DEPARTMENT: COMPUTER SCIENCE AND ENGINEERING
COURSE CODE: CS-506
COURSE TITLE: MACHINE LEARNING
COURSE OUTCOMES:

After the completion of the course, the students will have a:

- To have a thorough understanding of the basic principles, techniques and applications of machine learning.
- To familiarize with machine learning algorithms and their use in data-driven knowledge discovery and program synthesis.
- Knowledge of the strengths and weaknesses of different machine learning algorithms (relative to the characteristics of the application domain).
- The ability to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.

Course Outcomes	Program outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS-506												
CO 1		M	M		M			M			H	
CO 2		M	H	M	M				H	H	M	
CO 3					H	M			H		M	
CO 4		H		H		M		M		M		M

TOPICS COVERED

Introduction: Well-Posed Machine Learning Problems, Designing a Leaning System, Perspectives and Issues in Machine Learning.

Concept Learning and the General-to-Specific Ordering: Introduction, A Concept Learning Task, Concept Learning as Search, FIND-S: Finding a Maximally Specific Hypothesis, Version Spaces, and the CANDIDATE-ELIMINATION Algorithm.

Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate problem for Decision tree Learning, The Basic Decision Tree Learning Algorithm, Hypothesis Space Search in Decision Tree Leaning, Inductive Bias in Decision Tree Leaning, Issues in Decision Tree Leaning

Artificial Neural Networks: Introduction, Natural Network Representations, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Network and the BACKPROPAGATION Algorithm

Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Bayes Optimal Classifier, Native Bayes Classifier, An Example: Learning to Classify Text.

Instance- Based Learning: Introduction, K-NEAREST NEIGHBOUR Learning, Distance-Weighted NEAREST NEIGHBOUR Algorithm.

Genetic Algorithms: Motivation, Genetic Algorithms, Hypothesis Space Search, Genetic Programming, Parallelizing Genetic Algorithms.

Learning Sets of Rules: Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First-Order Rules, Learning Sets of First-Order Rules: FOIL, Induction as Inverted Deduction, Inverted Resolution.

BOOKS RECOMMENDED:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
3. Richard O. Duda, Peter E. Hart & David G. Stork, "Pattern Classification. Second Edition", Wiley & Sons, 2001.
4. RichardS. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction",MIT Press, 1998.
5. Nils J. Nilsson Introduction to Machine Learning

Machine Learning Course Plan

Topic	Objective	Date	Durations	Reading
Introduction	• Introduction to Intelligent Machines, Well-Posed Machine Learning Problems, Examples of Applications in diverse fields. • Data Representation: Time Series Forecasting, Forms of Learning: Supervised, Unsupervised, Reinforcement, Learning based on natural processes, Diversity of data. • To familiarize with Machine Learning systems, Advantages, and challenges in Machine Learning.		5	
Concept Learning and the General-to-Specific Ordering	• Understand concept learning task, Prototypical concept learning task, Hypothesis representation, and inductive learning hypothesis. • Familiarize with version space and candidate elimination: List-then-eliminate algorithm, candidate elimination algorithm.		6	
Decision Tree Learning	• Introduction to decision tree, Measures of impurity for evaluating splits in Decision Trees. • Discuss ID3, C4.5, and CART decision trees. • Understand tree pruning, strength, and weakness of Decision-Tree Approach.		4	
	Mid Term Examination			
Artificial Neural Networks	• Introduction to biological Neuron Model, Artificial Neuron Model, Artificial Neural Network • Understand Neural network architecture, Neural network learning problems. • To impart the basic knowledge of Multilayer network, Backpropagation Algorithm, Applications of neural network.		6	
Bayesian Learning	• Introduction to Pattern Recognition, Bayesian decision theory, and concept learning. • Study Bayes Optimal Classifier, Native Bayes Classifier, Bayesian belief networks, and Example of Learning to Classify Text.		5	
Instance- Based Learning	• Understand the basic concept of Instance-based learning, Nearest neighbor, locally-weighted regression, case-based reasoning methods. • Familiarize with K-NEAREST NEIGHBOUR Learning, Distance-Weighted K-NEAREST NEIGHBOUR Algorithm, curse of dimensionality.		6	
Genetic Algorithms	• Overview of genetic algorithm, Representation and implementation of Genetic Algorithm, Encoding of chromosomes, Implementation of genetic operators. • Study Hypothesis Space Search, Fitness functions, Objective functions Genetic Programming, Parallelizing Genetic Algorithms.		7	
Learning Sets of	• Introduction to set of rules, learning		8	

Rules	rules in propositional form, Bit vector, Learning rules in First-order form, Horn clauses. • Understand principle of Sequential Covering Algorithms, Requirement of the Learn-one-rule method, Greedy Search. • Learning Rule Sets: Do- while, If-then, Return, General-to-specific beam Search. • Familiarize with key dimension in the design of the rule learning algorithm, Learning First-Order Rules algorithm FOIL, Induction as Inverted Deduction, Inverted Resolution.			

Quiz tentative

Q1: 15/2/2024
Q2: 13/3/2024
Q3: 25/4/2024

Assignment 2