SUTD 50.021 AI

Week 01: Search

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Question 1 (Environment Types)

1. Playing a massively multiplayer online game, such as World of Warcraft

   - **Partially observable** as the game have different map locations, the agent only has access to the state of the environment for the current location;
   - **Strategic** as these games involves quests that are often planned out with a chain of set events such that if a player chooses an option, the next state is always the same. However, the game is multiplayer; hence the actions of other agents are not deterministic which might affect the quests;
   - **Sequential** as the states of the environment such as the stages of the quests are dependent on the previous states;
   - **Dynamic** as the game environment is constantly changing even when the agent (player) is Away-From-Keyboard (AFK) and deliberating;
   - **Continuous** as the agent can move around in the game and there are countless interactions and actions;
   - **Multi-agent** the game itself is multiplayer. Hence, there are other agents.

2. Buying a movie ticket online

   - **Fully observable** as we can see all the possible seating for that movie;
   - **Deterministic** as the environment next state is not random, the next state of the environment which is the seating is completely determined by the current seating and the action executed by the agent of whether he books a seat;
   - **Sequential** as the states of the environment, which is the possible seating depends on the actions taken in the previous states
   - **Dynamic** as the environment is constantly updating. While the agent is choosing the seat, other agents might also choose seats, which returns an error should the agent tries to select it as the seat will be reserved;
   - **Discrete** as there is a finite number of states which is the combinations of the seats being chosen/reserved/available;
   - **Multi-agent** as there might be other agents also aiming to choose their optimal seat.

3. Planning a holiday itinerary with your friends (assuming planning includes the bookings of the itinerary)

   - **Partially observable** as the environment only shows what the agent is searching on;
   - **Stochastic** as the next state of the environment is probabilistic since the next item to add to the itinerary does not depend only on the amount of time left in the planned schedule, but it also depends on the preferences and mood of everyone which can be probabilistic;
   - **Sequential** as the choice of the next item on the itinerary depends on the actions of the previous episodes, such as how much budget has been used;

- **Dynamic** as the environment is constantly updating as the booking sites are live updated;
- **Discrete** as there are finite many options when planning what to do in a holiday at a specific location;
- **Multi-agent** as there might be other agents also planning a holiday itinerary too.

Question 2 (Formulation)

> Three missionaries and three cannibals are on one side of the river. They all need to cross in a boat that only holds two people at once. There must never be a situation where there is a group of missionaries in one place who are outnumbered by cannibals.

Assuming they are crossing over from the left to the right side.

1. **Statespace:**
   An array representation: [No. of missionaries yet to cross, No. of cannibals yet to cross, Current Boat location (0: right side, 1: left side)];

2. **Initial state:**
   Initially, there are 3 missionaries and 3 cannibals who have yet to cross. The boat is on the left side. Array: [3,3,1];

3. **Actions**
   Actions are represented by an array too: [No. of missionaries crossing, No. of cannibals crossing, 1]. Therefore, there are 5 possible actions: [1,0,1], [2,0,1], [0,1,1], [0,2,1] and [1,1,1];

4. **Transition Model**
   Alternating subtraction and addition of the 5 possible actions, starting from subtraction from the initial state until our goal test is reached. For each node expansion, children nodes that violate the situation where there is a group of missionaries in one place who are outnumbered by cannibals is dropped. Also, the maximum value for the array is [3,3,1]. For example from the initial state, the only valid children nodes are: [3,2,0], [3,1,0] and [2,2,0];

5. **Goal test**
   To obtain a goal state of [0,0,0] where there are 0 missionaries and cannibals who have yet to cross. This implies all have crossed over. The boat is on the right side after ferrying the last time;

Question 3 (General Search)

1. **Difference between a node and a state:**

   A state which is a physical configuration does not have a parent, children, depth or path cost unlike a node which is a data structure constituting part of a search tree.

2. **Briefly describe what is a search strategy:**

   Starting at an initial, root node of the search tree, a search strategy is the picking of the order of the node expansion.

   The search strategies are evaluated based on the metrics of completedness, optimality, time complexity and space complexity.

3. **Describe the difference between Tree Search and Graph Search:**

During the node expansion, a tree search does not keep track of the previously visited states unlike a graph search.