

GUJARAT TECHNOLOGICAL UNIVERSITY

COMPUTER ENGINEERING (SOFTWARE ENGINEERING) (02)

PATTERN RECOGNITION

SUBJECT CODE: 2730207

M.E. SEM-III

Type of course: Major Elective – IV

Prerequisite: -

Rationale: The pattern recognition is used in many application areas like image analysis, speed and audio recognition, biometrics, bioinformatics, data mining and information retrieval. The syllabus introduces the concepts and principles of pattern recognition and covers the classifiers including linear and nonlinear, clustering, feature selection and generation, template matching and context dependent classification.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
	Introduction		
1.1	What is Pattern recognition, Features, Clustering vs. Classification ,Supervised, Unsupervised, and Semi-Supervised Learning, Pattern Recognition Applications, Patterns and Feature Extraction with Examples	8	10%
	Classifiers Based On Bayes Decision Theory		
2.1	Introduction, Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Bayesian Classification for Normal Distribution, Estimation of Unknown Probability Density Functions, The Nearest Neighbor Rule, Bayesian Belief Networks	10	25%
2.2	Linear and Nonlinear Classifiers Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Least Squares Methods, Mean Square Estimation Revisited, Logistic Discrimination, Support Vector Machine The XOR Problem, The Two and Three Layer Perceptrons, Algorithm Based On Exact Classification of Training Set, The Back propagation Algorithm, The Cost Function Choice, Choice of the Network Size, A Simulation Example, Networks with Weight Sharing, Generalized Linear Classifiers, Polynomial Classifiers, Radial Basis Function Networks, Support Vector Machines		
	Clustering		
3.1	Clustering Basic Concepts, Clustering Algorithms: Sequential and Hierarchical algorithms	14	30%
	Feature Selection and Generation		

4.1	Feature Selection Introduction, Pre-processing, Feature Selection Based on Statistical Hypothesis Testing, The Receiver Operating Characteristics (ROC) Curve, Class Separability Measures, Feature Subset Selection, Optimal Feature Generation, Feature Generation/Selection,	8	20%
4.2	Feature Generation : Data Transformation and Dimensionality Reduction, Basis Vectors and Images , The Karhunen-Loeve Transform , The Singular Value Decomposition , Independent Component Analysis , Nonnegative Matrix Factorization, Nonlinear Dimensionality Reduction, The Discrete Fourier Transform (DFT) , The Discrete Cosine and Sine Transforms , The Hadamard Transform, The Haar Transform , Discrete Time Wavelet Transform (DTWT), Applications Regional Features, Features for Shape and Size Characterization, A Glimpse at Fractals, Typical Features for Speech and Audio Classification		
Template Matching			
5.1	Introduction, Measures Based on Optimal Path Searching Techniques , Measures Based on Correlations , Deformable Template Models , Content-Based Information Retrieval: Relevance Feedback	5	10%
Context Dependent Classification			
6.1	Introduction, The Bayes Classifier ,Markov Chain Models, The Viterbi Algorithm , Channel Equalization , Hidden Markov Models , HMM with State Duration Modeling , Training Markov Models via Neural Networks , A discussion of Markov Random Fields	3	5%

Reference Books:

1. Pattern Recognition by Sergios Theodoridis and Konstantinos Koutroumbas, Elsevier
2. Pattern Recognition Statistical, Structural and Neural Approaches by Robert Schalkoff, Wiley
3. Pattern Recognition and Machine Learning by Christopher Bishop, Springer
4. Neural Networks for Pattern Recognition by Christopher Bishop

Course Outcome:

After learning the course the students should be able to

1. implement many applications pattern recognition techniques which include automatic speech recognition
2. classify the text into several categories (e.g., spam/non-spam email messages)
3. the recognition of handwritten postal codes on postal envelopes
4. automatic recognition of images of human faces
5. handwriting image extraction from medical forms.

List of Experiments:

- Minimum 10 experiments and 1 group exercise to be carried out based on the content of the syllabus.

Design based Problems (DP)/Open Ended Problem:

1. Design a system to recognize the individual Gujarati alphabets written by human.
2. Analyze the performance and accuracy of the system developed in Prob. 1.
3. Discuss the issues regarding use of multiple training sets with the classifiers.
4. Survey the different application areas of pattern recognition. Choose one of the areas and make the survey of current research issues into that area.

Major Equipments:

- Modern desktop PC with high end configuration
- Software tool - MATLAB

List of Open Source Software/learning website:

Tools: R GUI, Rapidminer, OpenCV

Other Sources:

1. <http://in.mathworks.com/discovery/pattern-recognition.html>
2. Pattern Recognition Course on the Web (by Richard O. Duda)
3. Introduction to Machine Learning (by Nils J. Nilsson)
4. Image Processing Course
5. Classification Society of North America
6. The Pattern Recognition Files
7. Pattern Recognition Journals
8. Machine Learning Resources
9. Morphing Bibliography of Mark Grundland
10. Neural Network Information
11. Neural Network FAQ's
12. Applets for Neural Networks
13. Face Recognition Home Page
14. Handwriting Recognition
15. Java Demos for Handwriting Recognition
16. Multivariate Analysis
17. Iris Data
18. Typography
19. Music Meter Recognition (PS file)
20. Combinatorial Geometric Problems in Pattern Recognition (compressed PS file)

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.