Course Code	CSE 343/543
Course Name	Machine Learning
Credits	4
Course Offered to	UG/PG
Course Description	This is an introductory course on Machine Learning (ML) that is offered to undergraduate and graduate students. The contents are designed to cover both theoretical and practical aspects of several well-established ML techniques. The assignments will contain theory and programming questions that help strengthen the theoretical foundations as well as learn how to engineer ML solutions to work on simulated and publicly available real datasets. The project(s) will require students to develop a complete Machine Learning solution requiring preprocessing, design of the classifier/regressor, training and validation, testing and evaluation with quantitative performance comparisons.

Pre-requisites

Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite(other)
MTH100 Maths I		
MTH201 Probability & Statistics		
CSE101 Intro to Programming		
MTH203 Maths III		

*Please insert more rows if required

Post Conditions*(For suggestions on verbs please refer the second sheet)

CO1	CO2	CO3	CO4
Explain the different types of learning problems along with some techniques to solve them	Model real-world problems, apply different learning techniques and quantitatively evaluate the performance	Identify and use advanced techniques through existing machine learning tools and libraries	Analyze performance of ML techniques and comment on their limitations

Weekly Lecture Plan

Week Number	Lecture Topic	COs Met	Assignment/Labs/Tutorial
1	Introduction to Machine Learning; Learning Problems and the Risk Minimization Framework	CO1	
2	Classification: Naïve Bayes; k-Nearest Neighbors; Decision Trees; Regression: Linear Models	CO1, CO2, CO4	
3	Linear Models for Regression & Classification: Linear and Logistic Regression; Practical Machine Learning: Bias-Variance; Training/Testing; Overfitting; Jackknifing/Cross-Validation; Occam's razor; Regularization and Model Selection	CO1, CO2, CO4	A1
4	Perceptron and Support Vector Machines (primal & dual form.)	CO1, CO2, CO3	P, Q1 (Prereq + W1-W3)
5	Soft-Margin SVMs; Kernel Methods	CO1, CO2, CO4	A2
6	MLP and Neural Networks, Backpropagation	CO1, CO2	
7	Overflow	CO1, CO2	Q2 (W1-W7)
8	Mid-sem	CO1, CO2, CO3, CO4	
9	CNN for Image Classification, Object Detection; PCA, Autoencoders and Generative Models	CO1, CO2	A3, P
10	Introduction to Reinforcement Learning (MDPs); Bellman Equation and Dynamic Programming; Value and Policcy Iteration	CO1, CO4	
11	Q-Learning; DQN; Ensemble Methods: Bagging, Boosting and Adaboost		A4, Q3
12	Random Forests; Unsupervised Learning: k-means clustering; Gaussian Mixture Models; EM		
13	Evolutionary Algorithms; Learning Theory (if time permits)	CO1	
14	Overflow		

*Please insert more rows if required

Weekly Lab Plan

Week Number	Laboratory Exercise	COs Met	Platform (Hardware/Software)

*Please insert more rows if required

Assessment Plan

Type of Evaluation	% Contribution in Grade
Homework	30
Quiz	10
Project	25
Mid-sem	15
End-sem	20

*Please insert more row for other type of Evaluation

Resource Material

Type	Title
Textbook	1. Machine Learning, Tom M. Mitchell, McGraw Hill, 1997
Reference	1. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2006
	3. Pattern Classification. Duda, Hart and Stork. 2nd ed., Wiley, 2006
	4. Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014
	5. Reinforcement Learning: An Introduction. Richard Sutton and Andrew Barto. MIT Press, 2016 (draft)
	Other Resources - Lecture Notes, etc.