Department of Computer Science and Information Systems
First Semester: 2024-2025
Course Handout: Part-II

Date: 31/July/2024

In addition to part-I (General handout for all courses appended to the timetable) this portion gives further specific details regarding the course:

Course No.	: CS F407
Course Title	: Artificial Intelligence
Instructor-in-Charge	: Kamlesh Tiwari **(kamlesh.tiwari@pilani.bits-pilani.ac.in)**
Instructor	: Vishal Gupta **(vgupta@pilani.bits-pilani.ac.in)**

1. Objective and Scope of the Course

Artificial Intelligence (AI) is a branch of computer science focused on creating technology that emulates human cognitive processes in computer systems. The primary objective of AI is to develop intelligent entities (called agents) capable of mimicking human intelligence traits such as problem-solving, reasoning, planning, handling uncertainty, and learning. This course introduces students to a comprehensive set of algorithms and techniques for constructing these intelligent entities. By the end of the course, students will gain a broad understanding of the AI field. They will learn to identify and apply AI techniques to solve various problems and critically evaluate new techniques as they emerge. The course covers essential issues and methodologies for developing computer systems that exhibit intelligent behavior. Key topics include AI search techniques, ML, game playing, planning, knowledge representation, reasoning under uncertainty, and reinforcement learning.

2. Course Material

Text Book:

[TB1]:	Stuart Russell and Peter Norvig. **Artificial Intelligence: A Modern Approach**, Pearson, 4e, Pearson

Reference Books:

[R1]:	Deepak Khemani. **A First Course in Artificial Intelligence**, McGraw Hill Education (India), 2013
[R2]:	Stefan Edelkamp and Stefan Schroedl. **Heuristic Search: Theory and Applications**, Morgan Kaufmann, 2011.
[R3]:	George F.Luger, **Artificial Intelligence,** Pearson Education
[R4]:	Ben Coppin, **Artificial Intelligence Illuminated,** Jones and Bartlett Publishers
[R5]:	Elaine Rich, Kevin Knight and S. B. Nair, **Artificial Intelligence,** Third Edition, McGraw Hill Publishers
[R6]:	Dan W Patterson, “Introduction to AI and Expert Systems”, Prentice Hall of India,

	New Delhi, 2010

3. Course Plan

Lecture	Topic(s)	Reference
1-2	**Introduction:** Foundation and History of AI. success stories, risk and benefits. Turing test and its variants.	CH-01
3-4	**Intelligent Agents:** Agents & Environments, Rational Behavior, Performance Measure, Environment, Actuators, Sensors (PEAS), Structure of Agents	CH-02
5-6	**Problem solving agent:** importance of goal, uninformed search strategies, BFS, DFS, Depth limited search, Iterative deepening depth-first search.	CH-03
7-9	**Informed search strategies:** Greedy best-first search, A* algorithm, Heuristic functions, Time & space complexity of search algorithms, Local search algorithms: Hill climbing, Simulated annealing, Local beam search, Partially Observable Environment	CH-03+04
10-11	**Constraint Satisfaction Problems (CSPs):** Definition, Modeling real-world problems as CSP, General purpose heuristic, Constraint propagation, Backtracking search for CSPs, Local search for CSPs, Structure of problems	CH-05
12-13	**Adversarial Search:** game theory, Alpha-Beta Tree search, Monte Carlo Search Tree	CH-06
14-21	**Knowledge Representation & Reasoning:** Knowledge-based agents, Propositional logic, First-order logic (FOL), Inference in FOL, Forward chaining, Backward chaining, Resolution, Theorem proving & model checking, Knowledge engineering in FOL.	CH-07+08+09
22-27	**Quantifying Uncertainty and Probabilistic Reasoning:** Bayesian probability & Bayes' theorem, Naïve Bayes' model, Bayesian Belief Networks (BBN), Semantics of BBNs, Inference in BBNs **Probabilistic Reasoning over Time:** Inference in temporal models, Hidden Markov Models (HMM), Kalman filters, Dynamic Bayesian networks	CH-12+13+14 Class-Notes
28-30	**Optimization Models:** Reinforcement Learning, Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization,	CH-22 Class-Notes
31-34	**Machine Learning:** Basics, Performance Evaluation, Supervised learning, Un-supervised learning, Ensemble learning, K-NN, Decision Tree, Random Forest, Linear Regression, Logistic Regression, SVM	CH-18 Class-Notes
35-36	**Neural networks:** Perceptron, Neuron, activation functions, power of multiple layers	CH-21 Class-Notes
37-38	**Convolution neural networks (CNNs):** convolution, pooling and its variations, different deep CNN architectures - LeNet, AlexNet, VGG, PlacesNet, DenseNet	CH-24 Class-Notes
39-40	**Applications:** Applications in vision, speech and natural language processing, End-to-End Spatial Transform Face Detection and Recognition, DeepFace and FaceNet, advanced topics.	CH-23+26 Class-Notes

4. Learning outcome

Students who complete this course would be able

1. To designing intelligent agents and represent knowledge in inference-based problem solving
2. To apply probability theory to describe and model agents operating in uncertain environments
3. To optimize computation models for processing real world application of intelligent agents
4. To understand the importance of general purpose solution with end-to-end learning.
5. To represent problem and derive reasoning using logical inferences

5. Evaluation Scheme

SN	Evaluation Component	Marks	Information
1.	Mid-Semester Test: FN1 - Oct 04, 2024	30%	Closed Book (Expected duration 90 Min)
2.	Quiz: One in Number	5%	Closed Book (Expected duration 40 Min)
3.	Term Project: *Could be done individually or in groups of two/three. A list of problems would be provided by the instructor. Require coding to develop and generate results.*	25%	Continuous Evaluation. Would be evaluated based on the Proposal (3%), Demonstration (7%+10%) report/viva/presentation (5%).
4.	Comprehensive Exam: FN - Dec 05, 2024	40%	Partially Open Book (Expected duration 180 Min)

6. Honor Code

All component are individual until specifically mentioned. Plagiarism in any form shall be tolerated (we would be using appropriate software tools). Student shall be awarded ZERO marks and case may be reported to the appropriate committee of the Institute for appropriate action. Every component is individual until specifically specified.

7. Notices

All notices would be put on **course website:** `www.ktiwari.in/ml` and NALANDA. Submissions would be through NALANDA.

8. Make-up Policy

To be granted only in case of serious illness or emergency, on case to case basis for the Comprehensive Exam only.

9. Chamber Consultation Hours

Tuesday 10-11 AM. Seek appointment if you wish to meet online.

Instructor-in-Charge