DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
UNIVERSITY OF BARISAL
FINAL EXAMINATION-2023
Course Title: Artificial Intelligence
Course Code: CSE-3205
3rd Year 2nd Semester
Admission Session: 2020-21

Time: 3 hours **Marks:** 60

Answer any five Questions from the followings.

1. a) Define Artificial Intelligence. Explain why "rationality" is central in AI. [4]
   b) Describe the structure of an intelligent agent with a smart home temperature control example. [4]
   c) Differentiate between reactive, model-based, and goal-based agents with examples. [4]

2. a) A robot is exploring a building with rooms connected by corridors. The rooms are: [5]
   Entrance (E), Hall (H), Office1 (O1), Office2 (O2), Lab (L), Storage (S), Exit (X).
   Connections (edges) are described verbally as follows:
   - E connects to H
   - H connects to O1 and O2
   - O1 connects to L
   - O2 connects to S
   - L connects to X
   - S also connects to X

   Let's draw the graph based on this description and Perform BFS from E to find the first path to X and list every step (frontier, visited, parents).

   b) Perform **DFS** from **E** to **X** and show the exact order of node expansion. [5]
   c) Explain why BFS and DFS return different paths in your graph. [2]

3. a) A navigation system must find the shortest path from Start (S) to Goal (G). [5]
   Nodes: **S, A, B, C, D, E, G.**
   Edges and costs are S → A = 3, S → B = 2, A → C = 4, B → C = 1, C → D = 2, D → E = 1, E → G = 5.
   Heuristic h(n):

Node	S	A	B	C	D	E	G
H(n)	10	7	9	6	4	2	0

   Now, draw the graph and perform **A* search** step-by-step: compute f(n) = g(n) + h(n), show OPEN, CLOSED lists and show how ties are broken

   b) Show the final optimal path. [2]
   c) Apply Greedy Best-First Search (GBFS) from S to G. Use only h(n) to choose which node to expand and show the following: 5
   - priority queue sorted by h
   - visited order
   - final path GBFS finds

4. a) Draw the game tree (MAX → MIN → MAX → LEAVES) from the following description. [6]
   - The root is a MAX node.
   - It has two MIN children: N_1 and N_2.
   - Each MIN node has two MAX children.
   - Each MAX node has two leaves, giving 8 leaf values total. Leaf utilities from left to right are: [3, 5, 6, 2, 9, 1, 4, 7].

   Now, Compute the Minimax value of each internal node.

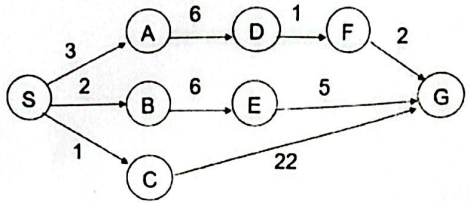
   b) Perform Alpha–Beta pruning with left-to-right traversal. Show all α and β updates at each node. Mark clearly which branches are pruned and why (state the $\alpha \geq \beta$ condition). [6]

5. a) You are given a map with 4 regions: A, B, C, D. Edges (borders) are: [3+3]
   - A is adjacent to B and C
   - B is adjacent to A, C, and D
   - C is adjacent to A, B, and D
   - D is adjacent to B and C

   Allowed colors: {Red, Green, Blue}.
   Draw the constraint graph for the map. Suppose variables are assigned in the following order: A → B → C → D. After assigning A = Red, use Forward Checking to update domains of B and C.

   b) Explain what Arc Consistency in Constraint Satisfaction Problems (CSPs). Describe in detail how the AC-3 algorithm works. How arcs are selected and revised, What conditions cause a domain to be reduced and why arc consistency alone does not guarantee a solution, even if all arcs become consistent [6]

6. a) [8]



   The graph above shows the step costs for different paths going from the start (S) to the goal (G). Use uniform cost search to find the optimal path to the goal.

   b) Write down the advantage of IDS over BFS and DFS. Also, shows times and space complexity among them. [4]

7. a) A company has three projects: **P**, **Q**, and **R**. Now consider the following statement and answer the below questions: [6]
   1. If project **P** is approved, then project **Q** cannot be approved.
   2. Either project **Q** or project **R** must be approved, but not both.
   3. If project **R** is approved, then project **P** must also be approved.

   Represent these statements in propositional logic formulas. Determine which projects can be approved simultaneously.

   b) Two suspects, Alice and Bob, are arrested for a minor crime. They are interrogated separately. Each has two choices: Cooperate (stay silent) or Defect (betray the other). The payoff (in years of jail) is as follows: [6]

	Bob: Cooperate	Bob: Defect
Alice: Cooperate	(-1, -1)	(-5, 0)
Alice: Defect	(0.-5)	(-3,-3)

   - Represent this as a normal form game.
   - Identify the dominant strategy for each player.
   - Determine the Nash equilibrium of the game.
   - Explain why both players end up with a worse outcome in the Nash equilibrium.

8. a) Explain the difference between supervised and unsupervised learning in terms of data input and output. Give one example for each. [4]

   b) For the following applications, classify whether they use supervised, unsupervised, or reinforcement learning: [4]
   - Predicting stock prices – S
   - Recommending movies based on user behavior – U
   - Training a self-driving car to navigate – R

   c) A dataset can have structured or unstructured data. Give two examples of each type of data commonly used in machine learning. [4]