GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Post Graduate Diploma In Data Science
Level: PG
Branch: Data Science
Subject Code: DS02080081
Subject Name: Pattern Recognition

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective - I

Prerequisite:	Nil
Rationale:	Nil

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
01	Know the major approaches in statistical and syntactic pattern recognition	RM
02	Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis	UN
03	Recognize and explain the theoretical challenges in pattern recognition system design, such as the curse of dimensionality and its implications on different models	AN
04	Apply pattern recognition techniques in practical problems	AP

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR		ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
4	0	2	5	70	30	0	50	150

Content:

Sr. No.	Content	Total Hrs
1.	Basics of Probability, Random Processes and Linear Algebra (recap): Probability: independence of events, conditional and joint probability, Bayes theorem, Applications of Bayes Theorem in AI. Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra.	06
2.	Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors, singular values, singular vectors, Applications in Machine Learning (e.g., PCA)	03
3.	Bayes Decision Theory: Minimum-error-rate classification. Classifiers,	03

	Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.	
4.	Parameter Estimation Methods: Maximum-Likelihood Estimation: Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition, K-Nearest Neighbour method.	12
5.	Dimensionality reduction: Principal component analysis - it relationship to Eigen analysis. Fisher discriminant analysis - Generalized Eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Non negative matrix factorization - a dictionary learning method.	08
6.	Linear discriminant functions: Gradient descent procedures, Perceptron, Support vector machines - a brief introduction.	03
7.	Artificial neural networks: Multilayer perceptron – feed forward neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks, Generative Adversarial Networks (GANs).	04
8.	Non-metric methods for pattern classification: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART). Random Forests and Feature Importance, Ensemble Methods (e.g., Gradient Boosting)	03
	TOTAL	

Reference Books:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4/e, Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
5. Robert J. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
6. Tom Mitchell, Machine Learning, McGraw-Hill
7. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.

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