Course Code CSA4008	APPLIED MACHINE LEARNING	Course Type LTP	Credits 4

Course Objectives

1. To understand the concepts of supervised and unsupervised learning techniques.
2. To analyse the regression, classification and clustering techniques and to implement their algorithms.
3. To evaluate the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes

At the end of the course, students should be able to

1. Identify the characteristics of machine learning that makes it useful to solve real-world problems.
2. Provide solution for classification and regression approaches in real-world applications.
3. Choose an appropriate clustering technique to solve real world problems.
4. Understand the methods to reduce the dimension of the dataset used in machine learning algorithms.
5. Indicate a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems.

Student Outcomes (SO): a,b,e,i

a. An ability to apply the knowledge of mathematics, science and computing appropriate to the discipline
b. An ability to analyse a problem, identify and define the computing requirements appropriate to its solution
e. An ability to identify, formulate and solve engineering problems.
i. Design and conduct experiments as well as analyze and interpret data

Module No	Module Description	No. of hours	SOs
1	**UNIT I Introduction to Machine Learning** Preface of Machine Learning, Types of Learning : Supervised - Unsupervised Learning- Reinforcement- theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation-generalization tradeoff – bias and variance – learning curve - Finite and Infinite Hypothesis Spaces, Probably Approximately Correct (PAC) Learning-Bayes theorem ,MDL principle.	8	a,b
2	**UNIT II Supervised Learning** Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Decision	9	a,b,e

	Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression. Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors.		
3	**UNIT III Ensemble Learning and Unsupervised Learning** **Ensemble Learning** Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost. **Introduction to clustering:** Hierarchical: Partitional: K-means clustering, K- Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models- Principal components analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis.	10	a,b,e
4	**UNIT V Reinforcement Learning** Passive reinforcement learning – Direct utility estimation - Adaptive dynamic programming- Temporal difference learning- Active Reinforcement learning –Exploration –learning an action-utility function -Generalization in reinforcement learning – policy search - Applications.	8	a,b,e
5	**Unit V Neural Networks and Machine Learning in Practice** Introduction to Neural Networks - Fundamental concepts: neuron models and basic learning rules-Multilayer neural networks and back-propagation - Machine Learning in Practice Design, Analysis and Evaluation of Machine Learning Experiments.	7	a,b,e,i
6	**Guest Lecture on Contemporary Topics**	**2**	
	Total Hours	**45**	

Mode of Teaching and Learning: Flipped Classroom, Activity Based Teaching/Learning, Digital/Computer based models, wherever possible to augment lecture for practice/tutorial and minimum 2 hours lectures by industry experts on contemporary topics.

Mode of Evaluation and assessment:
The assessment and evaluation components may consist of unannounced open book examinations, quizzes, student's portfolio generation and assessment, and any other innovative assessment practices followed by faculty, in addition to the Continuous Assessment Tests and Term End Examinations.

Text Books:

1.	Ethem Alpaydin, Introduction to Machine Learning , MIT Press, Prentice Hall of India, Third Edition 2014.

Reference Books:

1	Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 4th edition, 2008, ISBN:9781597492720.

2	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar ”Foundations of Machine Learning, MIT Press, 2012.
3	Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition, 1997.
4	Charu C. Aggarwal, Data Classification Algorithms and Applications, CRC Press, 2014.
5	Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, ―Learning from Data‖, AML Book Publishers, 2012.
6	Kevin P. Murphy ”Machine Learning: A Probabilistic Perspective”, The MIT Press, 2012.

Indicative List of Experiments

No.	Experiments
1	Implement Decision Tree learning.
2	Implement Logistic Regression.
3	Implement classification using Multilayer perceptron.
4	Implement classification using SVM.
5	Implement Adaboost Algorithm.
6	Implement Bagging using Random Forests
7	Implement K-means Clustering to Find Natural Patterns in Data.
8	Implement Principle Component Analysis for Dimensionality Reduction.
9	Evaluating ML algorithm with balanced and unbalanced datasets.
10	Comparison of Machine Learning algorithms.

Recommendation by the Board of Studies on	24.06.2020
Approval by Academic council on	29.06.2020
Compiled by	Dr S Sountharrajan