supervised classification, semi-supervised (constrained) clustering.
	Theoretical aspects – Bias, variance tradeoff – No Free Lunch theorem – Etc.

Text books/ References:

1. “Pattern Classification” by R. O. Duda, P. E. Hart and D. G. Stork.
2. “An Introduction to Statistical Learning” by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani.
3. “Pattern Recognition and Machine Learning” by Christopher M. Bishop.
4. “Introduction to Machine Learning” by Ethem Alpaydin.
5. “Pattern Recognition: An Algorithmic Approach” by M. Narasimha Murty, V. Susheela Devi.
6. “Machine learning” by Tom Mitchell.