Course Handout

Course Title: Foundations of Machine Learning

Semester and Year: MTech (Core)

Credit Sturucture: 3-0-2-4

Instructor name and email: Manjunath Joshi,
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Objectives

Machine Learning is a growing field in the area of pattern recognition, natural language processing, speech processing, image processing, computer vision etc. This course covers the topics in classical machine learning and if time permits introduces neural networks for deep learning. The objectives include: 1. Formulate machine learning problems related to different applications and develop algorithms to solve them. 2. Read current research papers and understand the issues:

Pre-requisite:

Basics of

- Linear Algebra
- Probability, random variables, estimation theory
- Optimization techniques.
- Languages – Python/R/Julia (any of these)

Course Contents (Strong Math content):

Supervised Vs Unsupervised learning, Linear and Polynomial regressions, [convex/non convex functions, convex sets, constrained/unconstrained minimization] Least squares (LS) estimation, Maximum likelihood (ML) and Maximum a posteriori (MAP) estimations,] logistic regression, soft max for multiclass classification, Support vector machine (Soft margin and Hard margin classifiers), Kernel Trick, bias and variance in machine learning, overfitting problem and regularization, Decision trees and Random

forest, cross validation, Linear Discriminant Analysis (LDA), Quadratic Discriminant Analysis (QDA), K means clustering, Principal component analysis (PCA), Independent component analysis (ICA), Gaussian Mixture Model (GMM)

If time permits: Introduction to Neural networks, Multilayer perceptron (MLP),

8-10 Labs will be conducted conducted.

Evaluation: Performance is evaluated based on continuous evaluation process that includes project, lab, one In-semester Examination and an End-Semester Examination.

Expected Outcomes

After studying this course, students will be able to understand a variety of machine learning architectures, use them to solve problems in object classification, segmentation (clustering). The course will be helpful for the students to come up with new research ideas in various application areas of machine learning.

This course has both Theory and Lab. Labs are based on the theory taught in the class.

READINGS

1. Kevin Murphy, Machine Learning A Probabilistic Approach, MIT
2. Hastie, Tibshirani, Friedman, The Elements of Statistical Learning.
3. Research papers from ICML, ICLR, NIPS, ICCV, CVPR etc

- **Evaluation Scheme (**TAs will also be part of evaluation process**):**

- Lab - 10%
- Class Participation 10% (Extra) – for answering questions asked during class hours (up to 10 points can be earned by a student for the entire course).
- Midsem exam -25%
- Endsem exam - 25%
- Course project: - 35%. Two presentations in a semester. At the beginning and towards the end. In a project group a person randomly chosen will be presenting on prescribed date (decided by the Instructor). The marks obtained by that student will be awarded to all students in that group. Codes to be verified by TAs
- Class Attendance – 5% (No special leave consideration)

MAP TO PROGRAM OUTCOMES (POs) OF NBA

P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
X	X	X	X					X	X		X