



Data Structures And Algorithms

(Course Code: CSC211)

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Assignment # 3

Lab Part

Lab 10

```
import numpy as np
import random

def create_8_queens_board():
    queens_board = np.full((8,8), '.')
    print(queens_board)

    # Place queens (represented by 'Q') on the board
    for row in range(0,8):
        col = random.randint(0, 7)
        print(row, col)
        queens_board[row, col] = 'Q'
    return queens_board

def board_chromosome(board):
    queens_positions = np.argwhere(board == 'Q')
    print('Q Positions', queens_positions)

    # Returns columns
    cols = queens_positions[:, 1]
    print('chromosome', cols)
    return cols

def calculate_fitness_numpy(board):
    queens_positions = np.argwhere(board == 'Q')
    num_queens = len(queens_positions)

    rows = queens_positions[:, 0]
    cols = queens_positions[:, 1]

    print("cols", cols)
    unique_cols, counts = np.unique(cols,
    return_counts=True)
    unique_only = unique_cols[counts == 1]
    col_attacks = num_queens - len(unique_only)
    print("Column attacks:", col_attacks)

    # diagonol attack
```

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        diagonal_attacks = 0        for i
in range(num_queens):              for j in
range(i + 1, num_queens):

        if abs(rows[i] - rows[j]) == abs(cols[i] -
cols[j]):
            diagonal_attacks += 1
        print("Diagonal attacks:",
diagonal_attacks)
        total_attacks = col_attacks +
diagonal_attacks

    fitness = 8 - total_attacks
return fitness

def top_two_chromosomes(boards, chromosomes, fitness_values):
combined = list(zip(fitness_values, boards, chromosomes))
    sorted_combined = sorted(combined, key=lambda x:
x[0])
    top_two = sorted_combined[-
2:]    return top_two

def single_point_crossover(parent1, parent2):
crossover_point = 4    print('crossoverpoint',
crossover_point)
    offspring1 =
np.concatenate((parent1[:crossover_point],
parent2[crossover_point:]))    offspring2 =
np.concatenate((parent2[:crossover_point],
parent1[crossover_point:]))

    return offspring1, offspring2

def mutate(chromosome):
    index =
random.randint(0, 7)
    new_value =
random.randint(0, 7)

```

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        print(f"Mutating index {index} →
{new_value}")
        chromosome[index] =
new_value    return chromosome

population_size = int(input("Enter number of boards (population size): "))
boards = []
chromosomes = []
fitness_values =
[]

# Generate population for i in
range(population_size):    print(f"\n-
-- Board {i+1} ---")    board =
create_8_queens_board()    chrom =
board_chromosome(board)    fit =
calculate_fitness_numpy(board)
    boards.append(board)
chromosomes.append(chrom)
fitness_values.append(fit)

# Select top 2 top_two = top_two_chromosomes(boards, chromosomes,
fitness_values) parent1 = top_two[-1][2] parent2 = top_two[-2][2]
    print("\nSelected Parent 1:",
parent1) print("Selected Parent 2:",
parent2)

# Crossover offspring1, offspring2 =
single_point_crossover(parent1, parent2)
    print("\nOffspring 1 before mutation:",
offspring1) print("Offspring 2 before mutation:",
offspring2)

# Mutation offspring1 =
mutate(offspring1) offspring2
= mutate(offspring2)
    print("\nOffspring 1 after mutation:",
offspring1) print("Offspring 2 after mutation:",
offspring2)

```

output:

● PS C:\Users\khans\OneDrive\Desktop\ai> python ga.py

Enter number of boards (population size): 4

--- Board 1 ---

```
[['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.']]
```

0 4

1 5

2 5

3 2

4 4

5 1

6 5

7 7

Q Positions [[0 4]

[1 5]

[2 5]

[3 2]

[4 4]

[5 1]

[6 5]

[7 7]]

chromosome [4 5 5 2 4 1 5 7]

cols [4 5 5 2 4 1 5 7]

Column attacks: 5

Diagonal attacks: 4

--- Board 2 ---

```
[['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']]
```

0 1

1 6

2 1

3 6

4 4

5 2

6 1

7 2

Q Positions [[0 1]

[1 6]

[2 1]

[3 6]

[4 4]

[5 2]

[6 1]

[7 2]]

chromosome [1 6 1 6 4 2 1 2]

cols [1 6 1 6 4 2 1 2]

Column attacks: 7

Diagonal attacks: 5

--- Board 3 ---

```
[[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']  
[ '.' '.' '.' '.' '.' '.' '.' '.' '.' '.']]
```

0 1

1 6

2 6

3 4

4 3

5 3

6 4

7 5

Q Positions [[0 1]

[1 6]

[2 6]

[3 4]

[4 3]

[5 3]

[6 4]

[7 5]]

chromosome [1 6 6 4 3 3 4 5]

cols [1 6 6 4 3 3 4 5]

Column attacks: 6

Diagonal attacks: 8

```

--- Board 4 ---
[['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']
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['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']
['.' '.' '.' '.' '.' '.' '.' '.' '.' '.']]
0 1
1 2
2 5
3 7
4 6
5 7
6 5
7 7
Q Positions [[0 1]
[1 2]
[2 5]
[3 7]
[4 6]
[5 7]
[6 5]
[7 7]]
chromosome [1 2 5 7 6 7 5 7]
cols [1 2 5 7 6 7 5 7]
Column attacks: 5
Diagonal attacks: 3

Selected Parent 1: [1 2 5 7 6 7 5 7]
Selected Parent 2: [4 5 5 2 4 1 5 7]
crossoverpoint 4

Offspring 1 before mutation: [1 2 5 7 4 1 5 7]
Offspring 2 before mutation: [4 5 5 2 6 7 5 7]
Mutating index 0 → 7
Mutating index 6 → 3

Offspring 1 after mutation: [7 2 5 7 4 1 5 7]
Offspring 2 after mutation: [4 5 5 2 6 7 3 7]
PS C:\Users\khans\OneDrive\Desktop\ai>

```