Artificial Intelligence (AI2002)

Assignment 1

Note: This is an open GPT assignment, allowing the use of various resources for assistance. However, please note that responses may need to be presented in a viva format rather than usual evaluation.

You need to submit its (.ipynb) file along with its latex report.

Understanding AI Agents and Their Interaction with Complex Environments

Scenario: AI in Autonomous Maritime Navigation

Maritime shipping is critical for global trade, yet it faces challenges like unpredictable weather, congested shipping lanes, and collision risks. Companies are developing AI-powered autonomous ships to navigate the oceans with minimal human intervention.

Assignment Questions:

1. Agent Perspective

a) AI Agent Classification and Implementation

- What type of AI agent best represents an autonomous ship? Justify your answer by detailing the perception mechanisms (e.g., sensors, cameras) used to gather environmental data.
- **Coding Task:** Design a basic simulation of an AI agent that uses sensor data to perceive its environment. Include pseudo-code for how the agent would process this data and make navigation decisions.

b) Data Integration and Decision-Making

- Discuss how the AI system of the ship interacts with various data sources (satellite positioning, radar, sonar, weather forecasts). How does it prioritize and filter this information to ensure safe navigation?
- **Coding Task:** Create a function that integrates multiple data sources. The function should take in raw data and output prioritized navigation decisions based on predefined safety metrics.

c) Single vs. Multi-Agent Systems

- Should an autonomous ship operate as a single intelligent agent or within a multi-agent system, communicating with other ships and authorities? Discuss real-world challenges in maritime transport that influence this decision.
- **Coding Task:** Outline an architecture for a multi-agent system that includes communication protocols between autonomous ships and port authorities.

Provide a sample code snippet for how one ship can send its position to another.

2. Environment Perspective

a) Classifying the Oceanic Environment

- Classify the oceanic environment in terms of observability, determinism, and dynamism. Explain how these characteristics create unique challenges for AI systems in maritime navigation.
- **Coding Task:** Develop a Python class that represents the oceanic environment and includes methods to simulate changes in visibility, weather conditions, and obstacle density.

b) Adapting to Unpredictable Conditions

- Given the ocean's unpredictability (e.g., rogue waves, marine life), how should the AI system adapt to maintain safety and efficiency?
- **Coding Task:** Write a function that simulates an adaptive algorithm for the ship's navigation system. This function should adjust the ship's course based on real-time data about obstacles and environmental conditions.

c) Decision-Making Without Standardized Rules

- Discuss how the lack of standardized lane markings affects the decision-making of an AI-driven ship. What strategies can be implemented for safe navigation in congested routes?
- **Coding Task:** Create a decision-making algorithm that considers various factors (traffic density, weather conditions, etc.) to determine the safest route. Include examples of how the algorithm would react to different scenarios.