BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2015-2016
Course Handout Part II

Date: 03/08/2015

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. **: BITS F464**
Course Title **: Machine Learning**
Instructor-in-charge **: NAVNEET GOYAL (goel@pilani.bits-pilani.ac.in)**

Catalog Description

Machine Learning is an exciting sub-area of Artificial Intelligence which deals with designing machines which can learn and improve their performance from examples/experience. This course introduces the student to the key algorithms and theory that forms the core of machine learning. The course will cover the major approaches to learning namely, supervised, unsupervised, and reinforcement leaning. The course emphasizes various techniques, which have become feasible with increased computational power and our ability to produce and capture huge volumes of data. The topics covered in the course include regression, decision trees, support vector machines, artificial neural networks, Bayesian techniques, Hidden Markov models, genetic algorithms etc. Some advanced topics like active & deep learning will also be covered.

Text Books:

Tom M. Mitchell, Machine Learning, The McGraw-Hill Companies, Inc. International Edition 1997.

Reference Books:

1. Christopher M. Bhisop, Pattern Recognition & Machine Learning, Springer, 2006.
2. Introduction to Machine Learning, N. J. Nilson, Stanford, Available online at author's website. http://robotics.stanford.edu/people/nilsson/mlbook.html
3. Machine Learning, Neural and Statistical Classification, D. Michie, D.J. Spiegelhalter, C.C. Taylor (eds), Ellis Horwood publishers, available online at http://www.amsta.leeds.ac.uk/~charles/statlog/

LECTURE PLAN

Topic	**Topic Details**	**Lecture #**	**Chapter Reference**
Overview	Introduction	1-2	Ch. 1
Preliminaries	• Probability theory • Decision theory • Information theory • Linear Algebra	Self Study	R1 – Ch.2, Appendix C
Some important principles/concepts/algorithms	• MAP Hypothesis • Minimum Description Length (MDL) principle • Expectation Maximization (EM)	3-5	Ch.6 + class notes + R1 Appendix E

	Algorithm • Bias-variance decomposition • Lagrange Multipliers • Mixture of Gaussians • PCA & SVD		
Linear models for Regression	• Linear basis function models • Bayesian linear regression	6-8	R1 – Ch. 3
Linear models for Classification	• Discriminant Functions • Probabilistic Generative Classifiers • Probabilistic Discriminative Classifiers	9-12	R1 – Ch. 4
Bayesian Learning Techniques	• Bayes optimal classifier • Gibbs Algorithm • Naïve Bayes Classifier	13-14	Ch. 6
Non-linear Models & Model Selection	• Decision Trees • Ensemble Classifiers • Neural Networks o Multilayer Perceptron o Network training o Error backpropagation • Instance-based Learning o *K*-NN o Case-based Reasoning	15-21	• Ch. 3 • Ch. 4 R1 – Ch. 5 • Ch. 8
Margin/Kernel Based Approaches	Support Vector Machines	22-24	Class Notes + R1 – Ch. 7
Graphical Models	• Bayesian Belief Networks • Hidden Markov Models	25-28	Ch. 6 + Class Notes
Unsupervised Learning	• Mixture Models • *K*-means Clustering	29-30	Ch. 6 R1 – Ch. 9
Genetic Algorithms	• Hypothesis space search • Genetic programming • Models of evaluation & learning	31-32	Ch. 9
Reinforcement Learning	• Q Learning • Non-deterministic rewards & actions • Temporal difference learning • Generalization	33-34	Ch. 13
Advanced Topics	• Active Learning • Deep Learning	35-38	Class Notes
Application Examples	• Speech Recognition • Image Retrieval	39-40	Class Notes

Evaluation Scheme:

Component	Duration	Weightage	Date (Time)
Assignments (02)	Take Home	40%	**TBA**
Midsem Test (CB)	90 Mins.	25%	**8/10 10:00 - 11:30 AM**

Comprehensive Exam	3 Hours	35%	**8/12 AN**

Notices: All notices shall be displayed on CSIS notice board in NAB and on course website

Chamber Consultation Hour: M, W 10 (6121-K, NAB)

Makeup Policy: To be granted only in case of serious illness or emergency.

Instructor-in-charge
BITS F464