Set A

BRAC UNIVERSITY

Department of Computer Science and Engineering

Examination: Semester Midterm | Semester: Spring 2024

Duration: 1 Hour 30 Minutes | Full Marks: 40

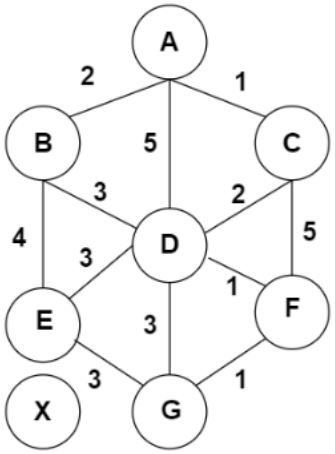
CSE 422: Artificial Intelligence

Answer all the following questions.

Figures in the right margin indicate marks.

Name:	ID:	Section:

1. CO1



States,n	h1(n)	h2(n)
A	5	5
B	5	4
C	3	2
D	2	2
E	3	2
F	1	1
X	??	??
G	0	0

Consider in the above graph, A is the initial state.

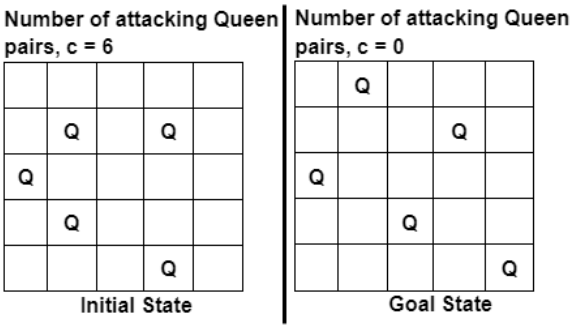
a. **Examine** node "X" and assign it a heuristic value. Provide reasons behind your logic. 2

b. Assuming both h1(n) and h2(n) are admissible, **apply** custom graph A* search on the given graph using the better heuristic. In the search, you replace an already existing node in the fringe only if the same node is visited again at a lower f-cost. 4

c. Suppose C is the initial state and E is the goal state. **Determine** whether an A* search using either h1(n) or h2(n) will return the optimal path from C to E. 2

d. If the cost from B to E and B to D becomes 3 and 2 respectively, then **determine** whether h1(B) 's heuristic value remains consistent. Show calculations 2

2. CO1



a. **Observe** the given states of a 5-Queen Problem. Now, sketch a portion of the state space tree (branching factor = 2) and showcase a scenario where hill climbing would get stuck in a Local Maxima. At each depth, you can select only one Queen and move it one step Up, Down, Left, or Right. [Note: You don't have to show the complete state space tree] 5

b. **Determine** how you can solve the problems of Hill Climbing Search. 3

c. **Examine** how Local Search is different from Informed Search. 2

Set A

3. CO1 Ruhan is a salesperson at B.Daily products. He is given a list of 5 cities with their corresponding coordinates on a 2D plane. The cities are numbered from 1 to 5 where 5 is the total number of cities. His objective is to find the most optimal route that visits all 5 cities exactly once and returns to the starting point. The optimality is measured based on the lowest distance traveled. The distance between two cities is calculated using the Euclidean formula. Euclidean Distance Formula points (x1, y1) and (x2, y2) is as follows:

$$\text{Euclidean\_distance} = \sqrt{(x1 - x2)^2 + (y1 - y2)^2}$$

City 1	City 2	City 3	City 4	City 5
(2,3)	(5,1)	(1,4)	(4,2)	(3,5)

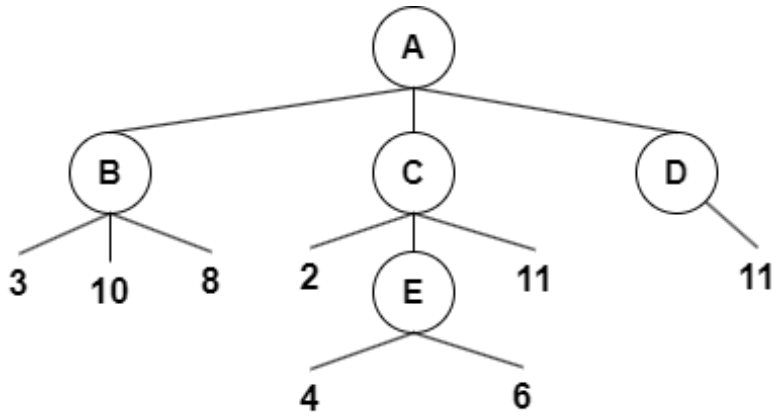
Now you are well-aware of an optimization algorithm named Genetic Algorithm. Your task is to help Ruhan achieve his goal using the following steps:

a. Encode the problem and create four parent chromosomes. Then **determine** an appropriate fitness function and choose the two fittest chromosomes. 4

b. **Apply** two-point crossover on the chromosomes derived from (a) to produce two offspring. [NB: The two-point crossover technique chooses two random points from chromosomes and genes are exchanged at these points]. 3

c. **Examine** how you can mutate the offspring derived from step (b) and comment on the fitness of the final produced offspring. 3

4. CO1



a. **Apply** alpha-beta pruning on the given game tree to find the best choice when at state A. Showcase the values of the alpha, beta, and the final value of the nodes. Also, show the pruned branches. 8

b. **Examine** how the parameters alpha and beta in the alpha-beta pruning algorithm help to reduce the search space. 2