

FOUNDATIONS OF MACHINE LEARNING

| IV Semester: CSE(AI & ML) | | | | | | | | |
|---|----------|-----------------------------|---|-------------------------------|---------|--------------------------|-----|-------|
| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
| ACAC03 | Core | L | T | P | C | CIA | SEE | Total |
| | | 3 | 1 | 0 | 4 | 30 | 70 | 100 |
| Contact Classes: 45 | | Tutorial Classes: 15 | | Practical Classes: Nil | | Total Classes: 60 | | |
| Prerequisites: Linear Algebra and Calculus, Probability and Statistics, Python Programming | | | | | | | | |
| I. COURSE OVERVIEW: | | | | | | | | |
| <p>This course introduces the fundamental concepts and methods of machine learning, including the description and analysis of several modern algorithms, their theoretical basis, and the illustration of their applications. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to text and speech processing, bioinformatics, and other areas in real-world products and services. This will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques.</p> | | | | | | | | |
| II. COURSE OBJECTIVES: | | | | | | | | |
| The students will try to learn: | | | | | | | | |
| <ol style="list-style-type: none"> I. The underlying mathematical principles from probability, linear algebra and optimization. II. The knowledge of using machine learning to make predictions in a scientific computing environment. III. The underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and un-supervised learning. IV. The advanced topics such as robotics, machine learning, deep learning, pattern recognition, computer vision, cognitive computing, human-computer interaction etc. | | | | | | | | |
| III. SYLLABUS: | | | | | | | | |
| MODULE – I: INTRODUCTION TO MACHINE LEARNING (09) | | | | | | | | |
| Machine Learning Foundations: Introduction to machine learning, learning problems and scenarios, need for machine learning, types of learning, standard learning tasks, the Statistical Learning Framework, Probably Approximately Correct (PAC) learning. | | | | | | | | |
| MODULE – II: SUPERVISED LEARNING ALGORITHMS (09) | | | | | | | | |
| Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression. | | | | | | | | |
| MODULE – III: ENSEMBLE AND PROBABILISTIC LEARNING (09) | | | | | | | | |
| Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking | | | | | | | | |
| Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Mining Frequent Patterns | | | | | | | | |
| MODULE - IV UNSUPERVISED LEARNING (09) | | | | | | | | |
| Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis | | | | | | | | |
| MODULE - V ADVANCED SUPERVISED LEARNING (09) | | | | | | | | |
| Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors. | | | | | | | | |

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, PHI, 3rd Edition, 2014.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2nd Edition, 2018.

V. REFERENCE BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill, Indian Edition, 2017.
2. Sahi Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2010.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2nd Edition, 2009.
5. Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Press, 2020.
6. Gareth James, Daniela Witten, Trevor Hastie and Rob Tibshirani, "An Introduction to Statistical Learning: with applications in R", Springer Texts in Statistics, 2017.

VI. WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc19_cs52/preview
2. <https://ece.iisc.ac.in/~parimal/2019/ml.html>
3. <https://www.springer.com/gp/book/9780387848570>
4. <https://www.cse.iitb.ac.in/~sunita/cs725/calendar.html>
5. <https://www.analyticsvidhya.com/blog/2018/12/guide-convolutional-neural-network-cnn/>
6. <https://cs.nyu.edu/~mohri/mlu11/>