

LAB:-1 Genetic Algorithm for optimization problems

Genetic algorithm 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)]
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# 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}")

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# 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 :- -7.290085674589, fitness: 82.305974562