

Master of Engineering (M. E)

Semester: I

Branch: Computer Engineering (Software Engineering)

Course Code:	20-CE-PG-049010103
Course Name:	Machine Learning
Category of Course:	Core
Prerequisite Course:	Data Structures, Basics of Probability and Statistics

Teaching Scheme				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
3	0	2	4	40

Course Objectives	
1	To understand the underlying fundamental concepts and techniques of Machine Learning.
2	To be able to formulate machine learning problems corresponding to different applications.
3	To understand a range of machine learning algorithms along with their strengths and weaknesses.
4	To be able to apply machine learning algorithms to solve problems of moderate complexity.
5	To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
6	To gain experience of doing independent projects study and research.

Syllabus			
Unit No.	Topic	Prerequisite Topic	Teaching Hours
01	Introduction	---	2 (05%)
	1.1 Motivation and Applications of Machine Learning		
	1.2 Challenges		
	1.3 Introduction and types of Unsupervised and Supervised Learning		
	1.4 Languages for Machine Learning		
02	Linear Models for Regression	---	5 (15%)
	2.1 Simple Linear Regression		
	2.2 Multiple Linear Regression		
	2.3 Non-Linear Regression		
	2.4 Logistic Regression		
03	Linear Models for Classification	---	5 (10%)
	3.1 Naïve Bayes		
	3.2 K-Nearest Neighbours		
	3.3 Classification Trees		
	3.4 Decision Trees		
04	Neural Networks	---	4 (10%)
	4.1 Biological Neurons and Biological Neural Networks		
	4.2 Perceptron Learning		
	4.3 Activation Functions		
	4.4 Back-propagation Neural Networks		
05	Clustering	---	4 (10%)
	5.1 Applications of Clustering		
	5.2 K-means		
	5.3 Hierarchical Based		
06	Generative Models	---	4 (05%)
	6.1 Gaussian Mixture models and latent factor models		
	6.2 Beta-binomial model		
	6.3 Maximum Likelihood Estimator		
07	Ensemble Methods	---	5 (15%)
	7.1 Model Selection		
	7.2 Boosting		
	7.3 Bagging		
	7.4 Random Forests		
08	Graphical Models	---	4 (10%)
	8.1 Bayesian Networks		

	8.2 Inference in Graphical Models		
	8.3 Comparing directed and undirected graphical models		
09	Markov and Hidden Markov models	---	4 (10%)
	9.1 Markov models and its applications		
	9.2 Hidden Markov models and applications		
	9.3 Inference in HMMs		
	9.4 Generalizations of HMMs		
10	Recent Trends in ML	---	3 (10%)
	10.1 Recent trends in various learning techniques of machine learning		
	10.2 Introduction to Deep Learning		
	10.3 Basics of Semi-Supervised and Reinforcement Learning		

Course Outcome

1	Extract features that can be used for a particular machine learning approach in various applications.
2	To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
	To mathematically analyze various machine learning approaches and paradigms.
3	Be able to recognize the characteristics of machine learning that make it useful to real-world problems.
4	Be able to use support vector machines.
	Be able to apply unsupervised algorithms for clustering.
5	Be able to apply the concept behind neural networks for learning non-linear functions.
7	Be able to practically employ the generative models.
8	Be able to practically employ Ensemble techniques.
9	Be able to practically employ inference and learning algorithms of the hidden Markov model.
10	Understand the recent trends of Machine Learning

Suggested Reference Books

1	Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press, 2012.
2	The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2009
3	Machine Learning in Action, Peter Harrington, Manning, Dreamtech press
4	Machine Learning for Big Data, Jason Bell, Wiley
5	Machine Learning in Python, Michael Bowles, Wiley
6	Machine Learning with TensorFlow for dummies, Matthew Scarpino, Wiley
7	Python Machine Learning By Example, Yuxi Liu, Packt
8	Advance Machine Learning with Python, John Hearty, Packt
9	Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press
10	Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2007.
11	Tom Mitchell, "Machine Learning", Latest Edition, Mc-Graw Hill
12	Shai Shalev-Shwartz, and Shai Ben-David, "Understanding Machine Learning", Cambridge University Press, 2017

Proposed Evaluation Scheme by Academicians (Percentage of Weightage out of 100%)

Theory Descriptive Test	<input type="text"/>	MCQ Test	<input type="text"/>	Hands on Project	<input type="text"/>
Formulas and Derivation Test	<input type="text"/>	Numerical Test	<input type="text"/>	Seminar	<input type="text"/>

Practical Project/Hands On Project

Sr. No.	List of Practical Projects	Linked with Unit
1	Implement Classifying text with distance measures using Python.	Unit 1
2	Implement decision trees to predict contact lens type using Python.	Unit 3
3	Implement K-Means Algorithm using Python.	Unit 5
4	Implement Classification with k-Nearest Neighbors using Python.	Unit 3
5	Implement Random Forest Algorithm using Python.	Unit 7
6	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	Unit 4
7	Implement Simple Linear Regression using Python	Unit 2
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm.	Unit 6
9	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.	Unit 8
10	Implement Support vector machines using Python.	Unit 3

List of Recommended MOOC Courses for this subject :

1. <https://www.coursera.org/learn/machine-learning>
2. <https://www.edx.org/course/machine-learning-fundamentals-2>
3. <https://www.simplilearn.com/big-data-and-analytics/machine-learning-certification-training-course>

4. https://www.coursera.org/learn/machine-learning-with-python?ranMID=40328&ranEAID=OyHlmBp2G0c&ranSiteID=OyHlmBp2G0c-WU81LlqCUnd1mqt6nl1hfg&siteID=OyHlmBp2G0c-WU81LlqCUnd1mqt6nl1hfg&utm_content=2&utm_medium=partners&utm_source=linkshare&utm_campaign=OyHlmBp2G0c