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***CSX433 Pattern Recognition and Machine Learning***

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

**Pre-requisites:** Basic engineering mathematical skills.

**Objectives/Overview:**

* To impart knowledge on basic principles of recognizing patterns using different machine learning techniques.
* To make students proficient in recognizing patterns using different supervised machine learning techniques.
* To impart ability to develop various pattern recognition systems.

**Course Outcomes:**

At the end of the course, a student should come to know:

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| Sl. No | Outcome | Mapping to PO |
|  | Basic concepts of probability distribution | PO1, PO2 |
|  | Different linear models of regression | PO1, PO2 |
|  | Concepts of different linear models of classification | PO1, PO2,PO3 |
|  | Concepts of various dimensionality reduction techniques | PO1, PO2,PO3 |
|  | Concepts and techniques of classifying patterns using Neural Network. | PO1, PO2, PO3, PO4, PO5, PO6 |
|  | Concepts and techniques of classifying patterns using Nearest Neighborhood classifier, different prototype selection strategies. | PO1, PO2, PO3, PO4, PO5, PO6 |
|  | Concepts and different kernels of Support Vector Machine and their usage in recognizing patterns. | PO1, PO2, PO3, PO4, PO5 |
|  | Concept and application of Bayes classifier in pattern recognition. | PO1, PO2, PO3, PO4, PO5 |
|  | Concept and application of Hidden Markov Model in pattern recognition. | PO1, PO2, PO3, PO4, PO5, PO6 |

**UNIT I: Introduction Lectures: 8**

Polynomial curve fitting, Probability theory, Model selection, Curse of dimensionality, Decision theory.

Probability distribution: Binary variables, Multinomial variables, Gaussian distribution.

Linear Models for Regression: Linear basis function models, Bayesian Linear Regression, Bayesian Model Comparison.

**UNIT II: Linear Models for Classification Lectures: 7**

Discriminant functions, Probabilistic generative models.

Dimensionality reduction: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA).

**UNIT III: Neural Networks Lectures: 10**

Feed-forward network functions, Network training, Multi-layer perceptron, Error Backpropagation.

Nearest Neighbor Classifier: Variants of nearest neighbor classifier, Efficient algorithms for nearest neighbor classification, Different Approaches to Prototype Selection.

**UNIT IV: Support Vector Machines Lectures: 8**

Optimal separation, Support Vector Machine Algorithm, Multi-class classification, SVM regression, Bayes Classifier.

**UNIT V: Lectures: 9**

Markov random fields, **Hidden Markov Models**- Forward algorithm, Viterbi algorithm, Gaussian mixture models, Application: Document recognition.

**Text/Reference Books:**

1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer.

2. Stephen Marsland, “.Machine Learning: An Algorithmic Perspective”, CRC Press.

3. Duda, Hart, Stork, “Pattern Classification”, Second edition, Willey India.