### Class 21BIT – Term II/2023-2024

### Course: CS300 – Artificial Intelligence

Homework 01

***Submission Notices:***

* *Conduct the homework by filling your answer into placeholders in the given word file.*
* *Export the completed file as pdf with the name following format below (student IDs are sorted in ascending order), and then submit directly without any kinds of compression (.zip, .rar, .tar, etc.)*

*<StudentID-1>\_<StudentID-2>\_HW01.pdf i.e.* ***1852001\_1852002\_HW01.pdf***

* *Careless mistakes are not accepted, and you will get 0.0 for this homework.*
  1. *Wrong file/filename format, i.e. not a pdf file, “-“ instead of “\_” for separators, etc.*
  2. *Disorder format of problems and answers*
  3. *Conducted not in English*
  4. *Cheating, i.e. copy from other students’*

**Problem 1. (1pt)** Briefly describe the concepts of the following research fields: Artificial Intelligence, Machine Learning, Deep Learning, and Data Science. For each concept, the description should be expressive enough to discriminate the corresponding research field from other fields.

*Please write your answer in the following table.*

|  |  |
| --- | --- |
| Concept | Description |
| Artificial Intelligence |  |
| Machine Learning |  |
| Deep Learning |  |
| Data Science |  |

**Problem 2. (2pts)** Discuss that, to what extent, the following systems are instances of AI. That is, you first decide its level of intelligence, low, fair/medium, or high, and then give your reasons.

|  |  |
| --- | --- |
| * **Product 01**: Streetlights turn on automatically at night. | Some Common Problems Regarding LED Street Light - AGC Lighting |
| * **Product 02**: The hotel card helps turning on the electricity in a hotel room when being put into a wall slot. | Card Reader and Card Holder for Energy Saving Switch Stock Image - Image of  holder, card: 160527477 |
| * **Product 03**: Deep Nostalgia uses video reenactment technology to animate the faces in still photos and create high-quality, realistic video footage. | A collage of two people  Description automatically generated |
| * **Product 04**: Autonomous drone delivers packages to customers in a variate of operating environments. |  |

*Please write your answer in the following table.*

|  |  |  |
| --- | --- | --- |
| Product | Level of intelligence | Reason |
| Product 01 | Low/Medium/High | ………………………. |
| Product 02 | Low/Medium/High | ………………………. |
| Product 03 | Low/Medium/High | ………………………. |
| Product 03 | Low/Medium/High | ………………………. |

**Problem 3. (1pt)** Consider the following scenario. *The agent is a human soldier. He is marching with his comrades in a parade for National Day. The performance takes place in a large square with lots of audiences.* Give the PEAS description for this activity.

*Please write your answer in the following table.*

|  |  |
| --- | --- |
| Factor | Specification |
| Performance measure |  |
| Environment |  |
| Actuators |  |
| Sensors |  |

**Problem 4. (1.5pts)** Consider an agent that is a gamebot playing the online video game PUBG: Battlegrounds. Describe the properties of the task environment for this agent.

Refer to the following link for more information about the game:

<https://en.wikipedia.org/wiki/PUBG:_Battlegrounds>

*Please write your answer in the following table.*

|  |  |
| --- | --- |
| Property | Description |
| Fully observable vs. Partially observable |  |
| Single-agent vs. Multi-agents |  |
| Stochastic vs. Deterministic |  |
| Episodic vs. Sequential |  |
| Static vs. Dynamic |  |
| Discrete vs. Continous |  |

**Problem 5. (2.5pts)** You are given a graph as shown below.

* The start and goal state are **a** and **z**, respectively.
* Numbers in orange are the heuristic values.
* For each of the following graph search strategies, work out the order in which states are expanded, as well as the path returned by graph search.
* In all cases, assume ties resolve in such a way that states with earlier alphabetical order are expanded first.

|  |  |
| --- | --- |
| 1. Breadth-first search 2. Uniform-cost search 3. Depth-first search (avoid infinite loops by checking new states against those on the path from the root to the current node) 4. Greedy best-first search 5. A\* | A-Star-Search-Algorithm |

*Please write your answer in the following table.*

|  |  |  |  |
| --- | --- | --- | --- |
| Algorithm | Expanded states | Returned path | Total cost |
| BFS |  |  |  |
| UCS |  |  |  |
| DFS |  |  |  |
| GBFS |  |  |  |
| A\* |  |  |  |

**Problem 6. (1pt)** You are given the initial state (a) and the goal state (b) of an 8-puzzle as shown below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | | 2 | 8 | 3 | | 1 | 6 | 4 | | 7 |  | 5 | | (a) |  | |  |  |  | | --- | --- | --- | | 1 | 2 | 3 | | 8 |  | 4 | | 7 | 6 | 5 | | (b) |

Apply A\* using Manhattan distance heuristic function.

* Draw the search tree including possible expanded states during the algorithm procedure.
* Compute the triple (g, h, f) for each state. Mark the optimal strategy found.

*Hint: How does an 8-puzzle search tree look like? Use Excel or PowerPoint to draw, for example,*

|  |  |
| --- | --- |
| 8-Puzzle Manhattan |  |

**Problem 7 (1pt)** You are playing the Pacman game in which the agent tries to get the food with the shortest path of movement. Pacman can move UP, DOWN, LEFT, and RIGHT with the cost of 1 for each step; however, it cannot go through the wall (blue lines).

An A\* algorithm with the heuristic function as Euclidean distance from the Pacman to the food is applied to help the agent. The heuristic function is admissible or not? Briefly explain your reason.

Diagram

Description automatically generated

*Please write your answer in the table*

|  |  |
| --- | --- |
| **Question** | **Answer** |
| *1. What is a state?* |  |
| *2. How to obtain a next state? (action)* |  |
| *3. The heuristic function is admissible?* |  |