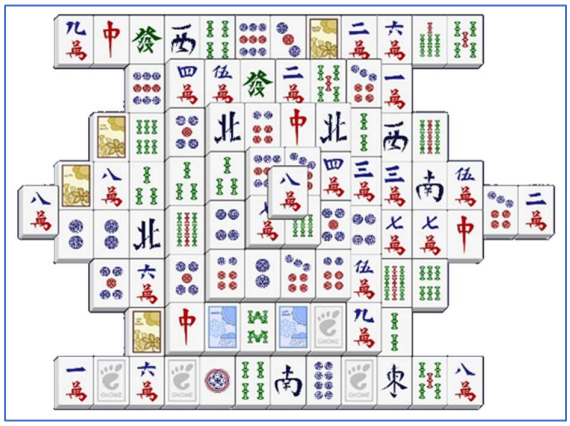
IN-CLASS EXERCISE (I1)

Student ID:..... Duration: 20 mins Date: 23/01/2024

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

Q1 (2pts) The **agent** in this situation is **a little boy playing a single round of the Mahjong solitaire game**. The 144 tiles are arranged in a four-layer pattern with their faces upwards. A tile is said to be open or exposed if it can be moved either left or right without disturbing other tiles. The goal is to match open pairs of identical tiles and remove them from the board, exposing the tiles under them for play. The game is won when all pairs of tiles have been removed from the board and lost if the remaining tiles contain no exposed pairs.



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 144 tiles are organized in a four-tiered pattern. Tiles on the upper layers may cover or hide those on the layers below.

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

● **Stochastic** ○ **Deterministic** **Explanation:** When an open pair of identical tiles is removed from the board, tiles under them are revealed, yet we cannot be sure which tiles they are.

(Note that it is slightly different from card games, where the number of cards is smaller, and the game rules allow us to predict more accurately.)

○ **Episodic** ● **Sequential** **Explanation:** We must remove pairs of tiles, as many as possible, until there is no tile left or the remaining tiles contain no exposed pairs.

Q2 (1pt) What does the term "branching factor" mean? Determine the maximum branching factor in the Knight's Tour problem and identify the specific board configuration where this maximum value occurs.

In a search problem, the branching factor refers to the average number of child nodes that any node in the search tree has. It represents the number of possible actions or choices available at each decision point in the search process.

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Q1 (2pts) The **agent** in this situation is **a skilled drummer, who is in a rehearsal with his band to prepare for a performance.** The drum kit they use encompasses multiple instruments, requiring the coordinated use of both hands and feet to produce rhythmic manipulation. Additionally, the drummer must attentively listen to the beats played by fellow band members, each providing distinct musical instructions, and synchronize their actions accordingly.

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: Successfully use of both hands and feet to produce rhythmic manipulation, attentively listen to the beats played by fellow band members to synchronize their actions accordingly.

E: The drum kit, other players, and their musical instruments

A: Both hands and feet to play the drum kit (feet for the bass drum and hands for other tools)

S: Ear (to listen the beats played by the fellow band members and himself), eye (to observe the environment and read his own musical score)

Q2 (1pt) Mr. Pacman and Mrs. Pacman are navigating in an NxN maze In each time step, **both simultaneously move** in one of the following directions: {NORTH, SOUTH, EAST, WEST, STOP}. They do not alternate turns. They can occupy the same square.
You can define a state representation by yourself such that the above problem can be formulated as a single-agent state-space search problem. Then, for that representation, what is the **number of states** in the state space? Explain your answer.

The state must include the 2-D coordinates of Mr. Pacman and Mrs. Pacman in the maze: $\langle x_r, yr, xs, ys \rangle$, where the first two elements are the x-position and y-position of Mr. Pacman and the later elements are for Mrs. Pacman. Mr. Pacman and Mrs. Pacman can be at any square in the maze, even the same square. Thus, $x_r, yr, xs, ys \in [1..N]$.

The number of states in the state space is : $N \cdot N \cdot N \cdot N = \mathbf{N^4}$

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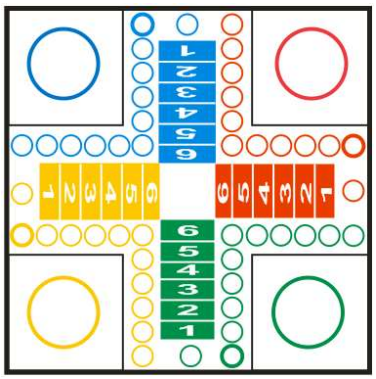
Q1 (2pts) The **agent** in this situation is **a little boy playing a single round of the "Cờ cá ngựa" game with his friends**. In the game, there is one square board divided into four sections, each section in a different color (blue, yellow, red, and green); one dice; and there are 16 horse-head game pieces divided into 4 colors matching the colors of the board, with each color having four pieces. The objective is to move one's game pieces in a clockwise direction around the board to reach the destination. The ability to move quickly or slowly depends on the outcome of rolling the dice. The first person to have all four game pieces reach the destination and correctly placed in the spaces numbered 6, 5, 4, and 3 in their respective home area is the winner. Others may continue to play to compete for the second and third positions. The player who completes last is considered to have lost.



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 observe the whole board and all the activities taken place during the game.

○ **Single-agent** ● **Multi-agents** **Explanation:** The agent is playing with his friends. They compete for the first, second, and third positions in the game.

● **Stochastic** ○ **Deterministic** **Explanation:** The ability to move quickly or slowly depends on the outcome of rolling the dice. We know the probability of each dice's side, but we cannot determine the exact outcome.

○ **Episodic** ● **Sequential** **Explanation:** Each move seems to be independent, yet it may affect the choice of a game piece in the next move. Furthermore, one player must arrange all his game pieces to their correct positions.

Q2 (1pt) Define the following types of nodes: An expanded node, a generated node, and a reached node.

An expanded node has had actions applied to its state, resulting in the creation of successor nodes.

A generated node is a successor of some expanded node; it is added to a frontier, available for expansion at any given point.

A reached node refers to both the above concepts, it is either an expanded node or a node in the frontier.

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Q1 (2pts) The **agent** in this situation is **an automated guided vehicles (AGVs) that transport inventory around the warehouse.** They usually follow magnetic stripes, or a track laid out on the warehouse floor, using radio waves, vision cameras, magnets, or lasers for navigation. A pleasing AGV tends to optimize its travel route to attain fast shipment and power-saving while efficiently avoiding collisions with other AGVs.

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: successfully transport inventory around the warehouse, optimize its travel route to attain fast shipment and power-saving while efficiently avoiding collisions with other AGVs

E: the warehouse with magnetic stripes or track laid out on the floor, inventories, other AGVs

A: robotic hands (to lift the inventories), wheels or rails that can detect magnetic stripes or track (to move)

S: sensors (to detect magnetic stripes, or a track laid out on the floor), radio waves, vision cameras, magnets, or lasers for navigation

Q2 (1pt) Mr. Pacman and Mrs. Pacman are navigating in an NxN maze In each time step, **both simultaneously move** in one of the following directions: {NORTH, SOUTH, EAST, WEST, STOP}. They do not alternate turns. They can occupy the same square.
You can define a state representation by yourself such that the above problem can be formulated as a single-agent state-space search problem. Then, for that representation, what is the **branching factor** for any state in the state space? Explain your answer.

The state must include the 2-D coordinates of Mr. Pacman and Mrs. Pacman in the maze: $\langle x_r, y_r, x_s, y_s \rangle$, where the first two elements are the x-position and y-position of Mr. Pacman and the later elements are for Mrs. Pacman. Mr. Pacman and Mrs. Pacman can be at any square in the maze, even the same square. Thus, $x_r, y_r, x_s, y_s \in [1..N]$.

Each individual, Mr. Pacman or Mrs. Pacman, can pick one of the five actions. That leads to the generation of successors for a state. The branching factor is $5 \cdot 5 = \mathbf{25}$.