

Write python codes for each of the following questions:

20*2=40

Q1. Suppose a Genetic Algorithm uses chromosomes of the form $x=abcdefgh$ with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as:

$$f(x) = (a+b) - (c+d) + (e+f) - (g+h)$$

And let the initial population consist of four individuals x_1, \dots, x_4 with the following chromosomes :

X1 = 6 5 4 1 3 5 3 2

X2 = 8 7 1 2 6 6 0 1

X3 = 2 3 9 2 1 2 8 5

X4 = 4 1 8 5 2 0 9 4

Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.

For above problem perform the following crossover operations:

- Cross the fittest two individuals using one-point crossover at the middle point.
- Cross the second and third fittest individuals using a two-point crossover (point's b and f)

Q2. Given a scenario suppose that the size of the chromosome population N is 6, and the fitness function is $15x - x^2$, and the binary code for the strings is 1100, 0100, 0001, 1110, 0111, 1001 here x in the fitness function is the decimal value of the given string. Perform the following:

- Find the fitness values of the strings and draw the Roulette wheel.
- After performing (a) do the first iteration in which crossover is done between 6th string and 2nd string at 3rd position. Onwards
- In second iteration perform mutation in 1st and 5th string at 2nd and 3rd position.
- Now draw the roulette wheel and tell the improvement fitness percentage