

DSPC3004 MACHINE LEARNING (3-0-0)

Course Objectives:

- To understand the basic concepts of machine learning.
- To understand and build supervised learning models.
- To understand and build unsupervised learning models.
- To evaluate the algorithms based on corresponding metrics identified.

Module-I (08 hours)

Introduction to Machine Learning

Basics, types of machine learning, Machine learning lifecycle; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off, Evaluation and Cross-Validation

Module-II (08 hours)

Supervised Learning

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Bayesian network, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

Module-III (08 hours)

Ensemble Techniques And Unsupervised Learning

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: k-Nearest Neighbours (KNN), feature selection, feature extraction, Gaussian mixture models and Expectation maximization.

Module-IV (08 hours)

Neural Networks

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

Module-V (8 hours)

Design And Analysis Of Machine Learning Experiments

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold Cross Validation, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

Course Outcomes:

At the end of this course, the students will be able to:

- Explain the basic concepts of machine learning.
- Construct supervised learning models.
- Construct unsupervised learning algorithms.
- Evaluate and compare different models

Text Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014.

Reference Books:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
5. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing, 3rd Edition, 2019