CSPE3002 PATTERN RECOGNITION (3-0-0)

Course Objectives:
The learning objectives of this course are to:
- To introduce the fundamentals of pattern recognition and its relevance to classical and modern problems
- To introduce the knowledge about state-of-the-art algorithms used in pattern recognition research
- To introduce Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
- To provide an understanding of pattern recognition techniques in practical problems and a main objective is to be able to identify where, when and how pattern recognition can be applied.
- To provide knowledge regarding various application of pattern recognition using machine learning model.

Module-I: Basic Concepts (08 Hrs)
Introduction Pattern recognition and learning (supervised, unsupervised), training and test sets, feature selection, Clustering vs. Classification; Applications; Linear Algebra, vector spaces, probability theory, estimation techniques

Module-II: Classification (10 Hrs)
Classification Univariate and multivariate density, discriminant functions for the normal Density different cases, Bayes decision theory – discrete features, compound Bayesian decision theory and context, Minimum-error rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case.

Module-III: Clustering (08 Hrs)
Clustering Different distance functions and similarity measures, Criterion for clustering, Methods of clustering - partitional, hierarchical, graph theoretic, density based, Cluster validity 05

Module-IV: Un-supervised Learning (08 Hrs)
Un-supervised learning and clustering: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Date description and clustering – similarity measures, criteria function for clustering

Module-V: Introduction to Pattern Recognition (08 Hrs)
Pattern recognition using discrete hidden Markov models: Discrete-time Markov process, Extensions to hidden Markov models, three basic problems of HMMs, types of HMM, continuous observation densities, multiple mixtures per state, speech recognition applications.

Course Outcomes:
At the end of this course students will be able to:
CO1: Able to explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.
CO2: Able to summarize, analyze, and relate research in the pattern recognition area along with various parameter optimization technique.
CO3: Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature
CO4: Able to apply pattern recognition techniques to real world problems such as document analysis and recognition.
CO5: Able to implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

Text Books:
1. Pattern Recognition: An Algorithmic Approach, By M. Narasimha Murty and V. Susheela Devi, Springer; 2011 edition
2. Fundamentals of Pattern Recognition and Machine Learning, By Braga-Neto, Springer International Publishing, 2020
3. Pattern Recognition, By S. Theodoridis and K. Koutroumbas, 4th Ed., Academic Press, 2009

Reference Books:

1. Pattern Recognition and Machine Learning, By Christopher Bishop, Springer-Verlag New York, 2006
2. Combining Pattern Classifiers: Methods and Algorithms, By Ludmila I. Kuncheva, 2nd Edition, John Wiley, 2014
3. Pattern Classification, By R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2001