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**Presidency University**

**Bengaluru**

 **School Of Computer Science and Engineering & Information Science**

**Summer term End-Term Examinations, August 2024**

**Date**:05-08-2024

**Time**: 1:00 p.m. to 4:00 p.m.

**Max Marks**: 100

**Weightage**: 50%

**Summer Semester**: 2023 - 24

**Course Code**: CSA3020

**Course Name**: Artificial Intelligence for Game Development

**Department:** SoIS

 **Instructions:**

1. *Read the all questions carefully and answer accordingly.*
2. *Do not write any matter on the question paper other than roll number.*

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| **Q. No.** | **Questions** | **Marks** | **CO** | **RBT** |
| 1 | 1. Mention the data structure which is used to keep to keep track of the frontier in Breadth-First Search
 | 4 | CO1 | L1 |
| 1. Uniform Cost Search is a method for finding out the distance between 2 nodes. However, we consider it as an uninformed search technique. Explain why uniform cost search is a type of uninformed search.
 | 6 | CO1 | L2 |
| 1. Consider the following map of cities. Starting from **Arad**, perform depth-first search to visit **every other city**. In case of a tie, push the **closest** city to the stack.

 | 10 | CO1 | L3 |
| OR |
| 2 | 1. Mention the data structure which is used to keep track of the frontier in Depth-First Search.
 | 4 | CO1 | L1 |
| 1. Consider the following map of cities in Romania. Evaluate whether the following routes between Arad and Bucharest which are possible using a breadth-first search. Show the working (i.e. the breadth-first search traversal) wherever it is possible. Ties are broken randomly.

a) Arad, Sibiu, Timisoara, Zerind, Fagaras, Oradea, Rimnicu Vilcea, Lugoj, Bucharest.b) Arad, Zerind, Timisoara, Sibiu, Oradea, Lugoj, Rimnicu Vilcea, Fagaras, Mehadia, Pitesti, Craiova, Bucharest.c) Arad, Sibiu, Timisoara, Zerind, Fagaras, Lugoj, Oradea, Mehadia, Rimnicu Vilcea, Bucharest.d) Arad, Timisoara, Zerind, Sibiu, Lugoj, Oradea, Rimnicu Vilcea, Craiova, Pitesti, Mehadia, Drobeta, Bucharest. | 6 | CO1 | L2 |
| 1. One of SAM’s friends wants to travel around Romania. He lands in Bucharest, and would like to visit Timisoara, Iasi, Craiova, Oradea, Arad, Pitesti, and Sibiu. Refer to the map in the previous part of the question, and find the length shortest paths he would need to visit each of these cities from Bucharest.
 | 10 | CO1 | L3 |

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| 3 | 1. Mention the data structure which is used to keep track of the frontier in Greedy Best First Search.
 | 4 | CO2 | L1 |
| 1. In Greedy Best-First Search, we always select the node on the frontier which has the least heuristic cost. Explain why this strategy does not allow us to get the shortest path between the source and the destination.
 | 6 | CO2 | L2 |
| 1. Prof. SAM wanted to go on a trip to North America to visit a number of relatives. So, he plans to visit the following cities in the United States – San Francisco (SFO), Seattle (SEA), Los Angeles (LAX), Dallas (DFW), Miami (MIA), Chicago (CHI), Toronto (YYZ), Honolulu (HNL), Washington D.C. (WAS) and New Orleans (MSY). The following are the costs to visit each of the cities:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SRC** | **SFO** | **SEA** | **LAX** | **DFW** | **MIA** | **CHI** | **YYZ** | **HNL** | **WAS** | **MSY** |
| SFO | 0 |  | $48 | $93 |  |  |  | $128 |  |  |
| SEA | $69 | 0 | $79 |  |  | $104 |  | $178 |  |  |
| LAX | $49 | $79 | 0 | $108 |  |  |  | $119 |  |  |
| DFW | $83 |  |  | 0 |  | $89 |  |  |  | $79 |
| MIA |  |  |  |  | 0 | $69 | $105 |  | $99 | $80 |
| CHI |  | $114 |  | $89 | $69 | 0 | $105 |  | $104 | $100 |
| YYZ |  |  |  |  | $123 | $137 | 0 |  | $129 |  |
| HNL | $200 | $188 | $169 |  |  |  |  | 0 |  |  |
| WAS |  |  |  |  | $64 | $104 | $106 |  | 0 |  |
| MSY |  |  |  | $79 | $80 | $99 |  |  |  | 0 |

Start from CHI (Chicago) and find the cost to visit every one of the other cities. | 10 | CO2 | L3 |

OR

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| 4 | 1. Mention the data structure which is used to keep track of the frontier in A\* Search.
 | 4 | CO2 | L1 |
| 1. Consider the directed graph (where the edge AB is different from the edge BA) with the edges specified as follows:
* AB = 1
* AG = 12
* BC = 3
* BD = 1
* CE = 3
* DE = 1
* DG = 2
* EG = 3

Compute the **upper bound** of the values of the heuristic function at each node (from A to E), given that the heuristic value of G, the goal node, is 0, such that the heuristic is admissible for ALL the nodes, i.e. it never overestimates the distance to the goal node.[Hint: In other words, if the **minimum cost** from A to G is 1000, the **upper bound** of the heuristic function of the node A is 1000.] | 6 | CO2 | L2 |
| 1. Find the path and path cost using **Greedy Best First Search** algorithm and **A\* Search** algorithm, from BA (Bengaluru Airport) to P (Portoroz). Heuristic values are in brackets in each node.

 | 10 | CO2 | L3 |

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| 5 | 1. One of the conditions in alpha-beta pruning is that we prune if alpha >= beta. Mention the value which is changed in a maximizing node in alpha-beta pruning.
 | 4 | CO3 | L1 |
| 1. Match the game types with the corresponding examples:

|  |  |
| --- | --- |
| **Game Name** | **Game Type** |
| 1. Contra | A. First Person Shooter |
| 2. Doom | B. Puzzle  |
| 3. Go  | C. Multi-player Turn-based Game |
| 4. Minesweeper  | D. Real-Time Strategy Game |
| 5. Pac-Man | E. Run and Gun Game  |
| 6. Scotland Yard  | F. Two-Player Turn-based Game |

 | 6 | CO3 | L2 |
| 1. For each location (lettered a to e) in the *Minesweeper* grid, state whether we should explore the cell, flag the cell, or do nothing.

 | 10 | CO3 | L3 |

OR

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| --- | --- | --- | --- | --- |
| 6 | 1. One of the conditions in alpha-beta pruning is that we prune if alpha >= beta. Mention the value which is changed in a minimizing node in alpha-beta pruning.
 | 4 | CO3 | L1 |
| 1. One of the reasons why we do alpha-beta pruning is to reduce the time and space complexity of the Adversarial Search. Consider a situation where we have a tree of height **M** and a branching factor (average number of child nodes of each node) of **B**. Show that:
2. The time complexity of searching the tree using Minimax Search is $O(B^{M})$.
3. The time complexity of searching the tree using Alpha Beta Pruning, after the tree is ideally ordered, is $O(B^{^{M}/\_{2}})$.
 | 6 | CO3 | L2 |
| 1. Consider the below tree for a two player game:

1. Find the expected value of the root node.
2. Perform alpha beta pruning on the tree
3. Reorder the nodes in the tree to get maximum pruning.
 | 10 | CO3 | L3 |

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| 7 | 1. List out the monsters in the game *Hunt the Wumpus*
 | 4 | CO4 | L1 |
| 1. There are 3 aspects in Game AI. Mention the aspect that:
2. Refers to algorithms that turn decisions into some type of motion
3. Involve a character deciding what action to take in a given scenario
4. Co-ordinates multiple decisions in order to achieve an outcome.
 | 6 | CO4 | L2 |
| 1. Consider the following Minesweeper grid. **Solve the grid** for the cells (A to O). In case it is a flag, write **F**, else, write the number. In case it is a blank cell, write **0**. NOTE: There are 8 mines left! There are **TWO** acceptable solutions. Either of them will fetch you marks.

 | 10 | CO4 | L3 |

OR

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| 8 | 1. Consider 3 cells, A, B and C, such that A is connected to B and C. Let Na, Nb, and Nc be the sector numbers of the cells A, B, and C. Mention the value of Nb – Nc.
 | 4 | CO4 | L1 |
| 1. Mention the uninformed search algorithm which is used to generate the distance map in a grid. Explain why we use that algorithm instead of any other uninformed search algorithms.
 | 6 | CO4 | L2 |
| 1. Odysseus (O) (in cell A1) needs to return home to Ithaca (I) (cell I9) after winning the Trojan War, while on his way home, he needs to pass through a narrow strait surrounded by rocks (R), that is guarded by 2 monsters. The first monster is Scylla (S) (in cell G3) who throws massive boulders from a high mountain that sink ships that come in its range (s). The second monster is Charybdis (C) (in cell C7), who has a giant mouth that sucks in massive amounts of water, causing a whirlpool that destroys ships that approach it (c)! Construct the **vector field** for the problem and **find a path** for Odysseus to return home to Ithaca, as well as **its cost**. Use the following influence requirements:
	1. Moves are only 4 directional – top, right, left, bottom.
	2. Influence of Scylla’s and Charybdis’s cells are +3
	3. Influence of Scylla’s and Charybdis’s ***neighbouring cells*** (i.e. those marked with a small s and small c) are +2 (if it is top, left, bottom, or right) and +1 (if it is diagonally adjacent), or adjacent to a cell which is +2.

Use the following grid:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** |
| **1** | O |  | R | R | R |  |  | R | R |
| **2** | R |  |  | R |  |  |  |  | R |
| **3** | R | R |  |  |  |  | S |  |  |
| **4** | R | R | R |  |  |  |  |  | R |
| **5** | R | R |  |  |  |  |  | R | R |
| **6** | R |  |  |  |  |  | R | R | R |
| **7** |  |  | C |  |  |  |  | R | R |
| **8** | R |  |  |  |  |  |  |  | R |
| **9** | R | R |  |  |  |  |  |  | I |

 | 10 | CO4 | L3 |

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| 9 | 1. State true of false. Dijkstra’s Single Source Shortest Path Algorithm is a generalized form of Uniform Cost Algorithm, where every other node is a goal state and you have to reach **any one** of the goal states.
 | 4 | CO1 | L1 |
| 1. As an avid traveller, SAM would like to visit different parts of USA. Use the given graph to find out the shortest path between Boston and Los Angeles using Uniform Cost Search.

Single source shortest path | Dijkstra's Algorithms – AcademyEra | 6 | CO1 | L2 |
| 1. Consider the following graph. Use BFS to find out a path from the source vertex to the destination. If your roll number is odd, start from **A**, else start from **V.** Uninformed Search
 | 10 | CO1 | L3 |

OR

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 10 | 1. Mention the criteria in which we stop searching for more connected sectors in the grid.
 | 4 | CO2 | L1 |
| 1. Given a distance map (combined with the influence map), explain how we generate a vector field.
 | 6 | CO2 | L2 |
| 1. Consider the following graph. Use DFS to find out a path from the source vertex to the destination. If your roll number is odd, start from **O,** else start from **E**. Uninformed Search
 | 10 | CO2 | L3 |