AI - CSE 643 Quiz-1 Monsoon 2024 Aug. 29, 2024

Time: 30 minutes Max. Marks: 10

Name and Roll No.: _____

Instructions:
- Do not plagiarize. Do not assist your classmates in plagiarism.
- Show your full solution for the questions to get full credit.
- Attempt all questions that you can.
- True / False questions will get full credit only if the justification and answer are both correct.
- A multiple choice question may have one or more correct answers. Credit will only be awarded if all correct answers are marked and none of the incorrect answers are marked.
- Match the following questions will have partial grading.
- In the unlikely case that you find a question ambiguous, discuss it with an invigilating TA/invigilator. Please ensure that you clearly write any assumptions you make, even after clarification from the invigilator.
V. Imp.: If you do not write your **Name and Roll No.**, you will get a zero.

1. (2 points) Rank the following on how well the entities on the right satisfy the property listed on the left. Write your answer in the form of $X > Y > Z$.

   a) Fully Observable: driving; document classification; tutoring a student

   b) Static: chat room; tennis; chess; tax planning

   Solution:

   a) Fully Observable: document classification > driving > tutoring a student

   b) Static: tax planning > chess > chat room > tennis

2. (2 points) Match the left & right columns in the table below. Assume that the sports activities are done in the physical world by human agents.

A. Playing Soccer	I. {PO, St, Sq, D, C, MA}
B. Playing a tennis match	II. {FO, St, Ep, D, C, MA.}
C. Practicing tennis against a wall	III. {FO, St, Ep, D, C, SA}
D. Shopping for AI books on the Internet.	IV. {PO, Dt, Sq, S, Ds, SA}

Legend: {[PO: partially observable, FO: fully observable] [Dt: deterministic, St: stochastic], [Sq: sequential, Ep: episodic], [S: static, D: dynamic], [Ds: discrete, C: continuous], [SA: single-agent, MA: multi-agent]}.

Solution:
A-I;B-II;C-III;D-IV

3. (1 point) Prove each of the following statements by specifying the evaluation function $f(n)$, or give a counterexample.

   (a) (0.25 point) Breadth-first search is a special case of A* search.

   (b) ($3 \times 0.25 = 0.75$ points) Breadth-first search, Depth-first search and Uniform-cost search are all special cases of Best-first search.

   Solution:

(a) When all step costs are equal, $g(n) \propto depth(n)$, and $h(n) = 0$, A* search reproduces breadth-first search.

(b) BFS: $f(n) = depth(n)$; DFS: $f(n) = -depth(n)$; UCS:$f(n) = g(n)$.

4. (5 points) Consider the unbounded version of the 2D grid. The initial state is at origin $(0, 0)$ and the goal state is at some (x, y). The links are connected to the immediate next nodes in the left, right, up and down directions. For each of the following, answer True or False and provide justification.

   (a) $h = |u - x| + |v - y|$ is an admissible heuristic for a state at (u, v).
   True. Since only 4-neighbors (left, right, up & down) are being considered, the smallest distance between two adjacent nodes will be given by h, which will underestimate the total distance. Therefore, it is an admissible heuristic.

   (b) If certain links are removed, the heuristic h is no longer admissible.
   False . Removing the links will not affect the smallest distance, therefore the heuristic will remain admissible. Adding links, however, will render this heuristic inadmissible (e.g., if 8-neighbors are considered, the heuristic function will no longer underestimate the Euclidean distance between two states). *Note*: In the 2D grid, we implicitly assume that the Euclidean distance between two states is the default evaluation function that is used.

   (c) If new links are added to connect non-adjacent nodes, the heuristic h remains admissible.
   False. Diagonal links could result in a shorter path than the heuristic, making it inadmissible.

   (d) Depth-first search always expands at least as many nodes as A* search with an admissible heuristic.
   False: A lucky DFS might expand exactly d nodes to reach the goal. A* largely dominates any graph-search algorithm that is guaranteed to find optimal solutions.

   (e) A reflex-agent does not make use of percepts from the environment.
   False. It does not use a *history of percepts*, but picks an action based on its current percept only.