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| Pandit Deendayal Energy University | | | | | | | School of Technology | | | | | |
| **20CP412T** | | | | | **Pattern Recognition** | | | | | | | |
| **Teaching Scheme** | | | | | **Examination Scheme** | | | | | | | |
| **L** | **T** | **P** | **C** | **Hrs/Week** | **Theory** | | | | **Practical** | | **Total**  **Marks** |
| **MS** | **ES** | | **IA** | **LW** | **LE/Viva** |
| **2** | **0** | **0** | **2** | **2** | **25** | **50** | | **25** | **-** | **-** | **100** |

**COURSE OBJECTIVES**

* To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.
* To introduce a variety of pattern recognition algorithms
* To develop skills of using pattern recognition methods on real world data

|  |  |
| --- | --- |
| **UNIT 1 INTRODUCTION TO PATTERN RECOGNITION**  Mathematical Foundations, Tree Classifiers: Decision Trees: CART, C4.5, ID3, Random Forests, Bayes Decision Theory | **7 Hrs.** |
| **UNIT 2 LINEAR DISCRIMINANT**  Separability, Perceptrons, Support Vector Machines, surfaces. Normal density and discriminant functions. Discrete features. Non-metric methods for pattern classification | **6 Hrs.** |
| **UNIT 3 UNSUPERVISED METHODS**  Principal component analysis - it relationship to eigen analysis. Fisher discriminant analysis, Local linear Embeddings, Clustering, Classifier Ensemble Methods: Bagging, Boosting/AdaBoost | **6 Hrs.** |
| **UNIT 4 GRAHPHICAL MODEL**  Bayesian Network, Sequential Models- Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs.  **Algorithm Independent Topics**: No Free Lunch Theorem, Ugly Duckling Theorem, Bias-Variance Dilemma, Jacknife and Bootstrap Methods | **7 Hrs.** |
| **Max. 28 Hrs.** | |

**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1- Understand the mathematical and statistical techniques commonly used in pattern recognition

CO2- Understand the concept of a pattern and the basic approach to the development of pattern recognition.

CO3- Apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data.

CO4- Interpret relevant information to design a simple pattern recognition systems.

CO5- Evaluate the result from a simple pattern recognition system.

CO6- Develop prototype pattern recognition algorithms that can be used to study algorithm behavior and performance against real-world multivariate data

**TEXT/REFERENCE BOOKS**

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Wasserman, K.Faust: Social Network Analysis: Methods and Applications, Cambridge Univ
3. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
4. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

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| --- | --- |
| **Max. Marks: 100** | **Exam Duration: 3 Hrs** |
| Part A: 10 Questions of 2 marks each-No choice | 20 Marks |
| Part B: 2 Questions from each unit with internal choice, each carrying 20 marks 80 Marks | |
| |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Pandit Deendayal Energy University | | | | | | | School of Technology | | | | | | **20CP412P** | | | | | **Pattern Recognition LAB** | | | | | | | | **Teaching Scheme** | | | | | **Examination Scheme** | | | | | | | | **L** | **T** | **P** | **C** | **Hrs/Week** | **Theory** | | | | **Practical** | | **Total**  **Marks** | | **MS** | **ES** | | **IA** | **LW** | **LE/Viva** | | **0** | **0** | **2** | **1** | **2** | **-** | **-** | | **-** | **50** | **50** | **100** |   **COURSE OBJECTIVES**   * To equip students with basic mathematical and statistical techniques commonly used in pattern recognition. * To introduce a variety of pattern recognition algorithms * To develop skills of using pattern recognition methods on real world data   **List of Practical**:  Practical list should be prepared by Course Instructor based on the content of the subject. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.  **Preferred Programming Language & Platform:** MATLAB and Scientific Python (SciPy, NumPy)   |  | | --- | | 1. Implementation of Edge Detection, Boundary Detection, Feature Extraction. | | 1. Implementation of Clustering and Classification Techniques. | | 1. Implementation of Bayesian Learning, Parameter Estimation, Pattern Matching. | | 1. Implementation of Supervised and Un-supervised Learning using Neural Network |   **COURSE OUTCOMES**  On completion of the course, student will be able to  CO1- Understand the mathematical and statistical techniques commonly used in pattern recognition  CO2- Understand the concept of a pattern and the basic approach to the development of pattern recognition.  CO3- Apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data.  CO4- Interpret relevant information to design a simple pattern recognition system.  CO5- Evaluate the result from a simple pattern recognition system.  CO6- Develop prototype pattern recognition algorithms that can be used to study algorithm behaviour and performance against real-world multivariate data  **TEXT/REFERENCE BOOKS**   1. Lab Manual-Pattern Recognition Laboratory 2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001 3. S.Wasserman, K.Faust: Social Network Analysis: Methods and Applications, Cambridge University Press 4. <https://nptel.ac.in/courses/117108048/>   **END SEMESTER EXAMINATION QUESTION PAPER PATTERN**   |  |  | | --- | --- | | **Max. Marks: 100** | **Exam Duration: 2 Hrs** | | Part A: Continuous Evaluation based on lab records and course project. | 50 Marks | | Part B: 2 Experiment conducted and Viva at final exam. | 50 Marks | | |

1. **Lesson Plan (Hour-to-Hour Plan)**

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| **Sr.**  **No.** | **Topic to be covered** | **Teaching Aid to be**  **used** | **Lectures** |
| 1 | What is Pattern Recognition, Mathematical Foundations of Pattern Recognition | BW+PPT | 1 |
| 2 | Tree Classifiers: Decision Trees: CART, C4.5, ID3 | BW+PPT | 3 |
| 3 | Random Forests, Bayes Decision Theory | BW+PPT | 3 |
| 4 | Separability, Perceptrons | BW+PPT | 1 |
| 5 | Support Vector Machines | BW+PPT | 1 |
| 6 | Surfaces | BW+PPT | 1 |
| 7 | Normal density and discriminant functions. | BW+PPT | 2 |
| 8 | Discrete features. Non-metric methods for pattern classification | BW+PPT | 2 |
| 9 | Principal component analysis - it relationship to eigen analysis | BW+PPT | 2 |
| 10 | Fisher discriminant analysis, Local linear Embeddings | BW+PPT | 1 |
| 11 | Clustering, Classifier Ensemble Methods: Bagging, Boosting/AdaBoost | BW+PPT | 3 |
| 12 | Bayesian Network | BW+PPT | 1 |
| 13 | Sequential Models- Hidden Markov Models (HMMs) | BW+PPT | 2 |
| 14 | Discrete HMMs. Continuous HMMs | BW+PPT | 1 |
| 15 | Algorithm Independent Topics: No Free Lunch Theorem, Ugly Duckling Theorem | BW+PPT | 2 |
| 16 | Bias-Variance Dilemma, Jacknife and Bootstrap Methods | BW+PPT | 2 |

**CO Assessment Tools (Direct Assessment):**

Various assessment tools used to evaluate CO’s (Rubrics) and the frequency with which the assessment processes are carried out are listed below.

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| --- | --- | --- | --- | --- | --- |
| **Assessment**  **Method** | **Assessment**  **Tool** | **Description** | **Marks** | **Mapping with**  **CO** | **Contribution to**  **CO’s** |
| Direct | Mid-sem | MCQ/Analytical/ Output-based/ questions on syllabus covered from Unit I, Unit II | 50 | CO1/CO2/CO3 CO4 | It fractionally contributes to 50% weightage of Direct Assessment to CO attainment.  (50/2) |
| Direct | MCQ/Class Assignment | MCQ/Output- based/ Theoretical questions on syllabus covered | 25 | CO1/CO2/CO3 CO4/CO5/CO6 | It contributes to 100% weightage of Direct Assessment to CO attainment. |
| Direct | End-Sem Examination | **Topics to be covered:** Unit I, II, III, IV | 100 | CO1,CO2, CO3,CO4, CO5, CO6 | It contributes to 50% weightage of Direct Assessment to CO attainment.  (100/2) |
|  | Total 100 Marks | | | | |

