COURSE DESCRIPTION FORM: AI2002 Artificial Intelligence (AI)

COURSE DESCRIPTION FORM

INSTITUTION FAST School of Computing, National University of Computer and Emerging Sciences, Karachi

PROGRAM TO BE EVALUATED	BS-CS– Spring 2023

Course Description

Course Code	AI2002 / AL2002
Course Title	Artificial Intelligence
Credit Hours	3+1
Prerequisites by Course(s) and Topics	
Grading Policy	Absolute grading
Policy about missed assessment items in the course	Retake of missed assessment items (other than midterm/ final exam) will not be held. For a missed midterm/ final exam, an exam re-take/ pre-take application along with necessary evidence are required to be submitted to the department secretary. The examination assessment and retake committee will decide the exam re-take/ pre-take cases.
Course Plagiarism Policy	Plagiarism in project or midterm/ final exam may result in F grade in the course. Plagiarism in an assignment will result in zero marks in the **whole assignments** category.
Assessment Instruments with Weights (homework, quizzes, midterms, final, programming assignments, lab work, etc.)	***75% Theory 25% Practical*** Assessment Items

Assessment Item	**Number**	**Weight (%)**
Assignments + Quizzes	3+3 (best 2)	10 + 5
Midterm Exam	2	15 each
Project (Theory / Lab)	1	10
Final Exam	1	50

Course Instructors	
Lab Instructors (if any)	
Course Coordinator	Dr. Muhammad Farrukh Shahid
URL (if any)	
Current Catalog Description	This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence. Upon completion, students should be able to develop

	intelligent systems by assembling solutions to concrete computational problems; understand the role of knowledge representation, problem solving, and learning in intelligent-system engineering; and appreciate the role of problem solving, vision, and language in understanding human intelligence from a computational perspective.
Textbook (or **Laboratory Manual** for Laboratory Courses)	1. Stuart Russell and Peter Norvig, Artificial Intelligence. A Modern Approach, 3rd edition, Prentice Hall, Inc., 2010.
Reference Material	

Course Learning Outcomes

A. Course Learning Outcomes (CLOs)

On successful completion of this course students will have to know how of:

CLO	Name	Domain	Taxonomy Level	PLO	Tools
01	To recognize the notions of rational behavior and intelligent agents.	Cognitive	C2 (Understanding)	2	A, M
02	To identify and relate of methods of blind as well as informed search and ability to practically apply the corresponding techniques.	Cognitive	C2 (Understanding)	2	A, M, F
03	To demonstrate understanding and ability to implement the major concepts, approaches and research in evolutionary algorithms, constraint satisfaction problems, probabilistic reasoning, supervised and unsupervised learning and other AI areas.	Cognitive	C2 (Understanding) C3 (Applying)	3	A, M, F

Tool: A = Assignment, Q = Quiz, M = Midterm, F=Final

B. Program Learning Outcomes

For each attribute below, indicate whether this attribute is covered in this course or not. Leave the cell blank if the enablement is little or non-existent.

1. Computing Knowledge	Apply knowledge of mathematics, natural sciences, computing fundamentals, and a computing specialization to the solution of complex computing problems.	
2. Problem Analysis	Identify, formulate, research literature, and analyze complex computing problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and computing sciences.	✔
3. Design/ Develop Solutions	Design solutions for complex computing problems and design systems, components, and processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	✔
4. Investigation & Experimentation	Conduct investigation of complex computing problems using research-based knowledge and research-based methods.	
5. Modern Tool Usage	Create, select, and apply appropriate techniques, resources and modern computing tools, including prediction and modeling for complex computing problems.	
6. Society Responsibility	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to context of complex computing problems.	
7. Environment and Sustainability	Understand and evaluate sustainability and impact of professional computing work in the solution of complex computing problems.	
8. Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of computing practice.	

9. Individual and Teamwork	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	
10. Communication	Communicate effectively on complex computing activities with the computing community and with society at large.	
11. Project Management and Finance	Demonstrate knowledge and understanding of management principles and economic decision making and apply these to one's own work as a member or a team.	
12. Lifelong Learning	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.	

C. Mapping of CLOs on PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CLOs	1		✔										
	2		✔										
	3			✔									

	Topics to be covered				
Topics covered in the course with number of lectures on each topic (Assume 15 weeks of instruction and 1 hour lecture duration)	**List of Topics**	**Week**	**No. of Weeks**	**Contact Hours**	**CLO(s)**
	Introduction: Introduction to AI, Foundations of AI, History of AI, AI in industry, the concept of neurons and neural networks, Basic components of AI ***(1 Lecture)*** --- Identifying AI systems, Branches of AI, ***(1 Lecture)*** --- Intelligent Agents Agents and Environments, sensors, actuators, ***(1 Lecture)***	**1**	**1**	**3**	**1**
	The Concept of Rationality, Performance measures, Rationality, Rationality V/S Omniscience (***1 Lecture)*** --- The Nature of Environment, Performance, Environment, Actuators and Sensors (PEAS), Agent Types, Properties of environments, The structure of Agents ***(1 Lecture)*** --- Problem Representation: Introduction to Trees and Graphs ***(1 Lecture)*** **Assignment no 1 Release (Start of Week 2)**	**2**	**1**	**3**	**1,2,3**
	--- Problem Solving by Searching: Problem Solving agents, Components of Problem, formulating problems, Searching for Solutions ***(2 Lecture)*** --- Measuring problem-solving performance, Uniformed Searching, ***(1 Lecture)*** **Assignment no 1 Submission (End of Week 2)**	**3**	**1**	**3**	**1,2,3**
	Informed Heuristic search strategies		**1**	**3**	**1,2,3**

	(1 Lecture) **----------** Local searching: **(1 Lecture)** **----------** Constraint Satisfaction Problems **(1 Lecture)** **Assignment no 2 Release** **(Start of Week 4)**	**4**			
	Constraint Satisfaction Problems Backtracking search for CSPs, Local search constraint satisfaction problems ***(2 Lectures)*** **----------** The structure of problems ***(1 Lecture)*** **Assignment no 2 Submission** **(End of Week 5)**	**5**	**1**	**3**	
	WEEK 6	***MID -1 Exam***			
	Adversarial Search, Games, Optimal decisions in Games, The minimax algorithm, Alpha beta pruning (***2 Lectures)*** **----------** Logical Agents, First Order Logic, Inference in First-Order Logic ***(1 Lecture)*** **Assignment no 3 Release** **(Start of Week 7)**	**7**	**1**	**3**	**2,3**
	Uncertainty, acting under uncertainty, Uncertainty in AI, Fuzzy Logic Basic Probability, Conditional Probability, Bayes Rule, Probabilistic Reasoning, representing Knowledge in an Uncertain Domain ***(2 Lecture)*** **----------** Bayesian Networks, ***(1 Lecture)***	**8**	**1**	**3**	**2,3**

	Dynamic Bayesian Network ***(1 Lecture)*** --- Introduction to Model-driven and Data-driven approach and Review on Probability and Linear Algebra, Performance evaluation [ROC, Confusion Matrix]. **Supervised Learning methods:** Linear Regression Logistic Regression ***(2 Lectures)***	**9**	**1**	**3**	**2,3**
	Non-parametric Methods, Decision Trees ***(1 Lectures)*** --- Neural Networks, Units in NN, Single Layer Feed-forward and Multi-Layer Feed-Forward NN. ***(1 Lecture)*** **Unsupervised Learning methods** Clustering (K-mean) ***(1 Lecture)*** **Assignment no 3 Submission (End of Week 10)**	**10**	**1**	**3**	
	Week 11	***MID -2 Exam***			
	Reinforcement Learning Agent, environment, reward, state, policy, Q value, model of the environment. Reinforcement learning algorithms, ***(3 Lectures)*** **Assignment no 4 Release (Start of Week 12)**	**12**	**1**	**3**	**2,3**
	Reinforcement Learning Type of Reinforcement learning Popular models of RL (Q and Markov decision process	**13**	**1**	**3**	**2,3**

	(3 Lectures) **Assignment no 4 Submission (End of Week 13)**				
	Recent trends in AI and applications of AI algorithms Trends, Case study of AI systems [Anomaly Detection], ***(3 Lectures)***	**14**	**1**	**3**	**1,2**
	Revision	**15**	**1**	**3**	
	Week 16	***Final Exam***			
	Review		**1**	**3**	**1,2,3**
	Total		**16**	**48**	
Laboratory Projects/Experiments Done in the Course	**Lab content is mentioned on the page number 11 of this document.**				
Programming Assignments Done in the Course	All the assignments would be programming based (e.g., C++, Java, Python)				

Class Time Spent (in percentage)	**Theory (%)**	**Problem Analysis (%)**	**Solution Design (%)**	**Social and Ethical Issues (%)**
	50	25	20	5

Oral and Written Communications	Every student is required to submit at least 1 written report of typically 10 pages in IEEE research report format. Students will also be called for viva/presentation of the project and any assignment where necessary.

AI Lab Learning Outcomes

A. LAB Course Learning Outcomes (CLOs)

On successful completion of this course lab students will have to know how of:

CLO	Name	Domain	Taxonomy Level	PLO	Tools
01	To identify and implement the methods of blind as well as informed search and ability to practically apply the corresponding techniques.	Cognitive, Psychomotor	C2 (Understanding) C3 (Applying)	3	A, M, F
02	To demonstrate understanding and ability to implement the major concepts, approaches and research in evolutionary algorithms, constraint satisfaction problems, probabilistic reasoning, supervised and unsupervised learning and other AI areas.	Cognitive, Psychomotor	C2 (Understanding) C3 (Applying)	3	A, M, F

Tool: A = Assignment, Q = Quiz, M = Midterm, F=Final

B. Program Learning Outcomes

For each attribute below, indicate whether this attribute is covered in this course or not. Leave the cell blank if the enablement is little or non-existent.

1. Computing Knowledge	Apply knowledge of mathematics, natural sciences, computing fundamentals, and a computing specialization to the solution of complex computing problems.	
2. Problem Analysis	Identify, formulate, research literature, and analyze complex computing problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and computing sciences.	
3. Design/ Develop Solutions	Design solutions for complex computing problems and design systems, components, and processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	
4. Investigation & Experimentation	Conduct investigation of complex computing problems using research-based knowledge and research-based methods.	
5. Modern Tool Usage	Create, select, and apply appropriate techniques, resources and modern computing tools, including prediction and modeling for complex computing problems.	
6. Society Responsibility	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to context of complex computing problems.	
7. Environment and Sustainability	Understand and evaluate sustainability and impact of professional computing work in the solution of complex computing problems.	
8. Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of computing practice.	

9. Individual and Teamwork	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	
10. Communication	Communicate effectively on complex computing activities with the computing community and with society at large.	
11. Project Management and Finance	Demonstrate knowledge and understanding of management principles and economic decision making and apply these to one's own work as a member or a team.	
12. Lifelong Learning	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.	

C. Mapping of CLOs on PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CLOs	1			✔									
	2			✔									

Lab/ Practical Component of the course

Weeks	Contents/Topics	Assessment Items (Case Study/ Exercise Assignment/ Quiz etc.)
Week 01	Getting familiarization to the Python- It's famous **IDE** and, Introduction to the AI with Practical Examples	
Week-02	Types of Agents and Environments to Implement and Revision of Python concepts and relevant Libraries	Task-1
Week-03	Searching Problem Solving by Searching – Uninformed/Blind Search Algorithms Searching Problem Solving by Searching – Informed/Heuristic Based Search	Task 2
Week-04	Demonstration on Raspberry *Pi* and *Arduino board* (HARDWARE) ***Project Announcement***	Task 3
Week-05	Constraint Satisfaction Problem ***Project Proposal Submission***	Task 4,
Week-06	**Theory MID-1 Exam**	
Week-07	Adversarial Search Evolutionary Search Algorithms	Task 5
Week-08	**LAB MID**	
Week-09	Dynamic Bayesian Networks, HMM, KF	Task 6
Week-10	Supervised Learning	
Week-11	**Theory MID-2 Exam**	
Week-12	Un-Supervised Learning	Task 7,8
Week-13	Reinforcement Learning	Task 9
Week-14	Project Evaluation / Case Study	Task 10
Week-15	**Lab Final Exam**	Term Project

Practical/ Programming Work/ Tools:
1) Python / Google Colab / Jupyter Notebook

Assessment Instruments with Weights *(Homework, quizzes, midterms, final, programming assignments, lab work, etc.)*

Assessment Item	Number	Weight (%)
Project	1	10
Lab Tasks	10	20

Lab Mid Term	1	20
Final Exam	1	50

Grading Policy: Absolute