

CS 302 – Artificial Intelligence – Mid semester exam – Jan 27, 2022  
Max Marks 65      Weight 25 %      Be Concise

- Describe the impact of the parameter  $T$  on the behaviour of the Simulated Annealing algorithm? How does the behaviour differ at the two extremes of  $T$ ? How is  $T$  controlled in the algorithm? [6]
- What is the Ordinal Representation for the following two TSP tours expressed in the Path Representation? [6]

Tour1: B C A H N O I J G K D L E M F

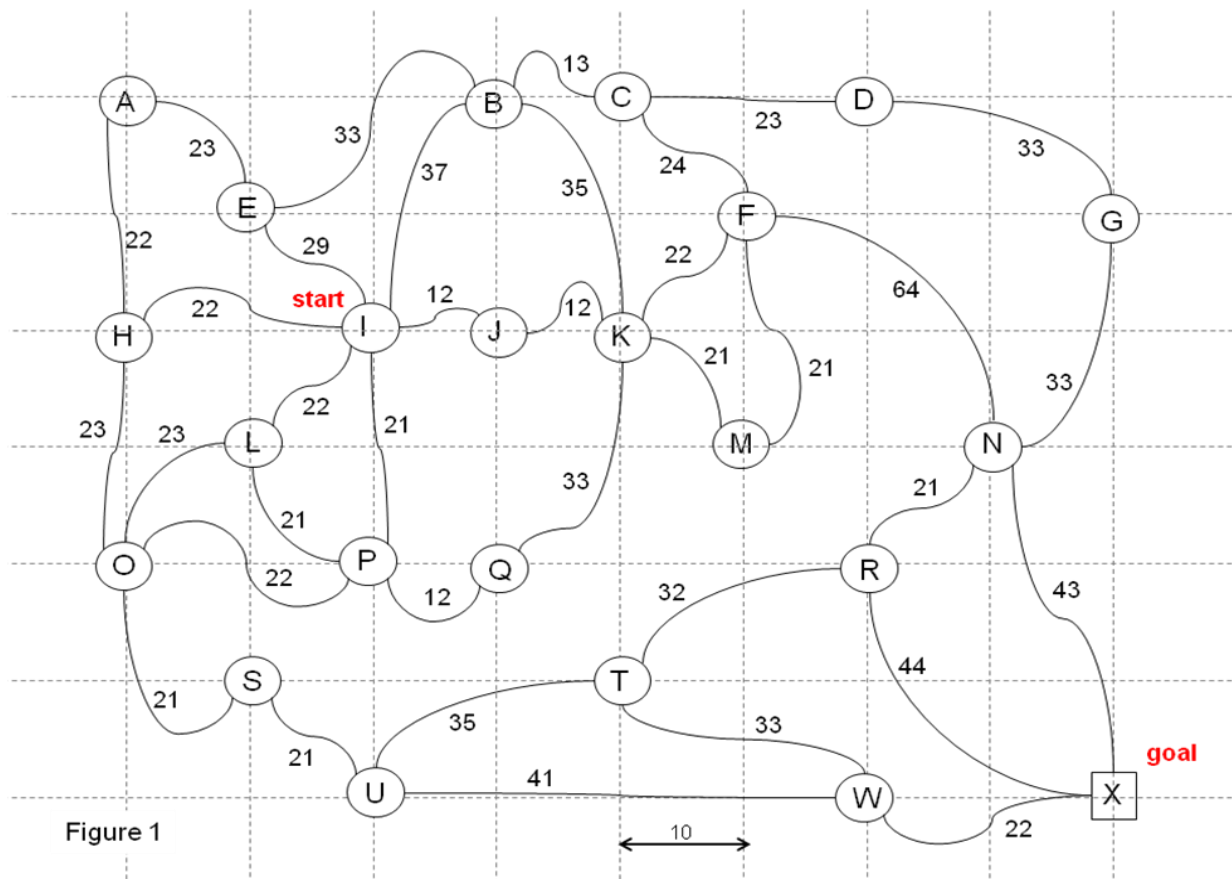
Tour2: F E D B C N A H G O I J K M L

- Identify the cycles (in Tour1) and illustrate the Cycle Crossover with the above two tours. [6]

Tour1: B C A H N O I J G K D L E M F

Tour2: F E D B C N A H G O I J K M L

In the graph given in Figure 1 each node represents a location that is on the grid where each unit is 10 km. Node  $I$  is the *Start* node and node  $X$  is the *Goal* node. The label on each edge is the edge cost. Use the Manhattan distance as the heuristic function wherever needed.



**Note: Questions 4-8 related to Figure 1.**

- Write the h-values of the nodes in the above graph. [4]
- Starting with node  $I$  list the order in which the Best First Search algorithm explores the graph till termination. [6]

6. Use Figure 1.1 below to draw the generated graph at the moment Best First Search terminates. Circle nodes on OPEN, and use double lined circles for nodes on CLOSED. Label the nodes with their values, clearly mark the parent pointers (arrow pointing from child to parent as shown in the drawing below), and the path found by Best First Search. What is the cost of the solution found? [8]

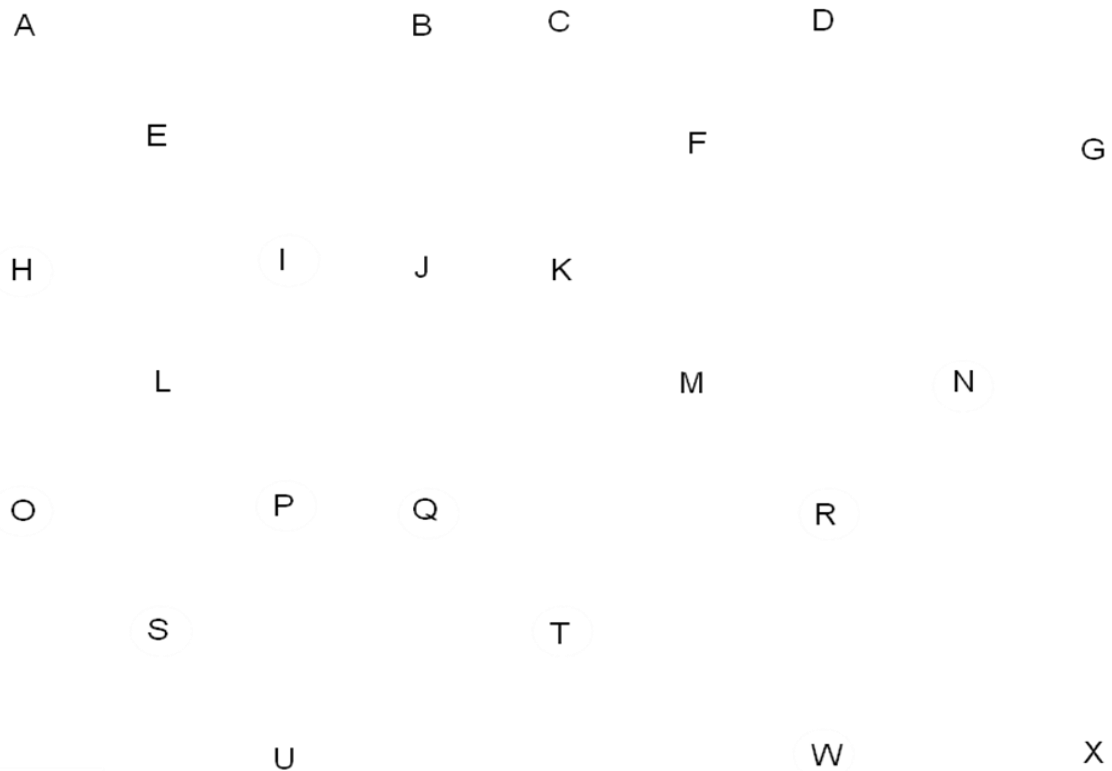
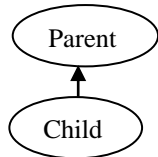


Figure 1.1

7. Starting with the node I list the first 9 nodes visited by the Branch & Bound algorithm, along with their values. [5]
8. Related to A\* algorithms
- Starting with the node I list the nodes in the order visited by algorithm A\* till termination. [6]
  - Use Figure 1.1 to draw the generated graph when A\* terminates. Circle nodes on OPEN, and use double lined circles for nodes on CLOSED. Label the nodes with their f-values, clearly mark the parent pointers (arrow pointing from child to parent as shown in the drawing of Q6), and the path found by A\*. What is the cost of the solution found? [10]
9.  $h_1$  is a consistent heuristic and  $h_2$  is an admissible heuristic, but not consistent. Justify if below is True/False [8]
- $\max(h_1, h_2)$  is a consistent heuristic
  - $\beta h_1 + (1-\beta) h_2$  is an admissible heuristic, where  $\beta \in [0, 1]$