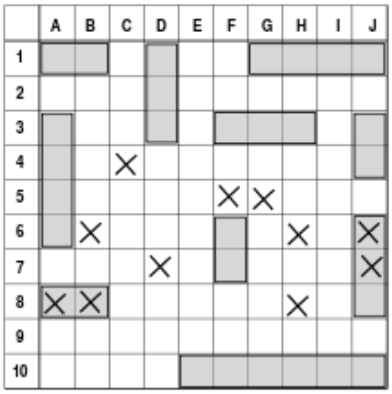
# IN-CLASS EXERCISE (I1)

Student ID:..... Duration: 15 mins Date: 12/06/2023

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

**Question 1 (2pts)** Consider the following scenario. *The agent being considered is a little boy, who plays Battleship with his friend. The game is played on four grids, two for each player. On one grid, the player arranges ships and records the shots by the opponent. On the other grid, the player records their shots. The objective of the game is to destroy the opposing player's ships.*
*Before play begins, each player secretly arranges their ships on their primary grid. Each ship occupies several consecutive squares on the grid, arranged either horizontally or vertically. The type of ship determines the number of squares for each ship. The ships cannot overlap (i.e., only one can occupy any given square in the grid). The types and numbers of ships allowed are the same for each player. Furthermore, he cannot see the other's ships.*




The above figure shows a map of one player's ships and the hits against them. The grey boxes are the ships placed by the player, and the cross marks show the squares that their opponent has fired upon.

Identify the following task environment properties of the above scenario. Do not forget to give your explanation for every dimension. *Note that a wrong explanation will give you 0 credit for the corresponding property.*

○ **Fully observable** ○ **Partially observable** **Explanation:** .....

.....

○ **Single-agent** ○ **Multi-agents** **Explanation:** .....

.....

○ **Stochastic** ○ **Deterministic** **Explanation:** .....

.....

○ **Episodic** ○ **Sequential** **Explanation:** .....

.....

**Question 2 (1pt)** What is a frontier? How do you implement a frontier if using Breadth-first search?

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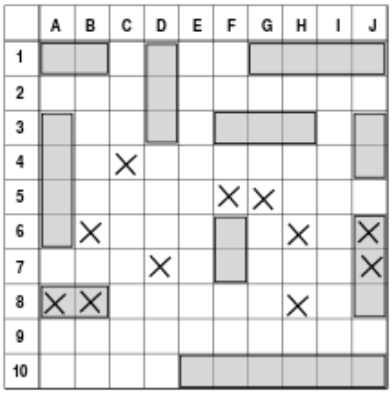


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Specify the PEAS description for the above scenario. * Note: for A and S, please briefly indicate the functionalities of the actuator/sensor, e.g., hands (to write).

**P:** .....

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**E:** .....

.....

**A:** .....

.....

**S:** .....

.....

**Question 2 (1pt)** Differentiate between a generated node and an expanded node.

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○ **Stochastic** ○ **Deterministic** **Explanation:** .....

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○ **Episodic** ○ **Sequential** **Explanation:** .....

.....

**Question 2 (1pt)** What is the maximum number of successors that can be generated from any state of the 4-queens problem on a chess board of size 4x4? Explain.

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**P:** .....

.....

**E:** .....

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**A:** .....

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**S:** .....

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**Question 2 (1pt)** What is the maximum number of successors that can be generated from any state of the Knight tour problem on a chess board of size 8x8? Explain.

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# SOLUTION

# IN-CLASS EXERCISE (I1)

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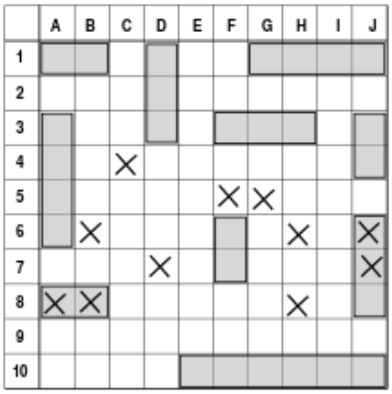


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Identify the following task environment properties of the above scenario. Do not forget to give your explanation for every dimension. *Note that a wrong explanation will give you 0 credit for the corresponding property.*

○ **Fully observable** ⦿ **Partially observable** **Explanation:** One agent cannot access the other agent's grids and thus he has partial information about the game environment

○ **Single-agent** ⦿ **Multi-agents** **Explanation:** The little boy plays Battleship with his friend, and thus his friend is an agent that may affect the little boy's behaviors.

⦿ **Stochastic** ○ **Deterministic** **Explanation:** The little boy, as well as his friend, cannot predict the other's ships precisely. They need to perform some random shots until one shot hits a ship.

○ **Episodic** ⦿ **Sequential** **Explanation**: If a shot hits some ship, the rational agent will attack adjacent cells instead of continuing to shoot randomly.

**Question 2 (1pt)** What is a frontier? How do you implement a frontier if using Breadth-first search?

A frontier is a data structure that stores nodes that are waiting to be expanded. It can be a queue, a stack, or a priority queue, depending on which search strategy is used.

A frontier in BFS is a FIFO queue.

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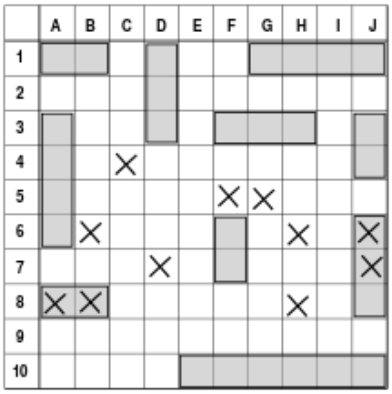


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Specify the PEAS description for the above scenario. * Note: for A and S, please briefly indicate the functionalities of the actuator/sensor, e.g., hands (to write).

**P:** Destroy all the the opposing player's ships before losing all one's own ships

**E:** Must have: Four grids (two for each player), pens, opponent

**A:** Must have: Hands (to record the shots), mouth (to announce the attacked cells)

**S:** Must have: Eyes (to view the grids), ear (to hear the information of attacked cells)

**Question 2 (1pt)** Differentiate between a generated node and an expanded node.

A generated node is a newly-created node, which is the successor of a node selected for expansion. This node will go to the frontier if satisfying some given constraints. Meanwhile, an expanded node is a node popped from the frontier and then we generate its successors; in graph-search, it is further marked for not visiting it again.

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Identify the following task environment properties of the above scenario. Do not forget to give your explanation for 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:** Each number suggests the number of mines in its neighborhood, and thus a rational move cannot be random.

However, we have no clue for the first move, and thus it is still ok if you choose Stochastic.

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

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**Question 2 (1pt)** What is the maximum number of successors that can be generated from any state of the 4-queens problem on a chess board of size 4x4? Explain.

**It depends on the state representation**.

Assume that we use the complete-state formulation, in which each column contains a single queen. Then, the number of successors from any state is 12 successors.

Explanation: each queen has three choices for the next move (except the current cell), and we can move only one queen at time -> 3x4 = 12

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

**P:** Open all the cells without clicking on any cell that contains a mine before time runs out .....

.....

**E:** Must have: Computer with screen and mouse, a game board with numbers, mines, flags, and unrevealed cells .....

**A:** Must have: Hands (to click the mouse) .....

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**S:** Must have: Eyes (to observe the board) .....

.....

**Question 2 (1pt)** What is the maximum number of successors that can be generated from any state of the Knight tour problem on a chess board of size 8x8? Explain.

**The maximum number of successors is 8.** It is when there are enough cells for the knight to perform L-shaped moves in 8 different directions .....