

Machine Learning



Picture taken from Machine Learning book by Academy Publish

Instructor: Khurram Nazir

Credit Hours: 3

Pre-Requisite: Data Structures, Probability, LA, Undergrad AI course.

Synopsis:

Machine learning investigates the mechanisms by which knowledge is acquired through learning. It studies adaptive computational systems that improve their performance with experience. Machine learning methods have been applied to a diverse number of problems ranging from learning strategies for game playing to recognizing human speech and learning to drive an autonomous vehicle. This course covers the primary approaches to machine learning, including inductive inference of decision trees, neural networks, Bayesian learning methods, and graphical models.

Goals:

1. Provide a comprehensive introduction to machine learning methods
2. Build mathematical foundations of machine learning and provide an appreciation for its applications
3. Provide experience in the implementation and evaluation of machine learning algorithms
4. Develop research interest in the theory and application of machine learning

Books:

We will not be following a specific text book. Most of the topics will be covered from the first two books.

- a) *Machine Learning, Tom Mitchell, McGraw-Hill International Edition, 1997.*
- b) *Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006.*
- c) *Machine Learning An Algorithmic Perspective by Stephen Marsland. Chapman and Hall/CRC, 2009.*
- d) *Introduction to Machine Learning, Ethem Alpaydin, Prentice Hall of India, 2010.*

Tentative List of Topics

1. **Introduction:** Overview of machine learning and its applications
2. **Concept Learning:** Boolean target functions, Basic Concepts, Generalization, limitations
3. **Decision Tree Learning:** ID3, C45, handling continuous variables
4. **Basic Bayesian Learning:** Evaluating learning algorithms in Bayesian framework, Learning algorithms that manipulate probabilities, such as; Bayes Optimal Classifier, MAP Classifier and Naïve Bayes Classifier with application to Text Classification.
5. **DTWC:** Intro to DTWC algorithm.
6. **Graphical Models:** Bayesian networks
7. **Neural Networks:** From concept till multi-layer perceptrons
8. **Reinforcement Learning:** Concept and different Techniques

Subject to Availability of Time

9. **Recommender Systems:** Introduction and Applications
10. **Dimensionality Reduction:** Intro to feature selection and extraction.
11. **Support Vector Machines:** Introduction to SVM and Kernel Methods
12. **Ensemble Learning:** Boosting, Bagging and Different Ways to Combine Classifiers

Guest Lectures

Speakers from academia and industry will be invited for talks on recommender systems and computational advertisement.

About the Instructor

Dr. Khurram Nazir was previously an Assistant Professor at FAST-NUCES. He did his PhD and MS from Lahore University of Management Sciences, and B.Sc. from University of Karachi. His research interests include data mining and machine learning algorithms and applications with main focus on text and e-mail spam analysis. He has published articles in top tier international Journals and Conferences and won international text classification competitions as well. His profile can be viewed at: <http://suraj.lums.edu.pk/~junejo/>