Course Description Format

TITLE : Probabilistic Graphical Models

Course Code :

Note: Please use course code for previously existing course

CREDITS : 3-1-0-4

TYPE-WHEN : Spring, 2020

FACULTY NAME : Girish Varma

PRE-REQUISITE : Probability, Discrete Maths, Linear Algebra.

OBJECTIVE : To understand how probability, statistics and graph theory can be used to model machine learning problems. We will further see efficient algorithms for these problems with provable guarantees on runtime and accuracy. An Introduction to Learning Theory (statistical and computational) will also be covered. The focus will be to understand the theoretical underpinnings.

COURSE TOPICS :

(please list the order in which they will be covered)

Introduction: Reminder of Probability Theory, Overview of Graphs, Graphical Models Examples, Introduction to Spectral Graph Theory.

Models: Bayesian Networks, Undirected Graphical Models, Template Based Representations, Gaussian Network Models Exponential Family of Models.

Inference: Variable Elimination, Belief Propagation, MAP Inference, Sampling Based Inference, Variational Inference.

Learning: Directed Models, Undirected Models, Latent Variable Models, Bayesian Learning, Structure Learning. Variational Autoencoder.

Learning Theory: PAC Learning, VC Dimension, Computational Learning Theory. Learning Boolean functions using Fourier Analysis.

PREFERRED TEXT BOOKS:

Probabilistic Graphical Models: Principles and Techniques
by Daphne Koller, Nir Friedman

Understanding Machine Learning: From Theory to Algorithms
by Shai Shalev-Shwartz and Shai Ben-David
https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf

***REFERENCE BOOKS:**

- ("GEV") *Graphical models, exponential families, and variational inference* by Martin J. Wainwright and Michael I. Jordan. Available online.
- *Modeling and Reasoning with Bayesian Networks* by Adnan Darwiche.
- *Pattern Recognition and Machine Learning* by Chris Bishop. Available online.
- *Machine Learning: A Probabilistic Perspective* by Kevin P. Murphy.
- *Information Theory, Inference, and Learning Algorithms* by David J. C. Mackay. Available online.
- *Bayesian Reasoning and Machine Learning* by David Barber. Available online.

***PROJECT:**

Yes

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz 1	**10**
Mid Sem Exam	**15**
Quiz 2	**10**
End Sem Exam	**25**
Assignments	**20**
Project	**20**
Term Paper	**NA**
Other Evaluation _____	**NA**

OUTCOME: To understand the theoretical underpinnings of Machine Learning Problems.

REMARKS: