



MIDDLE EAST TECHNICAL UNIVERSITY
NORTHERN CYPRUS CAMPUS

Department of Computer Engineering

CNG 462 - Assignment 1

Zuhayr Amin 2455426
Liban Gudhane 2406064

Part 1

Question 1:

The travelling salesman problem (TSP) involves finding a path that goes through all the required points once and only once. Some of the attributes which can be used to define a TSP problem are as follows:

State Space: The state space refers to the collection of states that the environment can take. This includes the nodes in which our agent can travel, in addition to the actions that can be taken by our agent in the environment.

Initial State: The initial state of an agent refers to the node in which our agent resides at the start of the problem. This node is one of many in our state space.

Goal State: The goal state defines the node (or alternative nodes) that our agent needs to travel to. Once the goal state has been reached, the problem is completed.

Action Function: The action function refers to the set of actions that can be taken by our agent to alter its state. In the TSP problem, the actions consist of moving from one city to another.

Transition Model: The transition model is a set of descriptions of what each action does. It tells us how an action affects the state of our agent.

Cost Function: The cost function gives us a frame of reference with which to judge the performance of our agent. This function can employ the use of various metrics to judge whether a given path is better or worse than the other paths that could be taken by the agent.

Potential Heuristics:

1. h_1 = Is the current node different from the goal node. Since this is a boolean heuristic (i.e: 1 or 0) and our agent has to move at least once, it will always underestimate the cost. This attribute makes it an admissible heuristic.
2. h_2 = The straight line distance from the current node to the goal node. The shortest distance between any two points is a straight line, therefore, this heuristic will always be less than or equal to the actual cost of travelling from the current state to the goal state. This heuristic guarantees a solution, given that there are no loops in the system.

Question 2:

- A. The Minimum-Spanning Tree (MST) heuristic involves building a tree that connects all possible cities with the minimum possible cost. The Travelling Salesman Problem (TSP) asks us to determine a path from a starting point, to visit all the cities once, with a minimum cost and return to the starting point. If we relax the requirements of TSP to visit a city more than once, then the solution is the same as MST. This ensures that child cities that are only connected to one city do not end the algorithm, since it can come back to a parent city and continue to the other cities in the state space.
- B. The shortest distance between any two points is a straight line; however, as we saw in the Arad-Bucharest example, the straight-line distance does not always represent a path that the agent can take. Using MST, we generate a tree with the minimum link cost connecting any two cities, and this is a path that the agent can travel, thus, making it a more effective heuristic. Furthermore, if the agent can travel a straight-line distance, it will be reflected in the MST. Therefore MST is the more dominant heuristic.