Student Name

**CS 480 Spring 2022 Written Assignment #01**

Due: **Thursday, February 17th, 11:00 PM CST**

Points: **20**

**Instructions:**

1. Use this document template to report your answers. Name the complete document as follows:

LastName\_FirstName\_CS480\_Written01.doc

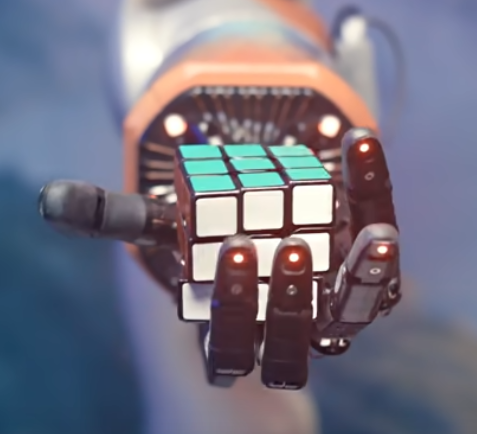
1. Submit the final document to Blackboard Assignments section before the due date. No late submissions will be accepted.

**Objectives:**

1. (8 points) Analyze an agent-environment system and apply the PEAS agent description.
2. (12 points) Demonstrate your understanding of a simple informed search algorithm.

**Problem 1:**

Consider the robotic Rubik’s cube solver shown on below (fig. 1). You are welcome to watch a short video about its development online at <https://www.youtube.com/watch?v=x4O8pojMF0w.>



*Figure 1: Open AI robotic Rubik’s cube solver (screen shot from: https://www.youtube.com/watch?v=x4O8pojMF0w).*

Your task is to:

* decide what is the agent and what is the environment in this system **[1 pt]**:

|  |  |  |
| --- | --- | --- |
| **Agent** | **Environment** | **Explanation** |
| robotic Rubik’s cube solver | Rubik’s cube | For the agent knows all outcomes to its every actions |

* analyze the system and apply the the PEAS (Performance measure, Environment, Actuators, Sensors) description **[3 pts]**:

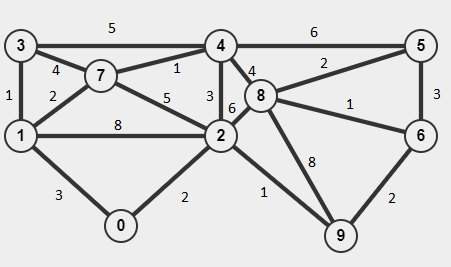
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Performance measure** | **Environment** | **Actuators** | **Sensors** | **Explanation** |
| Time cost,  Percentage of accuracy, hold firmly | the initial state of Rubik’s cube, the sound of environment, the gravity of Rubik’s cube, and outside intervention | hold cube, turn faces, move hand and display | the state sensor of Rubik’ cube, the turn direction sensor, and the hold sensor. | for the robotic Rubik’s cube solver, it need to learn how to hold a Rubik’s cube like a human, and lean to turn faces like human hand. And while the intervention from outside, it need to hold firmly like a human. |

* Specify the properties of this environment. Justify your decisions **[4 pts]**:

|  |  |  |
| --- | --- | --- |
| **Property** | **Your choice** | **Explanation** |
| Fully observable? | Yes | The next state is completely determined by the current state and agent action without considering outside intervention. |
| Multiagent? | No | There’s only one agent: robotic Rubik’s cube solver |
| Deterministic? | Yes | because next state is completely determined by the current state and agent action |
| Episodic? | No | next action is a function of previous action, it need to memorize it. |
| Dynamic? | Yes | Environment can change when the robotic Rubik’s cube is deciding and turning faces, for there’s some outside intervention. |
| Discrete? | Yes | state changes is discrete. |
| Known to Agent? | Yes | The robotic Rubik’s cube solver knows all outcomes to its actions (or their probabilities) |

**Problem 2:**

Consider the **undirected** graph presented below (fig. 2). Each node represents a single state (you can assume that each state represents a city on a map). If two states are neighbors, there is an edge between them.



*Figure 2: An undirected graph.*

Assume that edge weights represent **driving distances between cities/states in miles**.

Your task is to utilize the **Hill Climbing algorithm to find a shortest (minimum cost) path** between two states provided data. Here are the steps:

* assume that **repeated states are NOT allowed**,
* select two states / cities (initial and goal states) at random under the condition that there is at least two (2) states between your initial and state goals (that would correspond to **at least** three (3) actions),
* apply the Hill Climbing algorithm and show all steps / actions in Table A below,
* provide a search tree diagram illustrating the path chosen along with evaluation function values and all alternatives (you can paste in a scan or a photo of a hand-drawn diagram or use some software to create it).

**NOTE: The algorithm may get “stuck” and not reach the goal state.**

Select two states/ cities:

Initial state/city is: 1

Goal state/city is: 6

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TABLE A: Algorithm steps / actions [6 pts]** | | | | |
| Current state | Available actions and their costs | Selected action | Resulting state | Explanation / comments |
| 1 | 0, 2, 7, 3 | 3 | 1->3 | from 1 to 3 cost minimum, f(3)=1 |
| 3 | 1,7,4 | 7 | 1->3->7 | 1 is repeated state, from 3 to 7 cost minimum, f(7)=4 |
| 7 | 1,3,4,2 | 4 | 1->3->7->4 | 1,3 are repeated states, from 7 to 4 cost minimum, f(4)=1 |
| 4 | 3,7,2,8,5 | 2 | 1->3->7->4->2 | 3,7 are repeated states, from 4 to 2 cost minimum, f(2)=3 |
| 2 | 0,1,7,4,8,9 | 9 | 1->3->7->4->2->9 | 1,7,4 are repeated states, from 2 to 9 cost minimum, f(9)=1 |
| 9 | 2,8,6 | 6 | 1->3->7->4->2->9->6 | 2 is repeated states,  from 9 to 6 cost minimum, f(6)=2,  and arrive at goal state! |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

|  |
| --- |
| **Tree search diagram [6 pts]** |
|  |

Did the Hill Climbing algorithm pick the best (lowest total cost in miles) path?

|  |
| --- |
| **Your answer:** |
| The Hill Climbing algorithm doesn’t pick the best path.  For the hill climbing algorithm need cost total 1+4+1+3+1+2=12 in miles, and the lowest total is 3+2+1+2=8 in miles (1->0->2->9->6). |