| | | | |
|---|---|---|---|
| | Lec 38 | | |
| | Lec 39 | | |
| **14** | Lec 40 | Computational Learning Theory | |
| | Lec 41 | | |
| | Lec 42 | | |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessment (40%) | Test 1-3 | 20% | CO1 | C1, C2 |
| | | | CO2 | C3, C4 |
| | Class Participation | 5% | CO3 | A2 |
| | Mid term | 15% | CO3 | C4, P6 |
| Final Exam | | 60% | CO1, CO3 | C1-C4, C6 |
| | | | CO4 | P3, A4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**REFERENCE BOOKS**


1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, McGraw Hill (International Edition)
3. Introduction to Machine Learning, Second Edition - Ethem Alpaydin (2nd Edition)
4. Pattern Recognition –Sergios Theodoridis and Konstantinos Koutroumbas; Elsevier Inc.
5. Machine Learning: An Algorithmic Perspective - Stephen Marsland


**REFERENCE SITE**

## CSE-442: Machine Learning Sessional

| **COURSE INFORMATION** | | | |
|---|---|---|---|
| Course Code | : CSE 442 | Lecture Contact Hours | : 3.00 hrs in alternative week |
| Course Title | : Machine Learning Sessional | Credit Hours | : 0.75 |

**PRE-REQUISITE**

Course Code: Nil
Course Title: Nil

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**RATIONALE**

The Machine Learning Sessional course is structured to orient different algorithm of machine learning practically to best suit the current need. This course will help understand the iterative aspect of machine learning as models are exposed to new data, they are able to independently adapt. Models learn from previous computations to produce reliable, repeatable decisions and results and helps in implementing the enhanced learning parameters for maximum performance.

**OBJECTIVE**

1. To implement the appropriate learning algorithm to best suit the current need.
2. To use practical knowledge to enhance the learning parameters to achieve maximum performance and enhance the learning parameters to achieve maximum performance.

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Learning Outcome (Upon completion of the course, the students will be able to) | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | Develop a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc. | C2-C6, P1, P6 | 1 | 1 | 6 | T, Q |
| CO2 | Evaluate the strengths and weaknesses of many popular machine learning approaches. | C3, C6, A4, A5, P6 | 2 | 2 | 8 | ASG, T |
| CO3 | Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning. | C2 – C6 P1, A1, A2 | 6 | 4 | 2 | R, Q, Pr |
| CO4 | Design and implement various machine learning algorithms in a range of real-world applications. | P3, A4, C3, C4, C6 | 3, 7, EP2 | 3 | 5 | T, Q |

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

**COURSE CONTENT**

**Supervised Learning:** Regression, Model Selection and Generalization, Dimensions of a supervised learning algorithm; **Bayesian Decision:** Association Rules, Discriminant Functions; **Clustering:** k-means cluster, Hierarchical cluster, Expectation-Maximization Algorithm, Supervised Learning after Clustering; **Decision Tree:** Classification tress, Regression trees, Pruning, Multivariate trees; **Hidden Markov Model:** Basic problems of HMM, Evaluation problem, Model Selection in HMM, Find State Sequence; **Kernel Machines**: SVM, Victorian Kernels, Multiple Kernel Learning, One-Class Kernel Machine, Kernel Dimensionality Reduction; **Design and Analysis of ML Experiment:** Randomization, Interval Estimation, McNemer's Test, K-Fold Cross-Validated Paired t Test, Binomial Test, Approximate Normal Test.

**SKILL MAPPING**

| No. | Course Learning Outcome | PROGRAM OUTCOMES (PO) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO1 | Able to develop a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc. | | H | | | | | | | | | | |
| CO2 | Able to evaluate the strengths and weaknesses of many popular machine learning approaches. | | | | | H | | | | | | | |
| CO3 | Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning. | | | | M | | | | | | | | |
| CO4 | Able to design and implement various machine learning algorithms in a range of real-world applications. | | | H | | | | | | | | | |

(H – High, M- Medium, L-low)

**JUSTIFICATION FOR CO-PO MAPPING**

| Mapping | Level | Justifications |
|---|---|---|
| CO1-PO2 | High | Able to understand the complexity in analysis of data. Model selection, challenges and fundamental issues of machine learning. |
| CO2-PO5 | High | Able to identify the appropriate modern tools or learning algorithms and evaluate their strengths and weaknesses. |

| | | |
|---|---|---|
| CO3-PO4 | Medium | Able to appreciate the mathematical relationships and in depth investigation and experimentation of the paradigms of supervised and unsupervised learning. |
| CO4-PO3 | High | Able to implement Machine Learning algorithms and develop unique solutions to engineering problems from real-world. |

**TEACHING LEARNING STRATEGY**

| Teaching and Learning Activities | Engagement (hours) |
|---|---|
| Face-to-Face Learning | |
| Lecture | - |
| Practical / Tutorial / Studio | 21 |
| Student-Centred Learning | - |
| Self-Directed Learning | |
| Non-face-to-face learning | - |
| Revision | - |
| Assessment Preparations | - |
| Formal Assessment | |
| Continuous Assessment | 2 |
| Mid-Term Exam | - |
| Final Examination | 3 |
| Total | 26 |

**TEACHING METHODOLOGY**

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

**COURSE SCHEDULE**

| Week | Lecture | Topics | Remarks |
|---|---|---|---|
| **1** | Lab -1, 2 | **Supervised Learning:** Regression, Model Selection and Generalization, Dimensions of a supervised learning algorithm; | 3.00 in alternate week |
| **3** | Lab -3, 4 | **Bayesian Decision:** Association Rules, Discriminant Functions; | |
| **5** | Lab -5, 6 | **Clustering:** k-means cluster, Hierarchical cluster, Expectation-Maximization Algorithm, Supervised Learning after Clustering; | |
| **7** | Lab -7, 8 | **Decision Tree:** Classification tress, Regression trees, Pruning, Multivariate trees; | |
| **9** | Lab -9, 10 | **Hidden Markov Model:** Basic problems of HMM, Evaluation problem, Model Selection in HMM, Find State Sequence; | |
| **11** | Lab -11, 12 | **Kernel Machines**: SVM, Victorian Kernels, Multiple Kernel Learning, One-Class Kernel Machine, Kernel Dimensionality Reduction; | |
| **13** | Lab -13, 14 | **Design and Analysis of ML Experiment:** Randomization, Interval Estimation, McNemer's Test, K-Fold Cross-Validated Paired t Test, Binomial Test, Approximate Normal Test. | |

**ASSESSMENT STRATEGY**

| Components | | Grading | CO | Blooms Taxonomy |
|---|---|---|---|---|
| Continuous Assessmen | Test and Assignment | 40% | CO1 | C2, P6 |
| | | | CO2 | C3, A5 |

| | | | | |
|---|---|---|---|---|
| t (40%) | Class Participation | 10% | CO3 | C4, A2, A1 |
| | Presentation | 10% | CO2 | C6, A4, P3 |
| Final Exam (Online Test + Quiz) | | 40% | CO1, CO3 | C2-C6, P1 |
| | | | CO4 | P3, A4 |
| Total Marks | | 100% | | |

**(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)**

**REFERENCE BOOKS**


1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, McGraw Hill
3. Introduction to Machine Learning, Second Edition - Ethem Alpaydin
4. Pattern Recognition –Sergios Theodoridis and Konstantinos Koutroumbas; Elsevier Inc.
5. Machine Learning: An Algorithmic Perspective - Stephen Marsland


**REFERENCE SITE**

## CSE-443: Pattern Recognition

**COURSE INFORMATION**

| | | | |
|---|---|---|---|
| Course Code | : CSE-443 | Lecture Contact Hours | : 3.00 |
| Course Title | : Pattern Recognition | Credit Hours | : 3.00 |

**PRE-REQUISITE**

Course Code: Nil
Course Title: Nil

**CURRICULUM STRUCTURE**

Outcome Based Education (OBE)

**RATIONALE**

This course motivates to recognize patterns, regularities and also irregularities in data by using various pattern recognition algorithms and techniques to find useful information for science, business and organizational decisions as well as contributing to the field of machine learning, data mining and artificial intelligence.

**OBJECTIVE**

1. To provide a comprehensive introduction to pattern recognition techniques leading to the ability to understand contemporary terminology, progress, issues, and trends.
2. To specify sectors and context where the application of pattern recognition can provide a fruitful solution.

**LEARNING OUTCOMES & GENERIC SKILLS**

| No. | Course Learning Outcome (Upon completion of the course, the students will be able to) | Bloom's Taxonomy | CP | CA | KP | Assessment Methods |
|---|---|---|---|---|---|---|
| CO1 | Identify areas where pattern recognition techniques can offer a solution | C1-C3 | 1 | | 3 | T, F |
| CO2 | Analyze the strength and limitations of some techniques used in pattern recognition for classification, regression and density estimation problems. | C4 | 1 | | 1, 3 | MT |
| CO3 | Solve problems in regression and classification. | P3 | 7 | 3 | 6 | F |
| CO4 | Develop communication skill by presenting topics on pattern recognition | A2 | | 1 | 5 | Q, Pr |