IN-CLASS EXERCISE (I1)

Student ID:..... Duration: 20 mins Date: 22/01/2024

Student name: ..... Score: ...../ 3

Q1 (2pts) The **agent** in this situation is **a little boy playing a single round of the Minesweeper game**. In the game, the board is divided into cells, with hidden mines randomly distributed and located at the beginning of the game. When the player clicks on a cell without a mine, it reveals the number of mines adjacent to this cell. The first click is guaranteed to be safe. Using this information, he can determine cells that are safe and cells that contain mines. Cells suspected of being mines can be marked with a flag using the right mouse button. To win, the player needs to open all the cells without clicking on any cell that contains a mine before time runs out.

Identify the following task environment properties of the designated situation. Explain every dimension.

Note that a wrong explanation will give you 0 credit for the corresponding property.

○ **Fully observable** ⊙ **Partially observable** **Explanation:** Though the boy can choose any cell to open, hints for next moves are revealled partially during the game, he cannot get all hints at the beginning.

⊙ **Single-agent** ○ **Multi-agents** **Explanation:** This is a single-player game.

⊙ **Stochastic** ○ **Deterministic** **Explanation:** We mostly make deterministic moves using the available information on the board. However, there may be more than one configuration satisfying the available information and the one we chose may not match the hidden content. Thus, it should be stochastic.

The answer of Deterministic is acceptable. Each number suggests the number of mines in its neighborhood, and thus a rational move cannot be random. The first click is guaranteed to be safe.

○ **Episodic** ⊙ **Sequential** **Explanation:** Cells are opened gradually in several steps.

Q2 (1pt) Describe carefully what information frontier stores and what information a reached set stores.

A frontier holds nodes that have been reached but not yet explored. These nodes signify newly found states, with no actions taken upon them yet.

Meanwhile, a reached set encompasses all nodes that have been reached, comprising both expanded nodes and those in the frontier. Typically, the reached set associates a state with its respective nodes on the search tree, documenting the most optimal path discovered thus far from the initial state to that particular state.

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Q1 (2pts) The **agent** in this situation is **an automated drone for food delivery**, designed to function across expansive urban areas. Its primary task is to transport food orders to customers within the city. A drone typically has multiple electric motors and propellers for lifting and control and various sensors (e.g., GPS, gyroscopes, accelerometers, and altimeters) for navigation, stabilization, and altitude control.

To ensure a seamless delivery experience, the efficient drone must optimize its travel route, achieving both on-time deliveries and energy conservation. Simultaneously, it must adeptly steer clear of potential collisions with other drones or obstacles to ensure a safe and reliable delivery process.

Specify the PEAS description for the above scenario. For A and S, please briefly indicate the functionalities of the actuator/sensor, e.g., hands (to write).

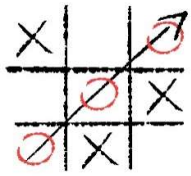
P: Ensure a reliable delivery process by optimizing its travel route, achieving both on-time deliveries and energy conservation, and avoiding collisions with other drones.

E: The urban area that the drone is working, the food packets, customers, and other AGVs

A: Electric motors and propellers for lifting and control

S: Various sensors (e.g., GPS, gyroscopes, accelerometers, and altimeters) for navigation, stabilization, and altitude control

Q2 (1pt) Tic-tac-toe is a paper-and-pencil game for two players who take turns marking the spaces in a three-by-three grid with X or O. The player who succeeds in placing three of their marks in a horizontal, vertical, or diagonal row is the winner.



What is the **upper bound** for the number of states in the state space, i.e., including both legal and illegal states? Explain your answer.

Each state can be X, O, or blank. It is unnecessary to fill all the blanks with X or O to end the game. The grid has 9 cells. Thus, the upper bound (including illegal states) is $\mathbf{3^9}$.

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Q1 (2pts) The **agent** in this situation is **a little boy who is playing the Jenga game with his friends.** The tower, consisting of wooden blocks meticulously stacked, stands tall on the table. Players take turns removing one block at a time from any level of the tower, except for the topmost completed layer. Players must use only one hand to touch and remove blocks. They can switch hands between turns. After removing a block, the player places it on top of the tower, creating a progressively less stable structure. The game continues until the tower collapses. The last player to successfully remove and place a block on the tower before it collapses is the winner.

Identify the following task environment properties of the designated situation. Explain every dimension.

Note that a wrong explanation will give you 0 credit for the corresponding property.

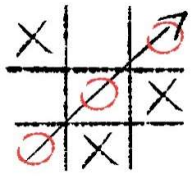
● **Fully observable** ○ **Partially observable** **Explanation:** The agent can fully observe the blocks and the activities of other players.

○ **Single-agent** ● **Multi-agents** **Explanation:** There are other players. The agent's welfare may be greatly affected by the other players' behaviors.

○ **Stochastic** ● **Deterministic** **Explanation:** There is no factor of randomness. Only one agent acts at a time, and therefore the result depends only on the skill of that player. Careless behaviors do not account for stochasticity.

○ **Episodic** ● **Sequential** **Explanation:** The agent needs to play on a progressively less stable tower until it collapses.

Q2 (1pt) Tic-tac-toe is a paper-and-pencil game for two players who take turns marking the spaces in a three-by-three grid with X or O. The player who succeeds in placing three of their marks in a horizontal, vertical, or diagonal row is the winner.



A sequence of moves refers to the chronological list of actions carried out by two players. How many **potential sequences of moves** exist in the game? Explain your answer.

The X player, who starts the game, has 9 choices to put his first X mark. Then, the O player has 8 choices to put his first O. Then, the X player again puts his second X mark in one of the remaining seven tiles, and so on. In the worst case, there is a tie game where all the nine tiles are filled.

Thus, the number of potential sequences of moves is 9 · 8 · 7 · 6 · 5 · 4 · 3 · 2 · 1 = **9!**

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Specify the PEAS description for the above scenario. For A and S, please briefly indicate the functionalities of the actuator/sensor, e.g., hands (to write).

P: Be the last player who completes a turn before the collapse; use only one hand to touch and remove blocks, place it on top of the tower, creating a progressively less stable structure.

E: The tower, consisting of wooden blocks meticulously stacked, stands tall on the table; other friends

A: Hands (to move the blocks)

S: Eyes (to observe the blocks)

Q2 (1pt) Consider the following puzzle. A robot on a rowboat needs to move three pieces of cargo across a river: a fox, a chicken, and a sack of chickenfeed. The fox will eat the chicken if it has the chance, and the chicken will eat the chickenfeed if it has the chance, and neither is a desirable outcome. The robot can keep the animals from doing harm when it is near them, but only the robot can operate the rowboat and only two of the pieces of cargo can fit on the rowboat together with the robot.

You can define a state representation by yourself. Then, for that representation, what is the **upper bound** for the number of states in the state space, i.e., including both legal and illegal states? Explain your answer.

A state represents the positions of four entities, {boat, fox, chicken, sack of chickenfeed} (the boat and the robot always go together, and thus we use one entity as representative of them). Each entity can be at either side of the river, and thus, a binary value is enough).

The upper bound for the number of states is $\mathbf{2^4}$, 4 for the four entities and 2 for the two states of each entity.