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**Amrita School of Computing, Coimbatore.**

**Department of Computer Science and Engineering**

**2022-2023 Odd Semester**

**B.Tech CSE – (2019-2023 Batch) Semester:7**

**Course Summary**

**(at the beginning of the semester)**

**Contents:**

1. **Syllabus with LTPC pattern.**
2. **Course Plan.**
3. **Evaluation Pattern.**
4. **Suggestions received from previous mentor and the changes incorporated.**
5. **List of online tools with corresponding activity planned.**
6. **Highlight on any other innovative practise added newly to show continuous improvement in the course delivery,**
7. **Syllabus with LTPC pattern.**

**19CSE432** Pattern Recognition L-T-P-C: 3-0-0-3

**Course Objectives**

The course introduces basic concepts of Pattern recognition and explores statistical pattern recognition algorithms.

The course gives an overview of supervised and unsupervised learning techniques.

**Course Outcomes**

**CO1:** Understand basic concepts in pattern recognition.

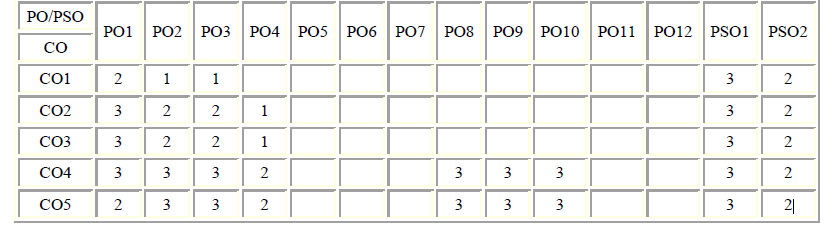
**CO2:** Understand discriminant functions and apply them for applications.

**CO3:** Understand and apply Parametric techniques of Pattern recognition.

**CO4:** Apply Non parametric techniques of PR and analyze their performance.

**CO5:** Understand the supervised and unsupervised learning algorithms and apply them for real world problems

**CO-PO Mapping**



**Syllabus**

**Unit 1**

Introduction: Machine perception – Pattern recognition systems – Design cycle – Learning and adaptation - Bayesian decision theory – discriminant functions – decision surfaces – normal density based discriminant functions -Maximum likelihood estimation – Bayesian estimation.

**Unit 2**

Bayesian parameter estimation – Gaussian case – problems of dimensionality - Components analysis and discriminants – hidden Markov models, Non-parametric Techniques: density estimation – parzen windows – nearest neighbourhood estimation – linear discriminant functions and decision surfaces – two category linearly separable case – perception criterion function.

**Unit 3**

Non-Metric Methods: decision trees – CART methods – algorithm independent machine learning - bias and variance – regression and classification - classifiers – Unsupervised learning and clustering – mixture densities and identifiably – hierarchical clustering – low dimensional representation – multidimensional scaling.

**Text Book(s)**

1. *Duda RO, Hart PE, Stork DG. Pattern Classification. John Wiley & Sons; 2012.*

**References:**

1. *Gose E, Johnsonbaugh R and Jost S. Pattern Recognition and Image Analysis, Prentice Hall of India;2002.*
2. *Bishop CM. Pattern Recognition and Machine Learning. Springer; 2006.*
3. *Bishop CM. Neural Networks for Pattern Recognition. Oxford University Press; 1995.*

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1. **Course Plan.**

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| **Lecture No(s)** | **Topics** | **Key-words** | **Objectives** | | **Remarks** |
| 1 | Introduction | Introduction to pattern recognition | Overview of the course | |  |
| 2-3 | Bayes Decision Rule | Bayes Theory | To understand Bayes Theory | | Chapter 2.1 and 2.2 from TB-1 |
| 4-5 | Minimum error rate classification | Minimax criterion , Neyman Pearson criteria | Designing a classifier after calculating he maximum risk | | Chapter 2.3 from TB-1 |
| 6-8 | Classifiers, Discriminant Functions and Decision  Surfaces, Normal Density and Discriminant functions | Univariate, Multivariate density, Dicriminant functions for normal density | To learn different types of Discriminant functions and Decision surfaces | | Chapter 2.4 to 2.6 from TB-1 |
| 7 |  |  |  |
| 9 | Error Probabilities and Integrals | Chernoff bound and Bhattacharya bound | To understand different types of error probabilities and integrals | | Chapter 2.7 to 2.8.2 from TB-1 |
| 10-12 | Bayes Decision Theory – Discrete Features | Independent binary features, Missing and noisy features , Bayesian Networks | To understand the application of Bayes Decision Theory to discrete features | | Chapter 2.9 to 2. from TB-1 |
| 13 | Bayes Theorem- Discrete Features | Missing features, Noisy features and Bayesian Networks | How to construct a Bayesian network and steps to be taken when there are missing and noisy features | | Chapter 2.10 to 2.11 from TB-1 |
| 14 | **Quiz -1** | | | | |
| 15-16 | Maximum Likelihood estimate , Bayesian Estimation | Overview of MLE, Univariate, Multivariate | Different parametric estimation techniques will be explored | | Chapter 3.2  (self reading), Chapter 3.3, 3.4 from TB-1 |
| 17 | Comparison of MLE and Bayes | Non-informative priors and variance | A comparative study of MLE and Bayes will be analysed | | Chapter 3.5  from TB-1 |
| 18 | Sufficient Statistics | Some common statistical Distributions | Different types of statistical distributions for different types of problems will be analysed | | Chapter 3.6  from TB-1 |
| 19 | Problems of Dimensionality | Accuracy, Dimension, and Training Sample Size , computational complexity | The students will come to know of the different dimensionality reduction problems | | Chapter 3.7  from TB-1 |
| 20 | Bayesian Belief networks | Belief network | Students will be introduced to a graphical method of representing the Bayesian probabilities | | Chapter 3.9  from TB-1 |
| 21 | **Quiz – 2** | | | | |
| 22-25 | Sequential Data and Hidden Markov Models | HMM Forward , backward | HMM’s will be introduced and the different types of algorithms involving HMM will be explored | | Chapter 3.10  from TB-1 |
| 26 | Fisher Linear Discriminant | Fisher Linear Discriminant | | Different types of dimensionality reduction techniques will be .explored | Chapter 3.10  from TB-1 |
| 27-29 | Component Analysis | PCA, Non-linear component analysis, ICA | | Chapter 10.13.1 (self reading), 10.13.2, 10.13.3  from TB-1 |
| 30 | **Quiz – 3** | | | | |
| 31-33 | Introduction to Non parametric techniques | Density Estimation and Parzen windows | | Non-parametric techniques will be introduced | Chapter 4.1 to 4.3.3  from TB-1 |
| 34 -37 | Algorithm independent Machine Learning | No Free Lunch Theorem, Bagging, Boosting. | | Students will understand how to design a classifier for different real world problems | Chapter 9.1 to 9.5 from TB-1 |
|  | **Quiz – 4** | | | | |
| 38-39 | Hierarchical clustering | Non Metric Methods: Unsupervised learning and clustering | | Unsupervised learning |  |
| 40-41 | Decision trees | Non Metric Methods: decision trees – CART methods | | Supervised learning |  |
| 42 | **Quiz – 5** | | | | |
| 43-45 | Low dimensional representation and multidimensional scaling | | | | |

**Evaluation Pattern.**

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| **Component** | **Internal** | **External** |
| Periodical 1 (P1) | 15 |  |
| Periodical 2 (P2) | 15 |  |
| Continuous Assessments ( 5 written quizzes) | 20 |  |
| End Semester |  | 50 |

1. **Suggestions received from previous mentor and the changes incorporated**

This is the first iteration of the course for the 2019-23 batch.

1. **List of online tools with corresponding activity planned**

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| **Online Tools** | |
| Tool/Language to be used | Remarks |
| Python | Simulations in Python of selected topics like Discriminant Functions, Parametric, Non metric and clustering will be shown in the class, |