1. Describe the steps of modelling the solution to a problem through genetic algorithm through an example.

2. Propose a genetic algorithm based solution to the following problems
    a. Knapsack problem https://en.wikipedia.org/wiki/Knapsack_problem
    b. Maximal clique problem https://en.wikipedia.org/wiki/Clique_problem
    c. Job Shop Scheduling https://en.wikipedia.org/wiki/Job_shop_scheduling
    d. Travelling Salesman problem https://simple.wikipedia.org/wiki/Travelling_salesman_problem

3. Explain exploration vs. exploitation. Discuss them w.r.t.
    a. Fitness function
    b. Selecting parents for "mating pool"
    c. Selecting next generation

4. Explain different techniques for choosing parents in a GA

5. Explain different techniques for choosing individuals for the next generation

6. Explain different types of encoding in GA with an example

7. 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:

$$\mathbf{f(x) = (a + b) - (c + d) + (e + f) - (g + h)\ ,}$$

and let the initial population consist of four individuals 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

a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.
b) Perform the following crossover operations:
    I. Cross the fittest two individuals using one–point crossover at the middle point.
    II. Cross the second and third fittest individuals using a two–point crossover (points b and f).
    III. Cross the first and third fittest individuals (ranked 1st and 3rd) using a uniform crossover.