Government Degree College, (Autonomous), Baramulla

Semester 8TH Major Course

INFORMATION TECHNOLOGY

Course Title: Artificial Intelligence **BITC1822M**

Credits (4+2): Theory 04, Lab -02) Contact hours: 60 (T) + 60 (p)

Course Objectives:

This course provides a comprehensive understanding of Artificial Intelligence, covering its evolution, paradigms, and real-world applications. It focuses on intelligent agents, problem formulation, and search strategies (informed, uninformed, and adversarial), along with logical reasoning using propositional and first-order logic for knowledge representation and inference. The course also introduces expert systems, environments, and agents. It equips students with core machine learning and neural network concepts, including supervised and unsupervised learning, regression, classification, and backpropagation, enabling them to design and analyze intelligent systems for real-world problems.

Learning outcomes:

By the end of this course, students will be able to:

- *Understand and explain fundamental concepts, paradigms, and applications of Artificial Intelligence.*
- *Model real-world problems using intelligent agents and appropriate problem formulations.*
- *Apply uninformed, informed, and adversarial search techniques to solve complex problems.*
- *Represent knowledge using propositional and first-order logic.*
- *Perform logical inference using unification, resolution, forward and backward chaining*
- *Analyze and design basic expert systems and their components*
- *Apply various learning approaches including inductive, statistical, and probabilistic methods*
- *Implement machine learning techniques for classification and regression tasks*
- *Understand and apply neural network models and the backpropagation algorithm*
- *Evaluate model performance using appropriate error and loss functions*

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Unit I:

History and Evolution of AI, Applications of AI, Paradigms of Intelligence (Thinking Humanly, Thinking Rationally, Acting Humanly, Acting Rationally). Turing Test, Intelligent agents, Agents and environments. The nature of environments (Static/Dynamic, Paritally/Fully Observable, Deterministic/Stochastic, Known/Unknown, discrete/continuous, episodic/sequential, and single/multi-agent), Structure of agents (Simple reflex, model-based, goal-based, utility-based, Learning Agents, Multi-Agent Systems, Hierarchical agents), Problem formulation representation (Initial state, State space, Actions, Goal test, Path cost). Searching for solutions (state space tree), Uninformed search strategies (Depth-first search, Breadth-first search). Informed search and exploration, Heuristic function, Local search algorithms, Local search in continuous spaces, and optimistic problems, Informed search strategies: A* Algorithm, Minimax Procedure, Alpha-beta Pruning.

Unit II:

Introduction to Logic in AI, Propositional Logic vs First Order Logic, Limitations of propositional logic, Syntax and semantics for First Order Logic, Using First Order Logic (predicates, quantifiers, interpretations). Inference in first-order logic (Unification and Lifting, Forward Chaining, and Backward Chaining), Resolution in first-order logic, Conversion to CNF, Refutation completeness.

Unit III:

Introduction & History, Characteristics of Expert Systems, Roles & Components of expert systems (Knowledge base, inference engine), Applications of expert systems, Knowledge in Learning: Logical formulation of learning, Explanation-based learning, Learning using relevant information, Inductive logic programming, Learning with complete data. Statistical learning models: Naive Bayes models, Learning from observations, Forms of learning, Inductive learning. Decision trees, Learning with hidden data: Expectation-Maximization Algorithm.

Unit IV: Supervised and unsupervised learning, Clustering vs Classification vs Regression problems. Linear Regression, K-nearest neighbour, Decision trees (splitting criteria with Information Gain and Gini Index), Neural Computing: Linear separability problems, Binary Decision Problems. Building blocks of Artificial Neural Networks: The McCullough-Pitts model, Adaline model, Madaline model, Single-layer perceptron and their limitations, Non-linearly separable problems, The Multilayer Perceptron, Activation Functions. Logistic Regression. Measuring Types of Error functions in training neural networks (Mean Squared Error Loss, Binary Cross-Entropy Loss, Categorical Cross-Entropy Loss). Learning using the Backpropagation algorithm (Stochastic Gradient Descent, Mini-batch Gradient Descent). Validation, Cross-validation, and testing.

LIST OF PRACTICALS:

1. Implement uninformed search techniques: BFS, DFS.
2. Implement heuristic search algorithms: Greedy-Best First Search, and A*.
3. Implement adversarial search using Minimax and Alpha-Beta Pruning for game playing.
4. Implement Linear Regression algorithm for regression problems.
5. Implement Logistic Regression algorithm for binary classification problems.
6. Implement k-nearest neighbour for multiclass classification problems.
7. Implement MCP Neuron model for classification problems.
8. Implement Adaline and Madaline models for classification/regression problems.
9. Implement Multilayer neural networks for non-linearly separable problems using various activation functions.
10. Implement artificial neural network models and perform performance analysis (accuracy, loss, precision, recall, and f1-score)

TEXT BOOKS:

1. Russell, S. and Norvig, P. (2004). *Artificial Intelligence-A Modern Approach* 2nd Edition, Pearson Education / Prentice Hall of India,
2. Sivanandam, S. N., & Deepa, S. N. (2011). *Principles of Soft Computing*, 2nd Edition. Wiley India Pvt. Ltd.

REFERENCES:

1. Patterson, D. W. (2015). *Introduction to Artificial Intelligence and Expert Systems*. Pearson Education India.
2. Rich, E., & Knight, K. (1991). *Artificial Intelligence* (2nd ed.). McGraw-Hill.