B.Sc. Engg. / HD CSE 6th Semester

09 August 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — **SUMMER SEMESTER, 2017-2018**

DURATION: 1 Hour 30 Minutes — **FULL MARKS: 75**

CSE 4617: Artificial Intelligence

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) What is a key limitation of stochastic local search and what is a key advantage? Consider two local search algorithms, A and B. A solves 85% of a given problem if it is given upto 10 minutes. B solves 35% of the problems it is given upto 55 seconds. Is it wise to use one of the two algorithms at all cases? If not, which algorithm would you use in which conditions? 6

   b) Consider the search problem represented in the following figure, where *a* is the start node and *e* is the goal node. The pair [*f*, *h*] at each node indicates the value of the *f* and *h* functions for the path ending at that node. 5+2+8

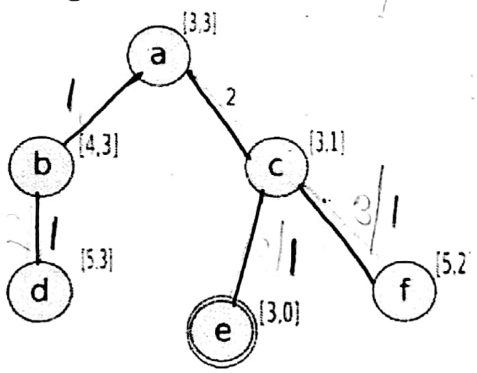


Figure 1: Figure for the Question 1.(b)

   i. Given this information, what is the cost of each arc? The cost <a,c> = 2 is given as a hint.

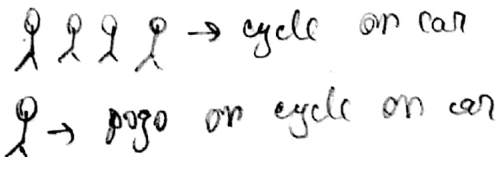
   ii. Is the heuristic function *h* admissible? Explain why or why not.

   iii. Trace A* on this problem. Show what paths are in the frontier at each step.

   c) If you use the generic search algorithm as the basis for implementing DFS and BFS, what would be the differences in your implementations? 4

2. Imagine the following scenario: a family of four needs to figure out how each family member will commute to work or school given several constraints. The family consists of a mother, father, son, and daughter. Each family member can bicycle or ride in the car. Additionally, the son has a pogo stick he can use for commuting to school. The assignment of transportation modes to family members is subject to the following constraints:

   - There are only two bicycles.
   - The car can only hold three people.
   - The son and daughter must take the same mode of transportation.
   - The son and daughter can only go by car if at least one of the parents is going by car, i.e. the parent(s) driving them to school.



a) What are the variables in this problem? What values are in the domain of each variable? [Hint: Read the problem definition carefully and take into consideration which entity is supposed to be assigned values and what values can be assigned to it.] 6

b) Draw the constraint network for this problem. [Hint: Constraints does not have to be mathematical inequalities/equations] 7

c) Run Arc consistency on the network by hand and show the final arc-consistent network. You do not have to show each of the steps in arc-consistency, only the final network is enough. 12

3. a) Prove that the worst-case space complexity of IDS is the same as DFS or BFS. If you have two heuristic function *h1* and *h2*. Give idea of a third heuristic *h3* which would use *h1* and *h2* to achieve a tighter yet admissible heuristic. 9+4

b) In 1942, Anthony S. Filipiak made a 10-block sliding puzzle called the Traffic Cop Tangle. The point of this puzzle is to swap the positions of the blocks labeled `A' and `B', by sliding around the pieces into the empty space (the unlabeled space between the A and the B). [N.B: Picture is to scale, so, both A and B blocks are twice the area of 3 and 6; 3 and 6 have twice the area of 1 and 2] 12

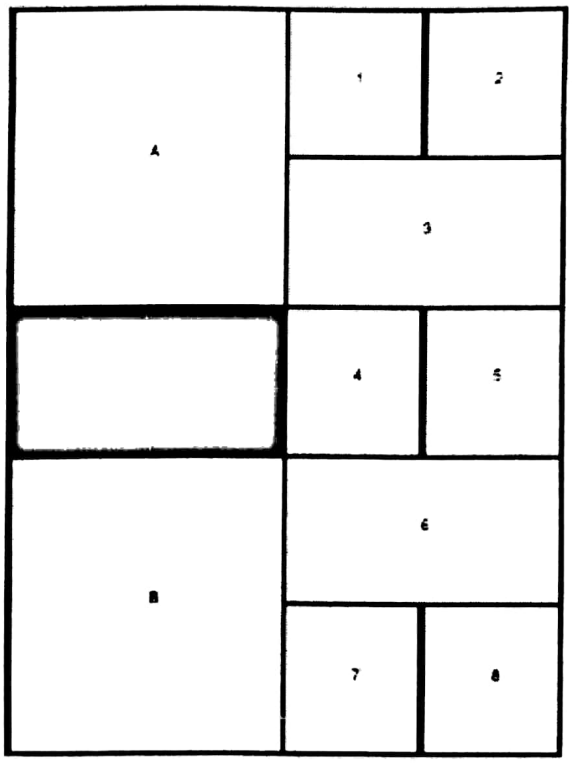


Figure 2: Traffic Cop Tangle Puzzle

Considering the aforementioned puzzle, what constitutes as a state for this problem? What is an action? A goal-state? What is a solution?

4. a) Consider the following simple tree/graph with S as start node and G as goal node. Values in nodes determine h values and values on arcs determine path cost from one node to another: 2+2+4+7

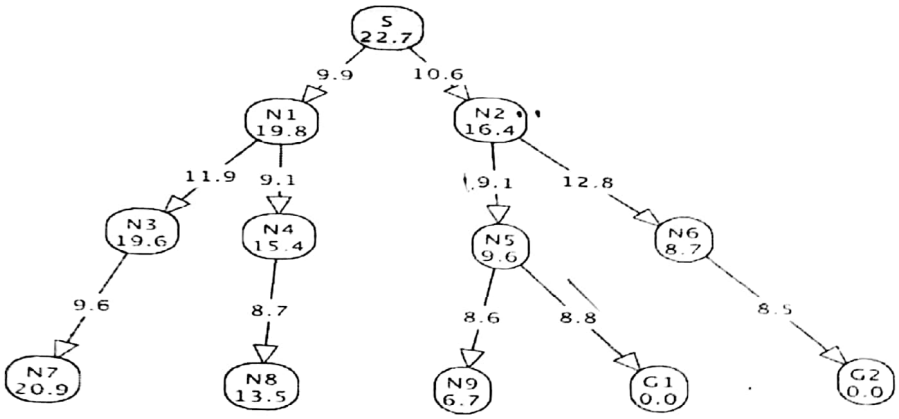


Figure 3: Simple tree/graph with heuristics and edge costs

If you use Branch and Bound (B & B) to solve the problem above then:

i. What is the UB when only the start node has been explored?
ii. Which solution would be found by B & B first?
iii. What is the UB immediately after the first goal node is found?
iv. What will happen when the algorithm explores the path that leads to the other goal node? Give your insights based on how UB and LB is updated?

b) Prove that if A* selects a path to the goal, it selects the optimal i.e. lowest cost path. 10