



LAB VI

Optimization Using Genetic Algorithm

1. Objective

Implement a Genetic Algorithm (GA) to optimize a real-valued function using binary encoding of solutions.

2. Problem Statement

You are required to maximize the following function:

$$\text{Maximize } f(x) = \frac{x^2}{2} - 3x,$$

subject to:

- $0 \leq x \leq 30$

3. Representation

- Each solution (chromosome) is represented using a 5-bit binary string.
- Decode the binary string into a real value $x \in [0,30]$ using:

$$x = x_{\min} + \left(\frac{\text{decimal value of chromosome}}{2^5 - 1} \right) (x_{\max} - x_{\min})$$

4. Genetic Algorithm Requirements

1. Initial Population

- Randomly generate a population of binary strings (suggested size: 4–10 individuals).

2. Fitness Evaluation

- Decode each chromosome to obtain x
- Compute fitness using $f(x)$

3. Selection

- Use roulette wheel selection or tournament selection

4. Crossover

- Apply single-point crossover
- Choose a random crossover point along the 5-bit chromosome

5. Mutation

- Perform bit-flip mutation
- Mutation probability $p = 0.1$ per bit

6. Replacement

- Form the next generation using offspring

7. Termination

- Run for a fixed number of generations (e.g., 10–20), or until convergence

Tasks

- 1. Generate an initial population and show all chromosomes.**
- 2. Decode each chromosome and compute its fitness.**
- 3. Perform selection and show selected parents.**
- 4. Apply single-point crossover and show offspring.**
- 5. Apply mutation with probability 0.1 and show updated chromosomes.**
- 6. Repeat for at least 2 generations.**
- 7. Report the best solution found and its decoded value of x .**
- 8. Compare results using different population sizes**