Subject Code: PCCS-114

Subject Name: Machine Learning

Programme: B.Tech. (CSE)	**L:**3 **T:**0 **P:**0
Semester: 6	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 03
Internal Marks:40	**Percentage of Numerical/Design/Programming Problems:** 30%
External Marks:60	**Duration of End Semester Exam(ESE):** 3 Hours
Total Marks:100	**Course Status:** Compulsory

Prerequisites: Data Mining Techniques

On Completion of the course the student should be able to:

CO#	COURSE OUTCOMES
1.	Implement probability concepts in learning problems with hypothesis and version spaces.
2.	Illustrate the features and algorithms of machine learning with real world problems.
3.	Characterize the machine learning algorithms as supervised learning and unsupervised learning and apply and analyze the various algorithms of supervised and unsupervised learning.
4.	Analyze the concept of neural networks for learning linear and non-linear activation functions.
5.	Apply the concepts of Bayesian analysis from probability models and methods.
6.	Explain and design genetic algorithms for engineering problems with their analysis using evaluation measures.

Detailed Contents

Part A

Introduction: Well defined learning problems, defining a learning system, perspectives and issues in machine learning, the concept learning task, concept learning as search, Find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Inductive bias, probability theory. **[4 Hours]**

Supervised Learning: Basic methods: Distance based methods, Nearest- Neighbors, Decision Trees, Naive Bayes, and Linear models: Linear regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and kernel Methods. **[5 Hours]**

Unsupervised Learning: Clustering: k-means/ kernel k-means, Dimensionality Reduction: PCA and

kernel PCA, Matrix Factorization and Matrix Completion, Generative models (mixture models and latent factor models). **[5 Hours]**

Decision Tree Learning: Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Ensemble methods- Bagging, Gradient Boosting, Random Forest. **[5 Hours]**

Part B

Artificial Neural Networks: Introduction, Neural network representation, appropriate problems for neural network learning, perceptron, gradient descent and the delta rule, Adaline, Multilayer networks, Derivation of Back propagation rule, back propagation algorithm, Initialization, Training & Validation. **[5 Hours]**

Bayesian Learning: Introduction, Bayes theorem and concept learning, Maximum likelihood and least squared error hypothesis for predicting probabilities, minimum description length principle, Bayes optimal classifier, Naive Bayes classifier, Bayesian belief networks. **[6 Hours]**

Genetic Algorithms: Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning. **[3 Hours]**

Design and Analysis of Algorithms: Study of factors and responses related with experimentation, Hypothesis testing, performance analysis, Evaluation measures-bootstrapping & cross-validation, ROC curve. **[3 Hours]**

Textbooks:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, First Edition.
2. Ethern Alpaydin, Introduction to Machine Learning, MIT Press, 3rd Edition.
3. Aditya Dwivedi, Machine Learning Textbook, Kindle Edition, Dec 2019.

Reference Books:

1. Chris Bishop, Pattern Recognition and Machine Learning, Springer.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2nd Edition

E-Books and Online Learning Material

1. Introduction to Machine Learning by Nils J. Nilsson
https://ai.stanford.edu/~nilsson/MLBOOK.pdf
2. Lecture Notes on Machine Learning by Sebastian Raschka
https://sebastianraschka.com/pdf/lecture-notes/stat479fs18/01_ml-overview_notes.pdf
3. https://www.tutorialspoint.com/machine_learning/machine_learning_tutorial.pdf

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/106106139/ Accessed on February 17, 2021
2. https://nptel.ac.in/courses/106106213/ Accessed on February 17, 2021
3. https://www.coursera.org/lecture/machine-learning/welcome-to-machine-learning-zcAuT

Accessed on February 17, 2021

4. https://www.udacity.com/course/intro-to-machine-learning-with-tensorflow-nanodegree--nd230
   Accessed on February 17, 2021
5. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
   Accessed on February 17, 2021