# FOUNDATIONS OF MACHINE LEARNING

**IV Semester:** CSE(AI & ML)

| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CIA | SEE | Total |
| ACAC03 | Core | 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:

The main emphasis of this course is to provide systems the ability to automatically learn and improve from experience without being explicitly programmed. The course includes the fundamental concepts to build, train, and predict data models using machine learning (ML) algorithms. This course providesa clear understanding on concepts of supervised learning through decision trees, advanced techniqueslike neural networks, Naive Bayes and k-nearest neighbor algorithm and introduction to unsupervised and reinforcement learning. Machine Learning has revolutionized industries like medicine, healthcare, manufacturing, banking, and several other industries

## II. COURSE OBJECTIVES:

**The students will try to learn:**

I The fundamental concepts and techniques of machine learning.

II The underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervisedlearning.

III The skills of using machine learning software for solving practical problems.

IV To choose suitable machine learning algorithms and evaluate the performanceof algorithms to provide solutions for various real-world problems.

## III. COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

| | | |
|---|---|---|
| CO 1 | **Demonstrate** the characteristics of Machine Learning thatmake it useful to solve real-world problems | Understand |
| CO 2 | **Make use of** Supervised Learning Algorithm for Classification Model and Decision Tree Learning. | Apply |
| CO 3 | **Build** a Prediction Model by using Linear Regression Techniques and Ensemble Techniques. | Apply |
| CO 4 | **Make use of** Bayesian Learning for Classification Model andoutline Unsupervised learning Algorithms for determining hidden patterns in data | Apply |
| CO 5 | **Discuss** the methodology of Neural Networks and Support Vector Machines to classify the Linear and Non-Linear data | Apply |
| CO 6 | **Identify** appropriate Machine Learning Algorithms depending on the nature of the Learning System | Apply |

## IV. 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.

## V. 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.


## VI. 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.


## VII. 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/