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| D:\UAAR\UIIT\courseOutlineCommittee\CourseContents_Final_V02\New folder\logo4.png | **PMAS Arid Agriculture University Rawalpindi**  **University Institute of Information Technology** | | | |
| CS-632 Artificial Intelligence | | | | | |
| **Credit Hours:** | | **4(3-2)** | **Prerequisites:** | **None** | |
| **Teacher:** | |  |  |  | |

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| **Course Description:** |
| This course serves as an introduction to the techniques and applications of artificial intelligence (AI) including a treatment of intelligent agents, search techniques, logical agents, knowledge representation and reasoning formalisms, learning paradigms and some of machine learning techniques like neural networks, decision trees etc. |
| **Course Outcomes:** |
| On completion of this module, students should be able to: Demonstrate an understanding of the fundamental ideas of problem solving in AI; Demonstrate an understanding of the fundamental ideas of Knowledge Representation and Reasoning; Demonstrate an understanding of the principles of a number of different approaches in Machine Learning; Demonstrate the ability to apply AI and Computational Intelligence techniques to a variety of research and application projects. |
| **Teaching Methodology:** |
| Lectures, Assignments, Presentations, Course Project etc. Major component of the course should be covered using practical implementation of AI techniques. |
| **Courses Assessment:** |
| Exams, Assignments, Quizzes. Course will be assessed using a combination of written examinations. |
| **Books &Reference Materials:** |
| * S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Latest Edition, Pearson Education Inc. * Denis Rothman, Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases, (2018) |

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| **Week/Lecture #** | | **Theory** | **Practical** |
| Week 1 | Lect-I | Introduction to AI | Python language, configuration and hello world |
| Lect-II | **Agents:** Types of agents | Lists, conditions, loops etc. in python. |
| Week 2 | Lect-I | **Informed Search**: Breadth and Depth first search, Greedy search algorithm | Trees implementation in Python, BFS, DFS. Greedy Algorithm implementation |
| Lect-II | A \* **Uninformed Search** and Heuristics, Hill Climbing Algorithm | A \* Algorithm implementation |
| Week 3 | Lect-I | **Constraint Satisfaction Problems** (CSP) | Implementing Coloring Problem, N-Queens problem using CSP.  Water jug, vacuum world problems. |
| Lect-II | CSP-II |  |
| Week 4 | Lect-I | **Game Trees:** Minmax, Alpha-beta pruning | Minmax algorithm implementation using trees |
| Lect-II | Game Trees: Expectimax | Expectimax implementation |
| Week 5 | Lect-I | **Genetic Algorithm:** Introduction to Evolutionary Computing, Genetic Algorithm (GA) as Uniformed Search Problem | Representing a chromosome as Python array, implementing cross over, selection and mutation operations |
| Lect-II | Genetic Algorithm: Genetic operators (Crosse over and Mutation) and its applications | Implementing optimizing for lesser iterations and more accuracy |
| Week 6 | Lect-I | **Markov Decision Processes (MDP)**: Stochastic decision making, | Markov Decision Process (MDP) Toolbox in Python Programming language |
| Lect-II | MDP-II: Markov Chain |  |
| Week 7 | Lect-I | **Expert Systems:** Knowledge Base Expert System, their types and Application, | Wampus world implementation using either prolog or python. |
| Lect-II | **Expert Systems:** Working of Expert Systems with its different components, Typical examples, its benefits, the down-side |  |
| Week 8 | Lect-I | **Planning:** Planning vs. problem solving, General Problem Solver GPS / STRIPS | implementation of planning algorithms |
| Lect-II | Planning: Situation calculus, Hierarchical decomposition (HTN planning) |  |
| **Mid Term Exam** | | | |
| Week 9 | Lect-I | **Computer Vision:** Edge detection kernels (Prewitt, Sobel) | Implementing edge detection using OpenCV in Python |
| Lect-II | Computer Vision: Gradient of Gaussian (Canny), Representing Image as Vector | Transforming images (feature vectors) to arrays for further processing by ANN. |
| Week 10 | Lect-I | **Artificial Neural Network (ANN):** Introduction to Artificial Neural Networks (ANN), Implementation for AND, OR, XOR | Implementing single layer neural network using Python. Implement AND, OR, XOR gates. |
| Lect-II | Artificial Neural Network: Backpropagation, Multilayered ANN | Implementing multi-layered neural network with backpropagation algorithm for weights assignment. |
| Week 11 | Lect-I | **Machine Learning:** Introduction to Learning, Supervised Learning (decision Tree) | Implementing Decision trees for any given dataset using Python Scikit-learn library. |
| Lect-II | **Machine Learning:** Unsupervised Learning, K-means Clustering Algorithm | Implement K-means clustering algorithm for any given dataset using Python Scikit-learn library. |
| Week 12 | Lect-I | **Machine Learning:** Probabilistic Models, Naïve Bayes Classification | Naïve Bayes Classification Using Scikit-learn |
| Lect-II | **Natural Language Processing (NLP)**: Tokenization, POS Tags, Dependencies etc. | Implementing NLP using NLTK Python libraray |
| Week 13 | Lect-I | Document Similarity: Jaccard Similarity, Cosine Similarity | Document vectorization of a given document set and computing similarity using cosine similarity measure |
| Lect-II | **Particle Swarm Optimization (PSO):** Introduction to Swarm Intelligence (SI), Particle Swarm Optimization (PSO) | Implementing particle swarm optimization (PSO) for solving a scheduling problem |
| Week 14 | Lect-I | Particle Swarm Optimization (PSO): PSO Pseudo Code and example. |  |
| Lect-II | **Digital Signal Processing**: Sound, Speech Signals, Sound Classification | Implementation of Sound Classifier using Scikit-learn |
| Week 15 | Lect-I | **Artificial Intelligence of Things** (AIoT): Machine to Machine / User-less Communication, Processing IoT Data | Collecting and Storage of IoT Sensor Data |
| Lect-II | Artificial Intelligence of Things (AIoT): Big Data and IoT, IoT Analytics |  |
| Week 16 | Lect-I | Project Demonstration: |  |
| Lect-II | Project Demonstration: |  |
| **Final Term Exam** | | | |

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| **Course Learning Outcomes (CLOs)** |
| At the end of course the students will be able to: |
| 1. Understand key components in the field of artificial intelligence. |
| 1. Implement classical artificial intelligence techniques. |
| 1. Analyze artificial intelligence techniques for practical problem solving. |