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***CSX439 Machine Learning***

**L-T-P-Cr: 3-0-0-3**

**Pre-requisites:** Fundamental knowledge of AI, linear algebra, probability & statistics, and algorithms

**Objectives/Overview:**

* To familiarize with Python programming language
* To learn common unsupervised machine learning approaches.
* To learn common supervised machine learning approaches.
* To understand single layer and multi-layer neural network models.
* To learn to apply common machine learning techniques for solving real world problems.

**Course Outcomes:**

At the end of the course, a student should:

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| **Sl. No.** | **Outcome** | **Mapping to POs** |
|  | Have knowledge of fundamental aspects of machine learning approach. | PO2 |
|  | Be able to choose appropriate regression technique for modelling real life problems. | PO1, PO2,PO3 |
|  | Have algorithmic knowledge of common clustering techniques. | PO3 |
|  | Understand the purpose of dimensionality reduction and unsupervised PCA technique  | PO2,PO3 |
|  | Have knowledge of simple classification techniques and able to classify simple datasets using them.  | PO1, PO2 |
|  | Conceptual understand the working of SVM and “Kernel Trick” | PO1, PO2 |
|  | Have algorithmic knowledge of supervised LDA dimensionality reduction technique.  | PO1, PO3 |
|  | Understand of the purpose of ensemble learning. | PO1, PO2 |
|  | Conceptually understand reinforcement learning and be able to iterate on simple problem datasets  | PO2 |
|  | Algorithmic knowledge of working of common neural network models and be able to iterate on simple problem datasets.  | PO1, PO2 |
|  | Be able to derive back-propagation of error for multi-layer neural networks.  | PO1, PO3, PO12 |

**UNIT I: Introduction Lectures: 8**

Types of learning, common aspects of machine learning approach: model, parameters, Bias-Variance. Test, train and validation datasets, error function. Curse of dimensionality. Predictive analysis using regression.

**UNIT II: Python Basics Lectures: 6**

Fundamental Data Types in Python, Looping and Decision making constructs, functions, classes, file handling, database access, output formatting, classes, modules, statistics module, numpy, introduction to popular machine learning libraries TensorFlow & Keras.

**UNIT III: Unsupervised Learning Lectures: 8**

Clustering, K-means, GMM & EM Algorithm. Eigen values and Eigen vectors, PCA – unsupervised dimensionality reduction technique.

**UNIT IV: Supervised Learning Lectures: 8**

Classification: KNN, Bayes, Decision Tree. SVM: soft and hard margin, kernel trick. LDA – supervised dimensionality reduction technique.

**UNIT V: Ensemble and Reinforcement Learning Lectures: 6**

Bagging, Random Forest and Boosting. Q-learning and SARSA algorithms

**UNIT VI : Neural Networks Lectures: 12**

Introduction, perceptron model, learning rules and activation functions, multi-layer feed forward, back-propagation, introduction to feed-back networks.

**Text/Reference Books**

1. Machine Learning. Tom Mitchell, McGraw-Hill.
2. Machine learning: an algorithmic perspective. Marsland, Stephen. Chapman and Hall/CRC, 2011.
3. Introduction to artificial neural systems. Zurada, Jacek M. Vol. 8. St. Paul: West publishing company, 1992.
4. A Tutorial on Support Vector Machines for Pattern Recognition. Christopher Burges, Data Mining and Knowledge Discovery, 1998.