Kadi Sarva Vishwavidyalaya

Faculty of Engineering and Technology

First Year Master of Engineering (Computer Engineering)

In Effect from Academic Year 2017-18

Subject Code: MECE106-N-A	Subject Title: MACHINE LEARNING

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
04	00	02	06	05	03	70	30	20	30	150

LEARNING OBJECTIVES:

Machine Learning is the discipline of designing algorithms that allow machines (e.g., a computer) to learn patterns and concepts from data without being explicitly programmed. This course will be an introduction to the Machine Learning algorithms, with a modern outlook, focusing on the recent advances, and examples of real-world applications of Machine Learning algorithms. It focuses on the principles and foundations of Machine Learning algorithms, delving deeper to understand what goes on "under the hood", and how Machine Learning problems are formulated and solved.

OUTLINE OF THE COURSE:

Unit No	Topics	Hours
1	Introduction	06
2	Parametric Regression	06
3	Supervised Learning	06
4	Generative Learning	06
5	Discriminative Learning	06
6	Neural Networks & Deep Learning	08
7	Support vector machines	07
8	Graphical and sequential models	08
9	Unsupervised learning	08
10	Learning Theory	03

Total hours (Theory): 64
Total hours (Practical): 32
Total hours: 96

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DETAILED SYLLABUS:

Sr. No	Topic	Lecture Hours	Weight age (%)
1	**Introduction** • Overview of machine learning • Related areas • Applications of ML • Current Problems in ML • Software Tools: MatLab	06	09
2	**Parametric Regression** • Linear regression with one variable • Linear regression with multiple variable • Polynomial regressions • Gradient descent • Kernel methods	06	09
3	**Supervised Learning** • Model and Feature Selection • Bayesian learning • Ensemble Systems: Bagging, Boosting • Evaluating and debugging learning algorithms	06	09
4	**Generative Learning** • Gaussian parameter estimation • Maximum likelihood estimation • MAP estimation • Bayesian estimation • Bias And Variance Of Estimators • Missing And Noisy Features • Nonparametric Density Estimation • Gaussian discriminant analysis • naive Bayes	06	09
5	**Discriminative Learning** • Linear Discrimination • Logistic Regression • Logit And Logistic Functions • Generalized Linear Models • Softmax Regressio	06	09

6	**Neural Networks & Deep Learning** • Neural Networks: Representation • Neural Networks: Learning • Neural Networks: the perceptron algorithm, multilayer perceptrons, backpropagation, nonlinear regression, multiclass discrimination, training procedures, localized network structure, dimensionality reduction interpretation. • Introduction to deep learning	08	13
7	**Support vector machines** • Functional And Geometric Margins, • Optimum Margin Classifier, • Constrained Optimization, • Lagrange Multipliers, • Primal/Dual Problems, • Kkt Conditions, • Dual Of The Optimum Margin Classifier, • Soft Margins, Kernels, Quadratic Programming, SMO Algorithm	07	11
8	**Graphical and sequential models** • Bayesian Networks, Conditional Independence • Markov Random Fields • Inference In Graphical Models, Belief Propagation • Markov Models, Hidden Markov models, decoding states from observations, learning HMM parameters	08	13
9	**Unsupervised learning** • K-Means Clustering • Expectation Maximization • Gaussian Mixture Density Estimation, Mixture Of Naive Bayes, Model Selection • Dimensionality reduction: Feature Selection , Factor Analysis, PCA (Principal Components Analysis), ICA (Independent Components Analysis), Multidimensional Scaling, Manifold Learning • Anomaly Detection	08	13
10	**Learning Theory** • Bias-Variance Tradeoff • Worst Case Learning	03	05
	Total	**64**	**100**

INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, white/black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.

- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents

STUDENTS LEARNING OUTCOMES:

On successful completion of the course, the student will:

- Be introduced to the fundamental problems of machine learning.
- Have understanding of techniques, mathematical concepts, and algorithms used in machine learning to facilitate further study in this area.
- Have understanding of the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms.
- Have pointers into the literature and exercise a project based on literature search and one or more research papers.
- Be able to practice software implementation of different concepts and algorithms covered in the course.

REFERENCE BOOKS:

1. Elements of Statistical Learning, T. Hastie, R. Tibshirani and J. Friedman, Springer, 2001.
2. Machine Learning, E. Alpaydin, MIT Press, 2010.
3. Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006.
4. Machine Learning: A Probabilistic Perspective, K. Murphy, MIT Press, 2012.
5. Pattern Classification, R. Duda, E. Hart, and D. Stork, Wiley-Interscience, 2000.
6. Machine Learning, T. Mitchell, McGraw-Hill, 1997.

FINAL PROJECT:

Students present selected topics and develop software implementation of related techniques based on the review of relevant literature. The work should be summarized in a concluding report which should include simulation results. A list of possible topics will be available prior to the project selection due date.