The Superior University Lahore
Gold Campus
Faculty of Computer Science and Information Technology
Artificial Intelligence – Assignment 1

Intelligent Agents, State Space & Problem Formulation

INSTRUCTIONS

- This is an **individual assignment**. Everyone must submit independently.
- **Zero tolerance for plagiarism or cheating** - violators will receive 0 marks.
- AI tools are permitted for research and understanding, but **direct copying is strictly prohibited**. Add your individual creativity and critical thinking.
- Each answer must include: **explanations, examples, diagrams (where applicable), and real-world connections**.
- File naming: **RollNo_Name_AI_Assignment.docx**
- Submit both hard copy (checked by instructor) and soft copy.

LEARNING OBJECTIVES

Upon completion of this assignment, you will be able to:

- Analyze and design intelligent agent architectures for real-world scenarios
- Formulate problems using state space representation
- Apply PEAS framework to diverse applications
- Critically evaluate agent types and environment characteristics
- Research and synthesize new AI concepts independently

PART A: CONCEPTUAL FOUNDATIONS

Question 1: Evolution and Applications of AI [10 Marks]

(a) Historical Timeline [3 marks]

Create a comprehensive timeline showing the major milestones in AI history from 1950 to 2025. Your timeline must include:
- At least 8 significant events/breakthroughs
- The year and a brief description (2-3 sentences) for each
- Why each event was important for AI development

(b) Turing Test Analysis [4 marks]

The Turing Test has been debated for decades. Analyze it critically:
1. Explain the Turing Test with a diagram showing how it works
2. Research and describe ONE modern AI system that has attempted or passed variants of the Turing Test
3. Do you think the Turing Test is still relevant today? Justify your answer with at least 3 points
4. Suggest ONE improvement or alternative test for modern AI

(c) Future Trends Research [3 marks]

Research and present your findings on:
- TWO emerging AI technologies or trends (2023-2025) not covered in class
- For each trend: What is it? How does it work? What are its potential applications?
- Cite at least 2 credible sources (research papers, tech journals, or official documentation)

Question 2: Intelligent Agents Deep Dive [15 Marks]

(a) Agent Architecture Comparison Table [5 marks]

Create a detailed comparison table with the following structure:

Agent Type	Key Characteristics	Advantages	Limitations	Real Example
Simple Reflex Agent	Fill in	Fill in	Fill in	Fill in
Model-Based Agent	Fill in	Fill in	Fill in	Fill in
Goal-Based Agent	Fill in	Fill in	Fill in	Fill in
Utility-Based Agent	Fill in	Fill in	Fill in	Fill in

(b) Rationality vs Intelligence [3 marks]

Many people confuse 'rational' with 'intelligent'. Clarify this distinction:
5. Define what makes an agent 'rational' in AI context
6. Provide an example where an agent can be rational but not seem intelligent to humans
7. Explain why rationality is preferred over human-like intelligence in AI system design

(c) Agent Structure Diagrams [4 marks]

Draw detailed architectural diagrams for:
- Simple Reflex Agent - showing sensors, condition-action rules, and actuators
- Model-Based Reflex Agent - showing the internal state and how the world model works

Note: Your diagrams should include all components, show the flow of information, and be clearly labeled.
For each diagram, briefly explain (2-3 sentences) how information flows through the agent.

(d) Learning Agents Research [3 marks]

We discussed several agent types in class. Research and present:
- What is a 'Learning Agent'? (This was NOT covered in class - research it yourself)
- Draw a diagram showing its four main components
- How does it differ from goal-based and utility-based agents?
- Give ONE real-world example of a learning agent system

Question 3: Environment Types and Characteristics [12 Marks]

(a) Environment Classification [6 marks]

Complete the following table by classifying each environment according to ALL relevant properties:
(Fully Observable/Partially Observable, Deterministic/Stochastic, Episodic/Sequential, Static/Dynamic, Discrete/Continuous, Single-agent/Multi-agent)

Environment/Application	Classification & Justification
Chess Game	Classify and explain why for each property
Self-Driving Car	Classify and explain why for each property
Email Spam Filter	Classify and explain why for each property
Medical Diagnosis System	Classify and explain why for each property
Stock Trading Bot	Classify and explain why for each property

(b) Environment Impact on Agent Design [4 marks]

Choose TWO environment characteristics (e.g., fully observable vs partially observable, OR deterministic vs stochastic).
For each pair:

- Explain what the characteristic means
- How does this characteristic affect the complexity of the agent design?
- Provide a concrete example illustrating the difference

(c) Critical Thinking Challenge [2 marks]

Design your own environment/application scenario that is:
- Partially observable
- Stochastic
- Sequential
- Multi-agent

Describe the scenario and justify why it has each of these properties.

Question 4: PEAS Framework Application [15 Marks]

(a) PEAS Analysis for Given Scenarios [9 marks]

Complete the PEAS description for each of the following three scenarios. Be specific and comprehensive:

Scenario 1: Smart Home Energy Management System

Performance Measure	
Environment	
Actuators	
Sensors	

Scenario 2: AI-Powered Customer Service Chatbot

Performance Measure	
Environment	
Actuators	
Sensors	

Scenario 3: Drone Delivery System

Performance Measure	
Environment	
Actuators	
Sensors	

(b) Design Your Own PEAS [6 marks]

Choose an application from your field of interest (e.g., agriculture, education, healthcare, entertainment, sports, etc.) and:

8. Describe the application scenario (3-4 sentences)
9. Design a complete PEAS description
10. Identify which agent type (reflex, model-based, goal-based, utility-based) would be most suitable and why
11. Discuss at least 2 challenges this agent would face in its environment

PART B: STATE SPACE & PROBLEM FORMULATION

Question 5: Understanding State Space Representation [18 Marks]

(a) State Space Fundamentals [5 marks]

Answer the following conceptual questions:
12. What is a 'state' in AI problem-solving? Explain with an example.
13. Define 'state space' and explain why it is important for problem-solving.
14. What is the difference between the 'state space' and the 'search tree'?
15. Explain what makes a problem representation 'good' for search algorithms.
16. Can a problem have an infinite state space? Give an example and explain.

(b) Vaccum cleaner – Problem Formulation [8 marks]

Complete the following:
17. State Representation: How will you represent a state? Explain your choice.
18. Initial State: Define the starting state.
19. Goal State(s): Define all possible goal states.
20. Actions/Operators: List ALL possible actions with their preconditions and effects.
21. Transition Model: Choose any 2 states and show what new states can be reached from them.
22. State Space Diagram: Draw a state space graph showing at least 10 states and the transitions between them. Mark the initial and goal states clearly.
23. Solution Path: Trace one complete solution path from initial to goal state.

Question 6: Problem Formulation Components [10 Marks]

(a) Formulation Elements [5 marks]

For proper problem formulation, we need to define several components. Explain each with examples:
24. States: What are they and how should they be chosen?
25. Initial State vs Goal State: Define and differentiate
26. Actions: What makes a good action definition?
27. Transition Model: Explain its role
28. Path Cost vs Step Cost: Explain the difference with an example

(b) Real-World Problem Formulation [5 marks]

Choose ONE of the following real-world scenarios and provide a complete problem formulation:
- Route planning for a delivery truck with multiple stops
- Scheduling classes in a university (avoiding conflicts)
- Solving a Sudoku puzzle

Your formulation must include:
- Clear state representation
- Initial and goal state definitions
- List of possible actions/operators
- Transition model explanation
- Cost function (if applicable)

Part C: Integration & Critical Reflection

Personal Learning Reflection [5 marks]

Reflect on your learning journey:
- What concept from this assignment was most challenging for you? How did you overcome it?
- Which topic did you find most interesting? Why?
- How has your understanding of AI changed after working on this assignment?
- Describe one real-world application where you could apply the concepts learned. Be specific.
- What additional topics or questions do you want to explore in AI after this assignment?

GRADING RUBRIC

Category	Marks	Criteria
Part A: Conceptual Foundations	52	Questions 1-4
Part B: State Space & Problem Formulation	28	Questions 5-6
Part C: Integration & Critical Reflection		
TOTAL	**80**	

Additional Evaluation Criteria

- **Quality of Diagrams:** Clear, labeled, and professionally presented
- **Depth of Analysis:** Going beyond surface-level answers
- **Critical Thinking:** Original insights and connections
- **Research Quality:** Credible sources and proper citations
- **Presentation:** Well-organized, clear writing, proper formatting
- **Examples & Applications:** Relevant, specific, and well-explained

TIPS FOR SUCCESS

- **Start Early:** This assignment requires research and critical thinking - don't wait until the last minute.
- **Use Multiple Sources:** Don't rely on a single source for your answers.
- **Draw Diagrams:** Visual representations often clarify concepts better than words alone.
- **Connect Concepts:** Look for relationships between different topics.
- **Real-World Examples:** Always try to connect theoretical concepts to practical applications.
- **Cite Your Sources:** Proper attribution is essential for research questions.
- **Review Before Submission:** Check for completeness, clarity, and correctness.
- **Ask Questions:** If you're unclear about any requirement, ask your instructor.

Good Luck! Trust yourself and do it on your own.
This assignment is designed to help you learn, not just to test you.

Your effort and critical thinking will be evident in your answers.