National University of Computer and Emerging Sciences, Lahore Campus

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Paper Date:	N/A	Weight	%
Section:	B	Page(s):	1
Exam:	Assignment	Roll No.	

Instruction/Notes: Hand Written Assignment - Upload scan copy to Google Classroom

Hill Climbing and Genetic engineering.

Q1 The famous N-QUEENS problem requires us to place N queens on an N x N chess board.

such that no queen is attacking the other queen. It has been decided to solve this problem by using the famous genetic algorithm.

1. Suggest a suitable representation of the chromosome (i.e. a possible solution) for this problem.
2. What is the size of the search space for the problem when N is 20.
3. How would you measure the fitness of a chromosome for this problem.

Q2 An unknown problem is being solved by using the genetic algorithm. The following table lists the initial population with each chromosome represented as a sequence of nine bits.

Initial Population	Fitness	New Population
100010111	6	
100000001	1	
010101010	0	
010100110	5	
001100111	0	
110110110	8	

For this initial population, determine the next population that results after one iteration.

Assume that fitness-proportionate selection is being used to select chromosomes and that a

single point cross-over is used by the algorithm. Also assume that the Mutation rate of 0.1. If

you need random numbers, choose in order from the following list and repeat from beginning if you need more.

.86, .59, .67, .14, .34, .08, .11, .29, .85, .76, .43, .47, .89, .80, .98, .58, .03, .57, .49, .92

b). Getting stuck in local minima is a problem of Hill climbing algorithm. Suggest one solution to avoid this problem. State your answer in 2 to 3 lines.

Q3 Consider the following Genetic Algorithm setup for some hypothetical problem.

Population size= 6	Goal: Fitness>= 6	Mutation Rate: 0%
Chromosome: array of 8 bits	Selection: Linear Rank selection	Update method= population 6 best from (population union population)
Fitness function is given as f (n) = number of 1's in chromosomes	Cross over method: One point, from random point.	

We have generated 6 random chromosomes in initial population given in table 1.

1. Find the fitness of chromosomes in initial population and their selection probability.

2. Perform first iteration using the selection, cross over and mutation method given above and generated new population.

3. Which chromosomes will go as population in 2nd iteration?

**NOTE: You can use suppose a random number if you need one, just mention its value where you use it. Show all steps and

working clearly.

Table 1: Initial Population

Chromosome 1	00001101
Chromosome 2	11000000
Chromosome 3	00000000
Chromosome 4	10101000
Chromosome 5	00111000
Chromosome 6	01000011

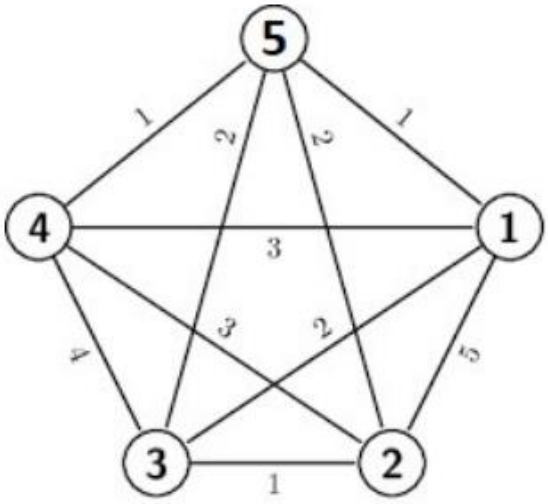
Q4 Given a list of n cities {C1, C2, …, Cn} a route is a sequence of n distinct cities Ci1, Ci2, … Cin starting at city Ci1 going to city Ci2 and ending at city Cin. Cost of a route is sum of the costs between successive cities and finally cost of coming back from city Cin to city Ci1. The travelling salesman problem (TSP) asks the following question: Given a list of n cities {C1, C2, … , Cn} and the distances between each pair of cities, what is the shortest possible route that starts at some city, visits each city exactly once and returns to the origin city?

In this question we are going to **use Hill climbing strategy** (i.e. a local search algorithm) to find an optimal/sub-optimal solution to a TSP problem.

1. How many different possible ways are there to start at some city and then visit each city exactly once and return to the original city for a problem of size n (i.e. n cities)? To get full marks give a brief justification of your answer as well.

2. How Many New Solutions can be generated from an existing solution using this simple operator? Give Reason.

3. For the following graph consisting of five cities, use hill climbing algorithm with the method of generating successors as given above to find an optimal solution of the problem using the following randomly generated solution as your initial solution. 1, 3, 4, 2, 5



Q5 The agent has been programmed by a selected team of students from a famous University (FAST) situated in the city of Lahore. The team programmed the agent such that it uses hill-climbing. strategy to solve such optimization problems. To represent state of the agent, while it is creating a plan to make a selection from a set of n items, the team used an array of size n with an index corresponding to one of the items in the set. Each index in the state array contains wither a 0 or a 1 where 0 at any index means that the agent will not pick the corresponding item and a 1 means the agent will pick the corresponding. item. Further, to generate successors of a state a very simple successor function is used that works by selecting an index and if the corresponding item is not already in the list of items to be picked it added it into the list by placing a 1 at the corresponding array index.

If the set of items contains 100 items

1. What is the size of search space the agent has to search from? (Justify)

2. How many successors a state can have at max? (Justify)

3. What will be a suitable evaluation function to carry out the hill-climbing search.