Indian Institute of Technology, Jammu

Department of Computer Science and Engineering

Mid-Term, Oct 26, 2024

Subject: AI

Time: 90 Minute Full Marks: 30

[**Note:** Answer all the 4 questions. Number at the each question denotes their respective marks. Please be brief and to the point. **No clarification during the exam**]

1. (5 points) Design a PEAS framework for an intelligent agricultural robot, detailing the Performance measures, Environment, Actuators, and Sensors. Discuss how each component interacts to enhance the robot's efficiency and effectiveness in tasks such as planting, watering, and monitoring crop health. Provide specific examples to illustrate your points.

2. (10 points) Assume that you're managing a network of N Hubs in a network setup startup, with relationships between these hubs represented in a Confidence Table $T[][]$. This table is of size $N \times N$, where each entry $T[i][j] = 1$ indicates that Hub i trusts Hub j, and $T[i][j] = 0$ signifies a lack of trust from Hub i towards Hub j. As an AI engineer, your task is to identify a **Reliable Hub**—a unique hub that does not trust any other hub but is fully trusted by every other hub in the network.

   Based on the problem description, answer the following questions:

   1. Formulate the problem of identifying a Reliable Hub.
   2. Design an algorithm to determine whether a Reliable Hub exists in the network or not.
   3. Comment on the optimality, completeness, time, and space complexity of your proposed algorithm?
   4. How can the solution be adapted for efficiently identifying a Reliable Hub in larger networks?

3. (10 points) Design a strategy for a computer to play a Snakes and Ladders game board(given in figure 1), aiming to complete the game in the minimum number of steps. Note that you have a dice that can yield outcomes of 1, 2, 3, or 4 only; outcomes of 5 and 6 are not available.

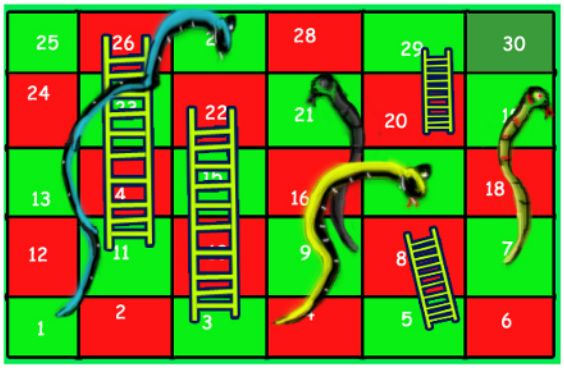

Figure 1: Snakes and Ladders game board

   1. Represent this problem as a graph search problem by defining the concepts of vertices, edges, and any relevant constraints.
   2. Calculate the total size of the valid state space.
   3. Suggest a search strategy to reach from the start node to the goal node.
   4. List the shortest path (if any) from the start node to the goal node.

4. (5 points) Consider that you are performing a Breadth-First Search (BFS) on a given graph in figure 2 using a queue data structure and an additional array to track visited nodes.

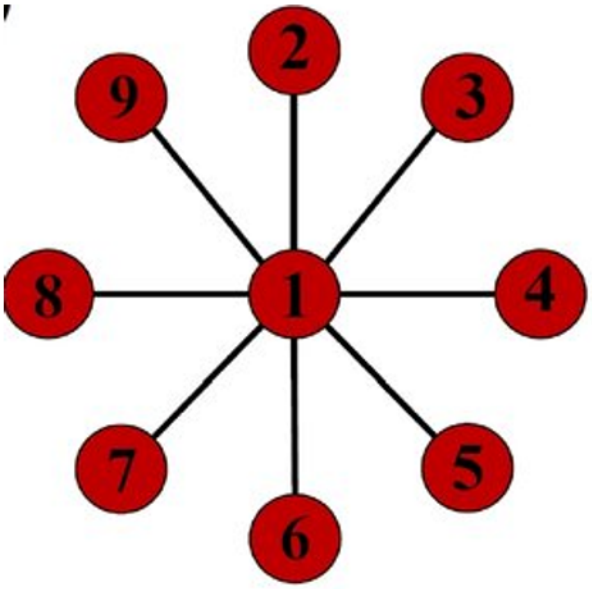

Figure 2: Graph

1. List three possible BFS traversal orders for a given graph.
2. Compute the total number of unique BFS raversal orders possible for the given graph.
3. Comment on the time and space complexity if you have to apply a random search instead of BFS.

Best wishes