COMSATS University, Islamabad.
Department of Computer Science

Class: BCS IVB   Submission Date: 15-12-25
Subject: CSC462 - Artificial Intelligence
Instructor: Dr. Muhammad Imran   Marks: 50

[CLO6]: Implement various searching technique, CSP and knowledge-based system to solve a problem.

Lab Project

Question 1:   [4 x 8 = 32 Marks]

The Traveling Salesperson Problem (TSP) is a classic NP-hard optimization problem in which a salesperson must visit a set of cities exactly once, return to the starting point, and minimize the total travel distance. For large numbers of cities, brute-force or exhaustive search approaches become computationally infeasible. Genetic Algorithms (GAs) provide an effective heuristic method to obtain near-optimal solutions within reasonable time. To implement a GA-based solution for TSP, the following components are required:

1. **Population Initialization:** Generate an initial random population of tours.
2. **Chromosome Representation:** Represent a tour (sequence of cities) as a permutation of city names.
3. **Fitness Function:** Calculate the fitness of each tour (chromosome) based on its total distance.
4. **Selection:** Implement a Tournament selection mechanism to choose parents for reproduction. Preserve a certain number of the best individuals from one generation to the next.
5. **Crossover:** Implement a TSP-specific Partially Mapped Crossover (PMX) crossover operator to create offspring.
6. **Mutation:** Implement a Swap mutation operator to introduce diversity into the population.
7. **Termination Criteria:** Stop the GA after a fixed number of generations or if the fitness improvement stops.
8. **Output:** Display the best-found tour and its total distance.

Question2:   [2 x 6 = 12 Marks]

Consider an agent A located in a Wumpus World environment as shown in Figure 1. The environment consists of a grid where some cells may contain pits or a Wumpus. The agent perceives the environment through its sensors and must reason about the locations of pits and the Wumpus.

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Use Prolog to build a knowledge base (KB) for a Wumpus World environment and implement logical inference to determine the presence or absence of pits and the Wumpus in specific cells. The KB should be sufficient to prove the following statements:

1. There is no pit in cells (2,2) and (1,3), i.e., $KB \vDash \neg Pit_{2,2} \wedge \neg Pit_{1,3}$ **[6]**
2. There is a Wumpus in cell (1,3), i.e., $KB \vDash W_{1,3}$ **[6]**

Figure 1. Wumpus World Environment

What to submit

This is an individual project. You have to submit source code of your implementation along with the screenshots of the program running with sample input/output. A short viva will be conducted in the lab last week.