

# National Institute of Technology Calicut

## Department of Computer Science and Engineering

### CS4023D Artificial Intelligence

Midterm Test 1 | 01/09/2021 | 01:30PM-3:30PM | Total Marks: 15

**1. [1x2=1 Mark]** For the following activities, give a PEAS description of the task environment and characterize it in terms of the properties *observable*, *deterministic*, *episodic*, *static*, *discrete* agents:

**1.a** Internet book-shopping agent    **1.b** Performing a high jump

**2. [1x2=2 Marks]** For each of the following assertions, say whether it is true or false and support your answer with appropriate examples or counterexamples:

**2.a** An agent that senses only partial information about the state cannot be perfectly rational

**2.b** There exist task environments in which no pure reflex agent can behave rationally

**3. [0.5+1.5=2 Marks]** Consider a state space where the start state is number 1 and each state has two successors: numbers  $2k$  and  $2k+1$ .

**3.a** Draw the portion of the state space for states 1 to 15

**3.b** Suppose the goal state is 11. List the order in which nodes will be visited for *breadth-first search*, *depth-limited search with limit 3*, and *iterative deepening search*.

**4. [1 Mark]** Give a complete problem formulation for the following problem description. Try to be precise.  
*Using only four colours, you have to colour a planar map in such a way that no two adjacent regions have the same colour.*

**5. [1 Mark]** You are given two jugs. One with four litre and another with three litre capacity. Neither has any measuring marks on it. There is a pump that can be used to fill the jugs with water. Draw the state space representation to get exactly two litres of water into the four litre jug. Clearly label each action with proper symbols.

**6. [0.5 Mark]** Is the following statement true or false? Explain your answer.  
*Breadth-first search is complete whenever the branching factor is finite, even if zero step costs are allowed*

**7. [1 Mark]** Describe a state space in which iterative deepening search performs much worse than depth-first search (for example,  $\mathcal{O}(n^2)$  vs.  $\mathcal{O}(n)$ ).

**8. [2.5 Marks]** Consider a best-first search with the evaluation function as  $f(n) = (2-w)g(n) + wh(n)$ .

**8.a** For completeness what values can  $w$  take?

**8.b** For what values is this search optimal, assume that  $h$  is admissible?

**8.c** What type of search does it perform when  $w = 0$ ,  $w = 1$ , and  $w = 2$ ?

**9. [4 Marks]** A farmer would like to get his cabbage, goat, and wolf across a river. He can take only one among these with him in the boat at a time. The cabbage and goat can not be left alone, similarly the goat and wolf also.

**9.a** Draw a complete state space representation of this problem clearly indicating initial and goal states. Also indicate the dead states. Use appropriate representations for river crossing in either direction.

**9.b** Give a solution sequence of states and its cost.

**9.c** If unit cost per each river crossing, give an A\* search solution for this problem with an appropriate heuristic function.

**9.d** Is this solution better than the solution provided in **9.b**. Justify.