CSC520 Spring 2022
Assignment 1 Due Jan. 31st at
11:59pm

This assignment includes conceptual questions. It must be completed individually. You may not collaborate with other students or exchange partial answers. Questions involving answers must be emailed to the instructor or TAs directly or discussed during office hours.

Your answers to the conceptual questions must be uploaded to Moodle as a single **PDF** file titled "**<unity id>_Assign1.pdf**". Replace "**<unity id>**" with your unity ID (not student ID).

Question 1 (15 points)

Your task is to design and deploy a search-and-rescue agent that controls a group of robots to search for survivors in a large collapsed building after the earthquake. The robots communicate with each other using wireless mobile communication nodes they carry. They use the same equipment to communicate with a central server to report the necessary findings. Communication quality depends on the terrain and other environmental factors. The robots must search for potential survivors in the environment and report survivors' location to human rescuers.

Answer each of the following questions with a paragraph or more of text.

1. **Define a PEAS specification for the agent. Justify your choices.**

    P: Number of survivors found, distinguish human and non-human, avoid reporting obstacles

    E: Places where buildings are collapsed

    A: signal, wheels, wireless mobile communication nodes

    S: Camera, GPS, motors, temperature sensing device, motion capture system

    The robots determine a survivor if they detect a temperature in range of human body temperature or a movement. The robots collect their location and pictures, then send it to the control server. Based on information of where survivors were found and where people were located before collapsed, the robots predict possible locations of undiscovered survivors.

2. **What is the minimum agent necessary for this task? Justify your answer with respect to the task.**

    Model-based reflex agent would be the minimum because the robots keep track the part of the world it can't see now. They need to remember where they already visited to avoid revisiting the same spots. Also, they need to keep tracking of where the survivors are, even though there are multiple survivors in the same location and sensors can't detect them all at once, to avoid reporting the same survivor multiple times.

3. **How would the environment and the design change if the building is prone to fire? Justify your answer**

    If the building is prone to fire, the agent must have information of what materials are risky to occur fire and its possibility of breaking out a fire so that it can detect possible dangerousness and report

to the central server to avoid making additional victims while rescuing. Also, temperature detecting system may not work if the robots are already in where the fire broke out, it may be inefficient to use temperature detecting system as a sensor to find survivors. Also, fire may block the camera's view. In this situation, robots may have firefighting equipment as actuator.

4. **If the agent chosen was a learning agent what would the critic function evaluate?**

The critic function would evaluate how well the agent correctly distinguished human survivors and obstacles that may have similar characteristics with human.

5. **State one weakness of the original design and how would you fix it.**

The robots with original design may not be able to find survivors who are cooped up under the wreckage because the robots cannot detect both movement and body temperature if survivors are not directly detected by camera and sensors. One possible way to fix is to make the agent learn the environment of rubbles by themselves so that the agent can predict the possibility of survivors' existence.

Question 2 (15 points)

For each of the following agents specify the features of the environment and justify each feature choice with a 1-2 sentence answer:

1. AlphaGo (The computer program that plays Go).

Fully observable: The board is fully observable, and the opponent's moves are also fully observable

Deterministic: There can be some possible options to move, and the agent can determine what move is the best

Multi-agent: 2 players role each agent

Sequential: The current movement can affect deciding a winner

Static: The environment is not changing

Discrete: Each movement of agents can be counted, it has a finite number of moves

Known: The outcomes for all movements are known.

2 Virtual customer support.

Fully observable: The agent has necessary customer information, product information, etc.

Deterministic: Virtual customer support usually has some certain actions that customers can choose. (e.g Refund request, Order tracking, and so on)

Single agent: Only one agent respond to user.

Episodic: Virtual customer support does not necessarily remember conversation with precious clients for next customer support

Static: Once user inputs something, nothing is changed in environment until the agent is looking for

answers.

Discrete: Conversation has an infinite number of states.

Known: Since the agent has limited possible actions, the agent knows the outcomes for all actions.

3. Amazon Product recommendation.

Fully observable: The agent has access to all information that user clicked, viewed, searched, purchased.

Deterministic: Items are predictable based on given knowledge of the user's search/order history

Single agent: Only one agent is needed to select recommended items.

Sequential: The agent's selection depends upon user's previous and future search/order history.

Dynamic: Users may keep searching/buying different types of products while the agent is deciding recommended items.

Continuous: The agent's output can be affected infinite amount of user's history

Unknown: The agent should learn from users' information to decide a list of product recommendation.

4. Siri response system.

Partially observable: Siri may take search Internet or look for information from the device depending on what user requests.

Stochastic: What Siri would answer will be changed depending on user's next input.

Single agent: One agent respond to user's input

Episodic: Siri does not necessarily remember previous conversation.

Static: Once user inputs, there is no environment changes until Siri makes output.

Discrete: Each conversation is discrete and has a finite number of states.

Unknown: Agent cannot know every single conversation with a user.

5. Self-driving Car.

Partially observable: The agent does not know what are around the car is

Stochastic: The actions are not predictable; it can be changed time to time

Multi-agents: Many agents for various functions are involved in decision making.

Sequential: Current decision that the self-driving car makes could affect all future decisions

Dynamic: Surroundings keep changing while driving

Continuous: Their actions are continuous, cannot be counted with numbers

Unknown: The self-driving car should learn from the environment to make right decisions