19ECS741: MACHINE LEARNING

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Machine Learning is the science of making machines think intelligently without being explicitly programmed. Machine learning is pervasive in everyday life today. This course is designed to enable students get in-depth understanding of different machine learning techniques including deep learning and reinforcement learning and apply them on real-life data.

Course Objectives:

- Understand the fundamental concepts of Supervised learning.
- Explore descriptive problem solving through unsupervised learning strategies.
- Acquire skills in developing as well as evaluating different machine learning models.
- Demonstrate the application of different deep learning methodologies.
- Gaingain an understanding of concepts like Reinforcement Learning and Active Learning.

Unit I **10L**

Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class

Learning Outcomes

After completion of this unit, the student will be able to

- explain the concept of machine learning and their applications to different real world datasets. (L2)
- demonstrate the working of different supervised learning algorithms and assess their suitability to a given problem. (L3)
- extend a binary classification problem to solve a multi-class classification problem.(L3)

Unit II **7L**

Unsupervised Learning: Clustering: K-means, Dimensionality Reduction: PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models)

Learning Outcomes

After completion of this unit, the student will be able to:

- demonstrate the working of different dimensionality reduction techniques on high-dimensional datasets (L3)
- illustrate the working of Generative Models mathematically. (L3)

Unit III 6L

Evaluating Machine Learning algorithms, Model Selection, Ensemble Methods (Boosting, Bagging, Random Forests)

Learning Outcomes

After completion of this unit, the student will be able to:

- interpret ensemble models as a function of different weak classifiers. (L3)
- compare the performances of different classification models. (L4)

Unit IV **9L**

Modeling Sequence/Time-Series Data, Deep Learning (Deep generative models, Deep Boltzmann

Machines, Deep auto-encoders, Applications of Deep Networks) and Feature Representation Learning

Learning Outcomes

After completion of this unit, the student will be able to:

- understand the methods for handling time series and sequence data. (L2)
- demonstrate the working of different deep learning approaches on complex data. (L3)

Unit V **9L**

Scalable Machine Learning (Online and Distributed Learning) Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Learning Outcomes

After completion of this unit, the student will be able to:

- apply reinforcement learning approach to applications like bioinformatics and personalized recommendation. (L3)
- analyses the working of Active Learning approach on complex data. (L4)

Text Book(s)

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
3. Jiawei Han, Micheline Kamber, Jian Pei , Data Mining: Concepts and Techniques, 3/e, Morgan Kaufmann, 2011.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Course Outcomes:

After successful completion of the course, the student will be able to

- relate knowledge about application of machine learning techniques to real world problems. (L3)
- apply deep learning methodologies to applications such as image recognition, video tagging etc.(L3)
- generate suitable unsupervised learning approaches to descriptive machine learning models. (L4)
- utilize supervised learning approaches to perform predictive modeling of data. (L3)
- assess different machine learning algorithms based on performance evaluation measures. (L5)