School of Engineering and Applied Science (SEAS), Ahmedabad University

# CSE 581 : Artificial Intelligence

## Mid-Term Exam (Monsoon Semester: 2023)

~~21~~ September 2022, Saturday. 8:00 AM – 9:30 AM [Time limit: 90 Minutes]

21/09/2023 Marks: 30, Wt.: 30 %

Name: _____ Roll Number: _____

| Question No. | 1 [5] | 2 [5] | 3 [5] | 4 [9] | 5 [6] | |
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| Marks | | | | | | |

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1. Consider an autonomous moon rover like Vikram rover carried to the Moon by the Chadrayaan-3 mission. Develop a PEAS description of the task environment and characterize the environment along the six dimensions discussed in the course.

2. You have four buckets measuring 12 Litre, 8 Litre, 5 Litre and 2 Litre and a water faucet. You need to measure out exactly one litre. Formulate it as a search problem. Give the initial state, goal test, successor functions, and cost function. The formulation must be precise. You are **not** required to find a solution of the search formulation.

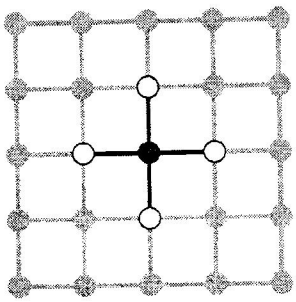
Note: If you are unable to formulate the seach problem but can give 1 or 2 solutions, you will get some partial credit.

3. Consider a state space where the start state is number 1, and the successor function for state $n$ returns two states labelled $2n$ and $2n+1$.

(a) Draw the portion of the state space for states 1 to 11.

(b) Suppose that the goal state is 9. List the order in which nodes will be visited for breadth-first search and iterative deepening search.

4. Consider the a 10x10 regular grid where the origin is at the left bottom corner and the rightmost top point is at (10,10). A 5x5 grid is shown below. The start state is at the origin, $(0,0)$, and the goal state is at $(x=10, y=5)$.



a. What is the branching factor $b$ in this state space?

b. How many distinct states are there at depth $k$ (for $k>0$)?

c. What is the maximum number of nodes expanded by breadth-first tree search?

d. What is the maximum number of nodes expanded by breadth-first graph search?

e. Is $h=|u-x|+|v-y|$ an admissible heuristic for a state at $(u,v)$? Explain.

f. How many nodes are expanded by A* graph search using $h$?

5. Give precise formulation of the following cryptarithmetic problem as constraint satisfaction problem identifying variables, domains and constraints. Starting from an arbitrary start state chosen by you, show one deep partial search tree for the problem. Find the solution of the problem.

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    N O
+ G U N
+   N O
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H U N T
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