BRAC UNIVERSITY
CSE422 : Artificial Intelligence
Assignment 2

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1. You are to solve the n-queen problem using a genetic algorithm.
a. Describe an encoding scheme to represent a solution to the given problem.
b. Define a fitness function to evaluate the chromosomes formed using the encoding scheme.

2. Given the pairwise similarity score of N elements, you are to partition the elements into two groups using a genetic algorithm, such that the similarity scores between elements in different subsets is maximized and the similarity score between elements in the same subset is minimized. Precisely, if two elements are in two different subsets, the fitness should increase and if the elements are in the same subset, the fitness should decrease.
a. Describe an encoding scheme to represent a solution to the given problem.
b. Define a fitness function to evaluate the chromosomes formed using the encoding scheme.

3. A Hamiltonian circuit is a path in a graph that visits every vertex exactly once and returns to the starting vertex. Given a connected, undirected, weighted graph, use a genetic algorithm to find the Hamiltonian circuit with the minimum total cost (also known as the Traveling Salesman Problem). Consider a solution to be invalid if it implies visiting any vertex more than once.
a. Describe an encoding scheme to represent a valid solution to the given problem.
b. Define a fitness function to evaluate the chromosomes formed using the encoding scheme.
c. Define a crossover operator that forms only valid chromosomes.
d. Define a mutation operator that forms only valid chromosomes.

4. Consider the following rules for a game:
- The game starts with a positive integer N.
- Two players take turns. On each turn, the current player must choose one of two possible moves:
  - Divide N by 2 and round down (i.e., set N = $\lfloor N / 2 \rfloor$)
  - Subtract 1 (i.e., set N = N - 1)
- The number N is updated based on the chosen move.
- The first player who makes N equal to 1 wins the game.
- A win earns 1 point, while a loss results in -1 point.

a. Given N = 13, you are to use the Minimax algorithm with Alpha-Beta pruning to determine the next move in the game.
- For each internal node, show its node value, alpha, and beta values.
- When generating child nodes:
  - Always expand the division move ($\lfloor N / 2 \rfloor$) as the left child
  - And the subtraction move (N - 1) as the right child
- Only expand nodes that are necessary for the Minimax search. Do not draw or evaluate pruned branches.