

**ASSIGNMENT 3: UNSUPERVISED LEARNING &
GENETIC ALGORITHMS (GROUP)**

SECTION 1

**ASSIGNED DATE: 25 MAY 2021
DUE DATE: 4 JUNE 2021 (11.59 pm)**

PART 1: K-Means Clustering

1. Given that $k = 3$, use the k-means algorithm to cluster the following 6 records in Table 1 into 3 clusters.

EmployeeID	YearService	Income (K)
E01	4	9
E02	8	4
E03	2	5
E04	5	8
E05	1	2
E06	7	5

Table 1

Suppose that the initial seeds (centers of each cluster) are E01, E03 and E05. Run the k-means algorithm for 1 epoch only and show the following :

- a) Calculate the Euclidean distances between each point and the cluster centers.
- b) Determine the new clusters (i.e. the examples/points belonging to each cluster)
- c) Determine the centers of the new clusters.
- d) Draw a 10 by 10 graph with all the 6 points and show the clusters after the first epoch and the new centroids.
- e) How many more iterations are needed to converge? Draw the result for each epoch.

PART 2: GENETIC ALGORITHM

2. Consider the following problem of maximizing the fitness function :

$$f(x) = (-x^2/8) + 4x$$

where x is an integer allowed to vary between 0 and 31. Thus, x can be encoded in binary bits of length 5 ranging from 00000 to 11111. Given the population of 10 chromosomes in Table 2:

Chromosome Number	Initial Population	x Value	Fitness Value $f(x)$	Selection Probability
1	01011	11		
2	01001	9		
3	00111	7		
4	01110	14		
5	01100	12		
6	11110	30		
7	10110	22		
8	11001	25		
9	00011	3		
10	10001	17		

Table 2 : Initial Population

- Complete the table by computing the fitness value $f(x)$ and selection probability (i.e. fitness ratio). Determine the two best parents by marking the chromosome selected based on their fitness of fit. Show your calculation steps clearly in detail.
- Perform crossover at bits 1, 3, 4 on the selected parents. Show the process clearly together with the newly generated offsprings (i.e., draw the process).
- Perform 2 bits mutation at even positions of the offsprings of (b). Show your steps clearly by drawing the chromosomes before and after mutation.