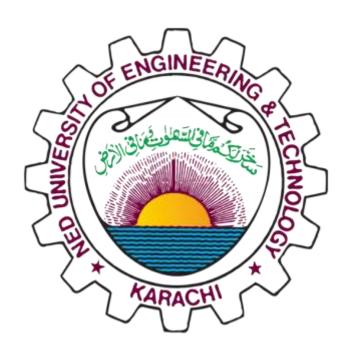
# **Open Ended Lab Report**

## **Artificial Intelligence**

Third Year-Computer and Information Systems Engineering
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## Introduction

Genetic Algorithms (GAs) are optimization techniques inspired by the process of natural selection. They are commonly used for solving complex problems where traditional methods are inefficient. This report explores the application of a Genetic Algorithm to solve the Knapsack Problem.

### **Problem Statement**

The Knapsack Problem involves selecting a subset of items with given weights and values to maximize the total value without exceeding a specified weight capacity. For this study, the problem is defined as follows:

#### Items:

Item 1: Weight = 2, Value = 3

Item 2: Weight = 3, Value = 4

Item 3: Weight = 4, Value = 5

Item 4: Weight = 5, Value = 8

Knapsack Capacity: 9

## **Details of Model**

The Genetic Algorithm employs the following components to solve the problem:

- **1. Encoding:** Each solution is represented as a binary chromosome where each bit indicates whether an item is selected (1) or not (0).
- **2. Population:** A set of chromosomes representing potential solutions.
- **3. Fitness Function:** The total value of selected items, with a penalty applied if the total weight exceeds the knapsack capacity.
- **4. Selection:** Roulette wheel selection is used to choose parents based on fitness.
- **5.** Crossover: Single-point crossover is applied to generate offspring from two parent chromosomes.
- **6. Mutation:** Random flipping of bits is performed to introduce diversity.
- **7. Termination:** The algorithm runs for a fixed number of generations.

## **Implementation**

The algorithm was implemented in Python. An initial population of chromosomes was randomly generated. At each generation, the population was evaluated using the fitness function, and new chromosomes were produced using selection, crossover, and mutation. The process was repeated for 10 generations. Below are the key parameters used:

- Population Size: 6
- Gene Length: 4 (corresponding to 4 items)
- Crossover Rate: 0.8
- Mutation Rate: 0.1
- Number of Generations: 10

## **Results**

The algorithm successfully converged to an optimal solution. The final results are summarized below:

- Best Chromosome: 1110
- Selected Items:

```
\circ Item 1 (Weight = 2, Value = 3)
```

- o Item 2 (Weight = 3, Value = 4)
- O Item 3 (Weight = 4, Value = 5)
- Total Value: 12
- Total Weight: 9 (within the capacity of 9)

### **Conclusion**

This study demonstrated the effectiveness of Genetic Algorithms in solving the Knapsack Problem. The algorithm successfully identified a high-quality solution within the specified constraints. The approach is versatile and can be adapted to other optimization problems by modifying the encoding, fitness function, and parameters. Future work could involve exploring alternative selection methods, dynamic parameter tuning, or hybrid approaches to further enhance performance.