# Machine Learning Fundamentals

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre- requisite of the Course (if any) |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| **Machine Learning Fundamentals** | **4** | **3** | **0** | **1** | **Class XII Pass** | **NA** |

## COURSE OBJECTIVE

The Learning Objectives of this course are as follows:

- This course will present foundations of Machine Learning algorithms, as well as their real- world applications.
- The course will cover two major learning approaches: supervised and unsupervised.

## COURSE OUTCOME

Upon successful completion of this course, the student will be able to:

- Differentiate between supervised and unsupervised learning tasks.
- Normalize the data and perform outlier analysis.
- Execute various machine learning algorithms learnt in the course.Understand the concepts of regression, clustering and dimensionality reduction.

## SYLLABUS

**Unit I** **(9 Hours)**

**Introduction to Machine Learning:**Definition, History, Future and basic concepts of Machine Learning, Key elements of Machine Learning, Supervised vs. Unsupervised Learning, Mamthematical Foundations: Data Structures for linear Algebra, Tensor Operations, matrix properties, Eigenvectors and Eigenvalues, Matrix operations for Machine Learning.

**Unit II** **(12 Hours)**

**Supervised Learning- I:**Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Over-fitting and Bias-Variance Trade-off, regularization. Regression evaluation metrics. Linear Discriminant Analysis

**Unit III** **(12 Hours)**

**Supervised Learning- II:**Logistic Regression, Naïve Bayes Classifier, K-Nearest Neighbour (K-NN), Support Vector Machine (SVM), Kernel SVM, Decision Tree Classifier, Evaluating Classification Model Performance

**Unit IV** **(12 Hours)**

**Unsupervised learning:**clustering: Approaches for clustering, distance metrics, K-means clustering, hierarchical clustering, and feature selection methods. Dimensionality reduction (Principal Component Analysis). Association Rules Learning.

**PRACTICAL COMPONENT (IF ANY)**

Use Python for practical labs for Machine Learning.

**LIST OF PRACTICALS Practical (30 Hours)**

1. Implement linear algebra operations such as matrix multiplication, eigenvectors, and eigenvalues using libraries like NumPy.
2. Develop a program for Simple Linear Regression to predict a continuous target variable.
3. Extend the implementation to Multiple Linear Regression and Polynomial Regression.
4. Implement Ridge and Lasso regression to demonstrate regularization.
5. Write a program to implement LDA for dimensionality reduction.
6. Develop a KNN algorithm from scratch and evaluate its performance on a dataset.
7. Create a Decision Tree Classifier to solve a classification problem.
8. Implement K-Means clustering and hierarchical clustering on an unlabelled dataset.
9. Perform Principal Component Analysis (PCA) to reduce the dimensions of a dataset and visualize the results.

## REFERENCES


1. Alpaydin, E. (2020). Introduction to machine learning. MIT press.
2. Mathematical Foundation of Machine Learning: A Comprehensive Exploration of the Mathematical Foundations Underpinning Machine Learning
3. James, G., Witten, D., Hastie, T., &Tibshirani, R. (2013). An introduction to statistical learning (Vol. 112, p. 18). New York: springer.
4. Raschka, S., &Mirjalili, V. (2019). Python machine learning: Machine learning and deep learning with Python, scikit-learn, and TensorFlow 2. Packt Publishing Ltd.
5. Shalev-Shwartz, S., & Ben-David, S. (2014). Understanding machine learning: From theory to algorithms. Cambridge university press.