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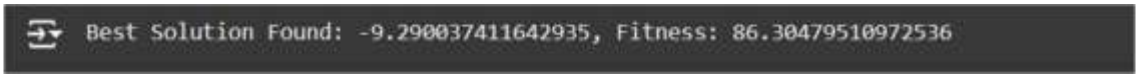
LAB-1 : Genetic Algorithm for Optimization Problems

CODE:

```
import numpy as np import
random


def objective_function(x):
    return x ** 2


population_size = 100
num_generations = 50
mutation_rate = 0.1
crossover_rate = 0.7
range_min = -10
range_max = 10


# Create initial population def initialize_population(size,
min_val, max_val): return
np.random.uniform(min_val, max_val, size)


# Evaluate fitness of the population def
evaluate_fitness(population):
    return np.array([objective_function(x) for x in population])


# Selection using roulette-wheel method
def selection(population, fitness):
```

```
total_fitness          =          np.sum(fitness)
probabilities = fitness / total_fitness

    return population[np.random.choice(range(len(population)), size=2, p=probabilities)] #
Crossover between two parents def crossover(parent1, parent2):       if random.random() <
crossover_rate:
        return (parent1 + parent2) / 2   # Simple averaging for crossover
return parent1  # No crossover



# Mutation of an individual def
mutate(individual):     if
random.random() < mutation_rate:
        return np.random.uniform(range_min, range_max)
    return individual


# Genetic Algorithm function def genetic_algorithm():       # Step 1: Initialize
population       population = initialize_population(population_size, range_min,
range_max)


    for generation in range(num_generations):
        # Step 2: Evaluate fitness         fitness
= evaluate_fitness(population)



        # Track the best solution        best_index
= np.argmax(fitness)            best_solution =
population[best_index]
        best_fitness = fitness[best_index]
        # print(f"Generation {generation + 1}: Best Solution = {best_solution}, Fitness =
{best_fitness}")

        # Step 3: Create new population
new_population = []        for _ in
range(population_size):

            # Select parents
            parent1, parent2 = selection(population, fitness)
            # Crossover to create offspring
offspring = crossover(parent1, parent2)

            # Mutate offspring
offspring = mutate(offspring)

            new_population.append(offspring)

        # Step 6: Replace old population with new population
population = np.array(new_population)

    return best_solution, best_fitness

# Run the Genetic Algorithm best_solution, best_fitness = genetic_algorithm() print(f"Best Solution Found: {best_solution}, Fitness:
{best_fitness}")
```

OUTPUT:



```
Best Solution Found: -9.290037411642935, Fitness: 86.30479510972536
```