COMSATS University Islamabad
Department of Computer Science
Course Syllabus

Course Information

Teacher: **Muhammad Jamil** Email: **jamil@cuisahiwal.edu.pk**
Course Code: **CSC462** Course Title: **Artificial Intelligence**
Credit Hours: **4(3,1)** Lecture Hours/Week: **3**
Lab Hours/Week: **3** Pre-Requisites: **CSC102-Discrete Structures**

Catalogue Description:

This course gives a broad overview of the fundamental theories and techniques of Artificial Intelligence. Topics include: Overview of Artificial Intelligence; Agents & Environments; Problem-Solving; Adversarial Search; Constraint Satisfaction Problems; Knowledge Representation & Reasoning; Uncertainty; and Automated Planning.

Text and Reference Books

Textbook:

1. Artificial Intelligence: A Modern Approach, Russell, S., and Norvig, P., Pearson, 2020.
2. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th Edition George Luger.

Reference Book:

1. Artificial Intelligence Basics: A Non-Technical Introduction, Taulli, T., Apress, 2019.

Unit wise Major Topics:

Unit	Topic	No. of teaching hours
1.	Fundamentals of Artificial Intelligence (AI), Thinking Humanly, Acting Humanly, Thinking Rationally, Acting Rationally, Weak AI, and Strong AI.	4.5
2.	Intelligent Agent, and Agent Environments (Observable Agents, Deterministic, Episodic Static, and Discrete.	6
3.	Agent Types: Simple reflex agents, Goal-based Agents, Model-based Reflex Agents, Utility-based Agents, and Learning Agents.	6
4.	Search Concepts, Problem Formulation, Search Space Definition, Types of Search Algorithms, Uninformed Search, and Breadth First Search (BFS).	7.5
5.	Uninformed Search: Depth First Search (DFS), and BFS & DFS Comparison.	9
6.	Informed Search: Heuristic Function, Greedy Best First Search, and A* search.	6
7.	Local Search & Optimization: Hill Climbing & Genetic Algorithm	6
Total Contact Hours		**45**

Week wise Plan:

Lecture #	CDF Unit #	Topics Covered	Reading Material
1.	1	Fundamentals of Artificial Intelligence (AI), Thinking Humanly, Acting Humanly, Thinking Rationally, Acting Rationally, Weak AI, and Strong AI, Reactive AI, Limited Memory, Theory of Mind, Self-aware, History.	AIMA: Ch1
2.	1	Common AI workloads, Applications of AI, Intelligent Agent, and Agent Environments (Observable Agents, Deterministic, Episodic Static, and Discrete).	AIMA: Ch2
3.	1	Agent Types: Simple reflex agents, Goal-based Agents, Model-based Reflex Agents, Utility-based Agents, and Learning Agents.	AIMA: Ch2
4.	2	Search Concepts, Problem Formulation, and Search Space Definition, Types of Search Algorithms, Uniformed Search, and Breadth First Search (BFS).	AIMA: Ch3
5.	2	Uninformed Search: Depth First Search (DFS), and BFS & DFS Comparison, Uniform Cost search.	AIMA: Ch3
6.	2	Informed Search: Heuristic Function, Greedy Algorithms (Prims & Kruskal), and A* search, Minimax Algorithm	AIMA: Ch3
7.	2	Local Search & Optimization, Hill Climbing Algorithm, Genetic Algorithm.	AIMA: Ch3
8.	3	Adversarial Search, Game as Search Problems, Game tree and Optimal Decisions in two Person Games.	AIMA: Ch6
9.	3	Imperfect Decision, and Minimax Algorithm.	AIMA: Ch6
10.	3	Evaluation Functions, Cutting-off Search, Alpha-Beta Pruning, and Effectiveness of Alpha-Beta Pruning.	AIMA: Ch6
11.	3	Monte Carlo Tree Search, Selection, Expansion, Simulation and Back Propagation.	AIMA: Ch6
12.	4	CSP: Defining CSP, and Variations on CSP Formulation.	AIMA: Ch5
13.	4	Constraint Graph, Backtracking, Most constrained variable, Least Constraint Variable,	AIMA: Ch5
14.	4	Backtracking Search for CSP, Forward Checking, Constraint Propagation, Inference in CSP.	AIMA: Ch5
15.	4	Local Search for CSP, Min-Conflicts Heuristics, and Constraint Weighting.	AIMA: Ch5
16.	4	Constraint satisfaction problem and back propagation in Neural Networks	AIMA: Ch5
Mid Term Exam			
17.	5	Introduction to Knowledge, Procedural Knowledge, Declarative Knowledge, Meta Knowledge, Heuristic Knowledge, Structural Knowledge. Knowledge Based Agent, Wumpus World, and PEAS.	AIMA: Ch7
18.	5	Logic, Propositional Logic, and Pros & Cons of Propositional Logic.	AIMA: Ch7
19.	5	Atomic/Complex Sentences, Validity, Satisfiability, Un-satisfiability, equivalent, Conjunctive Normal Form (CNF) & Disjunctive Normal Form (DNF).	AIMA: Ch8
20.	5	Inference Engine, Propositional vs First Order Predicate logic (FOPL), representing Knowledge in FOPL, Quantifiers in FOPL, Translating English to FOL, Sementic Networks.	AIMA: Ch9
21.	5	Forward Chaining Algorithm, and Backward Chaining Algorithm.	AIMA: Ch9

22.	5	Knowledge Representation: Categories & Knowledge-based Agents	AIMA: Ch10
23.	6	Acting under Uncertainty, Sources of Uncertainty, Probability.	CLRS: Ch12
24.	6	Basic Probability Notation: Proposition, Atomic event, Unconditional probability, Independence, Conditional Probability Inference Using Full Joint.	AIMA: Ch12
25.	6	Bayes' Rule & its Use, Naive Bayes Models, and Introduction to Fuzzy logic	AIMA: Ch12
26.	6	Time & Uncertainty, and Hidden Markov Models.	AIMA: Ch14
27.	7	Classical Planning & Algorithms: Forward & Backward State-Space Search for Planning, Planning as Boolean Satisfiability.	AIMA: Ch11
28.	7	Heuristics for Planning: Domain Independent Pruning, and State Abstraction in Planning, Path Planning and Bug algorithms.	AIMA: Ch11
29.	7	Hierarchical Planning: High Level Actions, Searching for Primitive Solutions and Searching for Abstract Solutions.	AIMA: Ch11
30.	7	Planning & Action in Nondeterministic Domains: Time, Schedules & Resources, Sensor-less Planning, Contingent Planning, and Online Planning.	AIMA: Ch11
31.	7	Time, Schedules & Resources, Sensor-less Planning	AIMA: Ch11
32.	7	Contingent Planning, and Online Planning.	AIMA: Ch11
Final Term Exam			

Student Outcomes (SOs)

S.#	Description
1	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements
2	Identify, formulate, research literature, and solve *complex* computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
4	Create, select, adapt, and apply appropriate techniques, resources, and modern computing tools to *complex* computing activities, with an understanding of the limitations.

Course Learning Outcomes (CLO)

Sr.#	Unit #	Course Learning Outcomes	Blooms Taxonomy Learning Level	SO
CLO's for Theory				
CLO-1	1	Articulate how artificial intelligence enables the capabilities of a computer, machine, or system to mimic the human brain.	*Understanding*	1
CLO-2	2-3	Apply various AI problem solving and searching techniques to a real-world problem.	*Applying*	1,2
CLO-3	4	Formulate a problem specified in natural language as a constraint satisfaction problem.	*Applying*	2

CLO-4	5	Apply resolution to a set of logic statements to answer a query.	*Applying*	2
CLO-5	6-7	Compare various planning strategies for different Applications under uncertainty.	*Analyzing*	2
CLO for Lab				
CLO-6	2-4	Implement various searching technique, CSP and Knowledge-based system to solve a problem.	*Applying*	2,4

CLO Assessment Mechanism

Assessment Tools	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5	CLO-6
Quizzes	Quiz 1	Quiz 2	Quiz 3	Quiz 4	-	-
Assignments	-	Assignment 1	Assignment 2	Assignment 3	Assignment 4	Lab Assignments
Mid Term Exam	Mid Term Exam	Mid Term Exam	Mid Term Exam	-	-	-
Final Term Exam	Final Term Exam					-
Project						Lab Project

Policy and Procedures

- **Attendance Policy:** Every student must attend 80% of the lectures as well as laboratory in this course. The students falling short of required percentage of attendance of lectures/laboratory work, is not allowed to appear in the terminal examination.
- **Course Assessment:**

	Quizzes	Assignments	Mid Term Exam	Terminal Exam	Total
Theory (T)	15	10	25	50	100
Lab (L)	-	25	25	50	100
Final Marks (T+L)	**(T/100)*75 + (L/100)*25**				

- **Grading Policy:** The minimum passing marks for each course is 50% (In case of LAB; in addition to theory, student is also required to obtain 50% marks in the lab to pass the course). The correspondence between letter grades, credit points, and percentage marks at CUI is as follows:

Grade	**A**	**A-**	**B+**	**B**	**B-**	**C+**	**C**	**C-**	**D+**	**D**	**F**
Marks	>= 85	80 – 84	75 – 79	71 - 74	68 - 70	64 - 67	61 - 63	58 - 60	54 - 57	50-53	< 50
Cr. Point	3.67-4.00	3.34-3.66	3.01-3.33	2.67-3.00	2.34-2.66	2.01-2.33	1.67-2.00	1.31-1.66	1.01-1.30	0.10-1.00	0.00

- **Missing Exam:** No makeup exam will be given for final exam under any circumstance. When a student misses the mid-term exam for a legitimate reason (such as medical emergencies), his grade for this exam will be determined based on the Department policy. Further, the student must provide an official excuse within one week of the missed exam.
- **Academic Integrity:** All CUI policies regarding ethics apply to this course. The students are advised to discuss their grievances/problems with their counsellors or course instructor in a respectful manner.
- **Plagiarism Policy:** Plagiarism, copying and any other dishonest behavior is prohibited by the rules and regulations of CUI. Violators will face serious consequences.

Signature:----------	Signature:----------	Signature:----------
Course Instructor: Muhammad Jamil	Area Head Dr. Muhammad Shoaib	Head of Department: Dr. Zafar Iqbal Roy