

**Advanced Machine Learning Techniques****Course Objectives**

- To understand the concepts of Machine Learning.
- To understand the theoretical and practical aspects of types of machine learning
- To teach and get familiarized with supervised learning and their applications.
- To teach and get familiarized with the concepts and algorithms of unsupervised learning.
- To appreciate the concepts and algorithms of deep learning.

**Unit I:**

**Introducing Machine Learning:** The Origins of Machine Learning, Uses and Abuses of Machine Learning \_ Basics of Machine Learning Algorithm Model Works - Steps to apply Machine Learning - Choosing a Machine Learning Algorithm - Using Machine Learning concepts.

**Managing and Understanding Data:** Data Structures, Vectors And Factors: Lists, Data frames, Matrixes and arrays - Managing Data - Exploring and Understanding Data: Exploring the Structure of Data, Exploring Numeric variables - Exploring Categorical Variables- Exploring Relationships between Variables.

**Unit II:**

Lazy Learning – **Classification Using Nearest Neighbors:** The kNN Algorithm- Diagnosing Breast Cancer with the kNN Algorithm- Probabilistic Learning – Classification Using Naive Bayes: Basic concepts of Bayesian Methods- The Naïve Bayes Algorithm- Example – filtering Mobile Phone Spam with the Naive Bayes Algorithm.

Divide and Conquer – **Classification Using Decision Trees and Rules:** Understanding Decision Trees- Example – Identifying Risky Bank Loans using C5.0 Decision Trees- Understanding Classification Rules- Example – Identifying Poisonous Mushrooms with Rule Learners.

**Unit III:**

Forecasting Numeric Data – **Regression Methods:** Understanding Regression- Example – Predicting Medical Expenses using Linear Regression- Understanding Regression Trees and Model Trees- Example – Estimating the Quality of Wines with Regression Trees and Model Trees.

Black Box Methods Neural Networks and Support Vector Machines: Understanding Neural Networks, from Biological to Artificial Neurons, Activation Functions, Network Topology, Training Neural Networks with Back propagation - Modeling the Strength of Concrete with ANNs- Understanding Support Vector Machines- Performing OCR with SVMs- Finding Patterns – Market Basket Analysis Using Association Rules: Understanding Association Rules- Example – Identifying Frequently Purchased Groceries with Association Rules.

#### **Unit IV:**

Finding Groups of Data – **Clustering with K-Means:** Understanding Clustering- The k-means Algorithm for clustering- Finding teen market segments using k-means Clustering- Evaluating Model Performance: Measuring Performance for Classification- Beyond Accuracy – other Measures of Performance, Visualizing Performance Tradeoffs.

Improving Model Performance: Tuning Stock Models for Better Performance- Using Caret for Automated Parameter Tuning- Creating a simple Tuned Model- Customizing the Tuning Process- Improving Model Performance with meta-learning- Understanding Ensembles- Bagging- Boosting- Random forests.

#### **Unit V:**

**Introduction to Deep Learning:** Introduction to Deep Learning, Single Layer Perceptron Model (SLP), Multilayer Perceptron Model (MLP), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Restricted Boltzmann Machines (RBMs).

**Convolutional Neural Networks (CNNs):** Structure and Properties of CNNs - Components of CNN Architectures- Convolutional Layer, Pooling Layer, Rectified Linear Units (ReLU) Layer, Fully Connected (FC) Layer, Loss Layer - Tuning Parameters ,Notable CNN Architectures, Regularization- Recurrent Neural Networks (RNNs): Fully Recurrent Networks, Training RNNs with Back-Propagation Through Time (BPPT)- Elman Neural Networks, Neural History Compressor, Long Short-Term Memory (LSTM), Traditional and Training LSTMs - Structural Damping Within RNNs, Tuning Parameter Update Algorithm.

#### **Text Books:**

1. Brett Lantz, "Machine Learning with R", Addison-Wesley Packt Publishing, 2013.
2. Taweh Beysolow, "Introduction to Deep Learning Using R: A Step-by-Step Guide to Learning and Implementing Deep Learning Models Using R", San Francisco, California, USA, 2017.

## Reference Books:

1. Daniel T. Larose, Chantal D. Larose, "Data mining and Predictive analytics", Second Ed., Wiley Publication, 2015.
2. Bertt Lantz, "Machine Learning with R: Expert techniques for predictive modeling", 3rd Edition, April 15,2019,
3. Jason Bell, "Machine Learning: Hands-On for Developers and Technical Professionals", Wiley Publication,2015.

## Course Outcomes

**On the successful completion of the course, students will be able to**

CO1	To understand, impart and analyze the concepts and of Machine Learning Techniques and types of data	<b>K1-K6</b>
CO2	To comprehend, apply and evaluate the classification techniques for real-world applications	<b>K1-K6</b>
CO3	To understand, use and perform evaluation of Regression methods	<b>K1-K6</b>
CO4	To recognize, implement and analyse the unsupervised techniques for real-world applications	<b>K1-K6</b>
CO5	To understand, identify, implement and review the deep learning techniques for real-time applications	<b>K1-K6</b>

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create**

## Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	-	-	S	L	-	S	-	-	-	-
CO2	S	S	M	-	S	L	-	S	-	-	-	-
CO3	S	S	S	-	S	L	-	S	-	S	S	S
CO4	S	S	M	-	S	L	-	S	-	-	-	-
CO5	S	S	S	-	S	L	-	S	-	S	S	S

**S- Strong; M-Medium; L-Low**