Laboratory Experiment 3b:

Locating the Emergency Unit

v01.00

I. Objective:

a. The project will provide a program that will allocate an Emergency Unit to the most efficient location in which it will be able to give service to all of the locations given as quick as possible.
b. The program will randomly pick for a location and test if the location will be an efficient location for the EU.
c. Using the distance formula the cost function of every location will be determined.
d. After 100 generations the location with the least cost function will be the most efficient for the allocation of the unit.
e. The designed GA program must be implemented with Genetic Operators like recombination and mutation.
f. The program will also display the cost function graph to show that for every generation, the target cost is minimized.

II. Materials

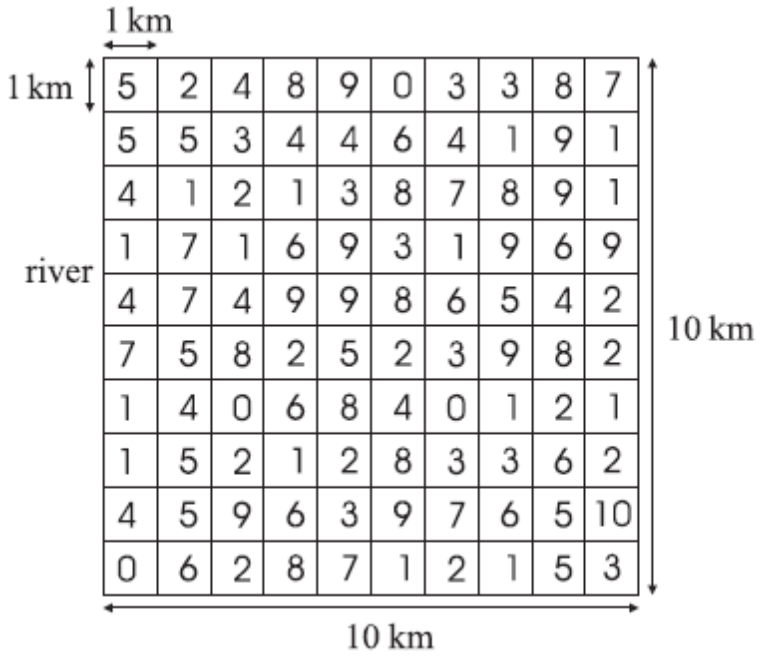
a. Matlab
b. SRS
c. PC

III. Cost Function

$$cost = \sum_{n=1}^{100} w_n \sqrt{(x_n - x_{fs})^2 + (y_n - y_{fs})^2}$$

where

(x_n, y_n) = coordinates of the center of square n
(x_{fs}, y_{fs}) = coordinates of the proposed emergency response unit
w_n = fire frequency in square n (as shown in Figure 4.9)



5	2	4	8	9	0	3	3	8	7
5	5	3	4	4	6	4	1	9	1
4	1	2	1	3	8	7	8	9	1
1	7	1	6	9	3	1	9	6	9
4	7	4	9	9	8	6	5	4	2
7	5	8	2	5	2	3	9	8	2
1	4	0	6	8	4	0	1	2	1
1	5	2	1	2	8	3	3	6	2
4	5	9	6	3	9	7	6	5	10
0	6	2	8	7	1	2	1	5	3

Figure: A model of a 10 X 10 km city divided into 100 equal squares.

IV. Program Flow

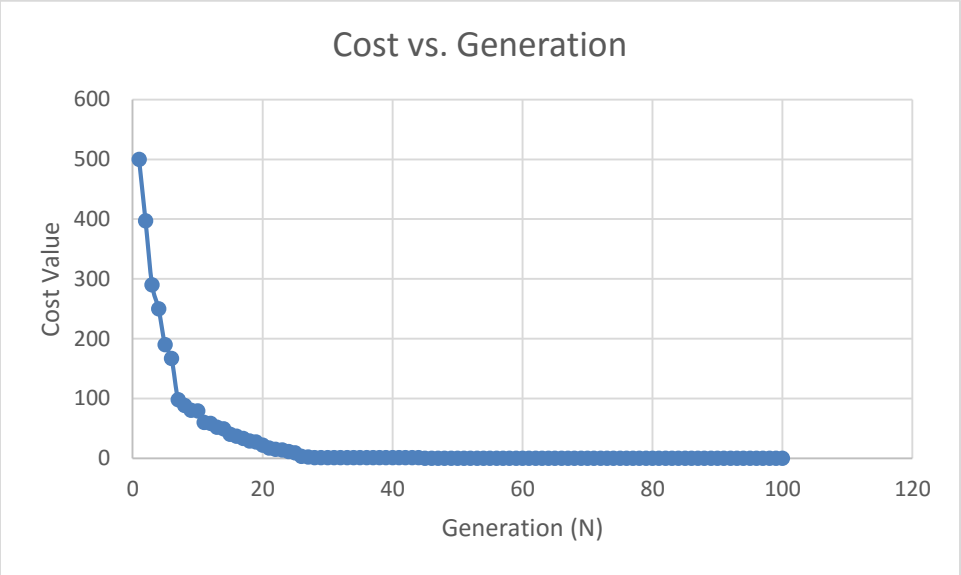
a. An emergency response unit is to be built that will best serve a city. The goal is to provide the minimum response time to a medical emergency that could occur anywhere in the city. After a survey of past emergencies, a map is constructed showing the frequency of an emergency in a given section of the city.

   The city is divided into a grid of 10 X 10 km with 100 sections, as shown in Figure above. The response time of the fire station is estimated to be **1.7 + 3.4r** minutes, where r is in kilometers. This formula is not based on real data, but an actual city would have an estimate of this formula based on traffic, time of day and so on.

b. The Proposed Coordinate (X_{fs}, Y_{fs}) of the emergency unit shall be randomized and will be implemented with Genetic Algorithms with genetic operators (cross-over and mutation).
c. The program must display a table of Generation, Proposed Coordinate, Cost Value and response time (minutes).

Generation	Proposed Coordinates	Cost Value	Response time (min)
1	Coordinate (X_{fs1}, Y_{fs1})	XXXXXX	xxxxx
2	Coordinate (X_{fs2}, Y_{fs2})	XXXXXX	xxxxx
3	Coordinate (X_{fs2}, Y_{fs2})	XXXXXX	xxxxx
…			
100	Optimized Coordinate (X_{fs}, Y_{fs})	0	xxxxx

d. The Program will display a graph that will show the relationship of the cost value versus the generation.



e. The Program will display the proposed coordinate.