BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
SECOND SEMESTER 2020-2021
Course Handout Part II

Date: 16/01/2021

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 **: NAVNEET GOYAL (goel@)**

Course Description

Artificial Intelligence (AI) is a field of computer science that attempts to build technology to inculcate human cognition in computer systems. A primary goal of AI is to build intelligent entities to mimic the attributes of human intelligence such as problem solving, reasoning, planning, uncertainty handling, learning etc. The course introduces students to a large collection of algorithms and techniques for building these intelligent entities. By the end of the course, the students should have a general knowledge of the field of AI. They should be able to recognize when and how to use AI techniques to solve problems. The students should also be able to evaluate new techniques they encounter.

This course covers the issues and techniques involved in the creation of computer systems that display intelligent behavior. The following are among the topics that we will cover: AI search techniques, Game Playing, Planning, Knowledge Representation, Reasoning under Uncertainty and Reinforcement Learning.

Text Book:

TB. Stuart Russell and Peter Norvig.
Artificial Intelligence: A Modern Approach, Pearson, 4e, Prentice Hall

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.

LECTURE PLAN (42 lectures)

Topic	Topic Details	No. of Lectures	Chapter Reference
Section 1: Introduction (6 lectures)			
Overview	Introductory, Foundational, and Historical perspectives of AI	2	Ch. 1 - TB
Ubiquitous AI	Some landmark success stories of AI from different domains/disciplines	1	Class Notes & research papers
The Turing Test: Variants and Milestones	1. Turing test & its importance 2. Turing Test Variants 3. Milestones	1	Ch.1 – TB + Class Notes + web resources
Agents, Environments, & Interactions	1. Types of Agents & Environments 2. Rational Behavior 3. Performance Measure, Environment, Actuators, Sensors (PEAS)	2	Ch. 2 – TB

	4. Structure of Agents		
Section 2: Problem Solving (12 lectures)			
Search	1. Problem solving agents 2. Search algorithms 3. Uninformed search strategies o Breadth-first search o Depth-first search o Depth limited search o Iterative deepening depth-first search 4. Informed search strategies o Greedy best-first search o A* algorithm 5. Heuristic functions 6. Time & space complexity of search algorithms 7. Local search algorithms o Hill climbing o Simulated annealing o Local beam search o Genetic Algorithms 8. Search in Complex Environments 9. Adversarial search & Games o Game theory o Optimal Decisions in games o Heuristic Alpha-Beta Tree Search o Monte Carlo Tree Search o Stochastic games o Partially observable games o Limitations of game search algorithms	10	Chs. 3-5 – TB
Constraint Satisfaction Problems (CSPs)	1. Definition 2. Modeling real-world problems as CSP 3. General purpose heuristic 4. Constraint propagation 5. Backtracking search for CSPs 6. Local search for CSPs 7. Structure of problems	2	Ch. 6 - TB
Section 3: Knowledge, Reasoning, & Planning (8-2 lectures)			
Knowledge Representation & Reasoning	**Logic & Inference** 1. Knowledge-based agents 2. Propositional logic 3. First-order logic (FOL) 4. Inference in FOL	2	Chs. 7-9 – TB

	○ Forward chaining ○ Backward chaining ○ Resolution 5. Theorem proving & model checking 6. Knowledge engineering in FOL **Knowledge Representation** 1. Ontological Engineering 2. Categories & objects 3. Event calculus 4. Reasoning system for categories 5. Reasoning with default information **Planning** 1. Classical planning 2. Heuristics for planning 3. Hierarchical planning 4. Planning in non-deterministic domains	2 2	Ch. 10 – TB Ch. 11 – TB
Section 4: Dealing with Uncertainty (6 lectures)			
Quantifying Uncertainty and Probabilistic Reasoning	1. Bayesian probability & Bayes' theorem 2. Naïve Bayes' model 3. Bayesian Belief Networks (BBN) 4. Semantics of BBNs 5. Inference in BBNs	3	Chs. 12-13 - TB
Probabilistic Reasoning over Time	1. Inference in temporal models 2. Hidden Markov Models (HMM) 3. Kalman filters 4. Dynamic Bayesian networks	3	Ch. 14 - TB
Section 5: Learning (9 lectures)			
Machine Learning	1. Supervised learning 2. Un-supervised learning 3. Ensemble learning	5	Ch. 19 - TB
Reinforcement Learning (RL)	4. Motivation 5. Exploration vs. Exploitation tradeoff 6. Markov Decision Process (MDP) 7. Action and state spaces 8. Q-Learning Algorithm 9. Inverse Reinforcement Learning (IRL)	4	Ch. 22 + web resources
Section 6: Recent Topics in AI (3 lectures)			
Recent Topics	1. Responsible AI 2. Explainable AI 3. Privacy preserving AI 4. Edge AI	3	Research papers & web resources

Evaluation Scheme:

Component	Duration	Weightage	Date (Time)
MidSem Test (Closed Book)	90 Mins.	30%	TBA
Assignment(s)	Take Home	30%	TBA
Comprehensive Exam (Closed book)	2 Hours	40%	11/05 (FN)

Notices: All notices will be uploaded on NALANDA only.
Chamber Consultation Session: Online session once a week (T-10). Interested student(s) need to inform apriori through NALANDA if a session is required.
Makeup Policy: To be granted only in case of serious illness or emergency.
Email Policy: Communication through email is highly discouraged. If you want to discuss anything, request/attend the chamber consultation session. Academic queries/doubts can be posted on NALANDA (a discussion forum has been created on the course page)
Plagiarism Policy: If any student is found involved in any kind of plagiarism in any of the evaluation components, the matter will be directly reported to the Examination Committee.
NC Policy: Students securing 10% or less marks will get an NC grade. Students in the [10-15%] bracket are also likely to get NC.

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