

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. (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  $(u, v)$ .
  - (b) If certain links are removed, the heuristic  $h$  still remains admissible.
  - (c) If new links are added to connect non-adjacent nodes, the heuristic  $h$  still remains admissible.
  - (d) Depth-first search always expands at least as many nodes as A\* search with an admissible heuristic.
  - (e) A reflex-agent does not make use of percepts from the environment.

2. (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

3. (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, D, 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]}.

4. (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.

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1. (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.
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2. (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
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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) Depth-first search always expands at least as many nodes as  $A^*$  search with an admissible heuristic.

(b) A reflex-agent does not make use of percepts from the environment.

(c)  $h = |u - x| + |v - y|$  is an inadmissible heuristic for a state at  $(u, v)$ .

(d) If new links are added to connect non-adjacent nodes, the admissibility of the heuristic  $h$  changes.

(e) If certain links are removed, the admissibility of the heuristic  $h$  does not change.

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- (a)  $h = |u - x| + |v - y|$  is an admissible heuristic for a state at  $(u, v)$ .
  - (b) If certain links are removed, the heuristic  $h$  is no longer admissible.
  - (c) If new links are added to connect non-adjacent nodes, the heuristic  $h$  remains admissible.
  - (d) Depth-first search always expands at least as many nodes as A\* search with an admissible heuristic.
  - (e) A reflex-agent does not make use of percepts from the environment.