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| **Course Code:**  CSE3008 | **Course Title: Introduction to Machine Learning** | | **TPC** | | **3** | **2** | **4** |
| **Version No.** | **1.0** | | | | | | |
| **Course Pre-requisites/ Co-requisites** | MAT2003 | | | | | | |
| **Anti-requisites (if any).** | None | | | | | | |
| **Objectives:** | 1. Introduce the fundamental problems of machine learning. 2. Provide understanding of techniques, mathematical concepts, and algorithms used in machine learning to facilitate further study in this area. 3. Provide understanding of the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms. 4. Practice software implementation of different concepts and algorithms covered in the course. | | | | | | |
| **Expected Outcome:** | On completion of the course, students will have the ability to   1. Understands basic machine learning techniques 2. How to apply Neural Networks and genetic algorithms concepts 3. Apply the concepts of Bayesian and Computational Learning 4. Analyze different instance based learning models 5. Understand Hidden Markav Models and its applications to solve real time problems | | | | | | |
| **Module No. 1** | **Introduction** | **6 Hours** | | | | | |
| Learning problems, perspectives and issues, concept learning, version spaces and candidate eliminations, inductive bias, decision tree learning, representation, algorithm, heuristic space search. | | | | | | | |
| **Module No. 2** | **VC Dimension** | **6 Hours** | | | | | |
| Definitions, Examples and uses, Bounds, VC dimension of a finite projective plane, VC dimension of a boosting classifier, VC dimension of a neural network | | | | | | | |
| **Module No. 3** | **Support Vector Machine** | **8 Hours** | | | | | |
| functional and geometric margins, optimum margin classifier, constrained optimization, Lagrange multipliers, primal/dual problems, KKT conditions, dual of the optimum margin classifier, soft margins, kernels, quadratic programming, SMO algorithm. | | | | | | | |
| **Module No. 4** | **Bayesian and Computational Learning** | **10 Hours** | | | | | |
| Bayes theorem , concept learning, maximum likelihood, minimum description length principle, Bayes optimal classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian belief network, EM algorithm, probability learning, sample complexity, finite and infinite hypothesis spaces, mistake bound model. | | | | | | | |
| **Module No. 5** | **Instance Based Learning** | | **6 Hours** | | | | |
| K-Nearest neighbor learning, locally weighted regression, radial basis functions, case based learning. | | | | | | | |
| **Module No. 6** | **Hidden Markov Models** | | | **9 Hours** | | | |
| Introduction, discrete Markov processes, hidden Markov models, three basic problems of HMMs evaluation problem, finding the state sequence, learning model parameters, continuous oservations, the HMM with input, model selection in HMM. | | | | | | | |
| **Text Books**   1. Tom M. Mitchell, Machine Learning, McGraw Hill , 2013. 2. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004 | | | | | | | |
| **References**   1. U[nderstanding Machine Learning](http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/). Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017 2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, 1/e, Springer, 2001.   3. M Narasimha Murty, Introduction to Pattern Recognition and Machine Learning, World Scientific Publishing Company, 2015 | | | | | | | |
| Lab Exercises  In machine learning lab session student will work selected set of problems and case studies on the following topics, tools and techniques.  1. Simple Classification Problems  2. K-Means  3. Support Vector Machines  4. Bayes optimal classifier  5. K-NN classifiers  6. EM algorithm  7. Gradient Descent  8. Polynomial regression | | | | | | | |
| **Mode of Evaluation** | **Practice Tests-20%, Continuous Assessment Tests-60%, Practical Assesment-20%**  Practice Tests - Cumulative for 16 Weeks 20%  Continuous Assessment Test-1 20%  Continuous Assessment Test-2 20%  Continuous Assessment Test-3 20%  Practical Assessment (Mini Project) 20% | | | | | | |
| **Recommended by the Board of Studies on** | 06.07.2018 | | | | | | |
| **Date of Approval by the Academic Council** | 2nd Academic Council 21.07.2018 | | | | | | |