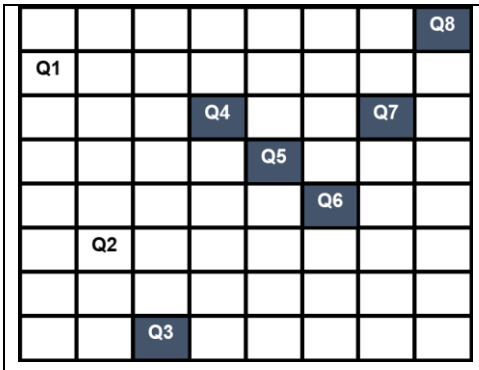
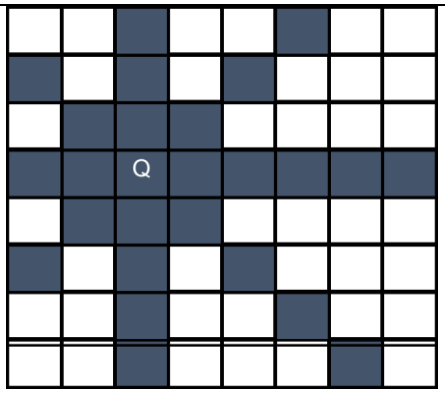
Issue Date: 29 Mar, 2022 Due date: 04 April, 2022

1. Implement a program in python to solve the 8 Queens Problem using a genetic algorithm. The aim of the N-Queens Problem is to place N queens on an N x N board, in a way so that none of them can attack the other (means when any queen moves in directions vertical, horizontal and diagonal no other queen found in the path)




Consider it a start state, to represent the board as chromosomes show the queen position column-wise, here 2 is row number in first column, 6 is row number in second column and so on.

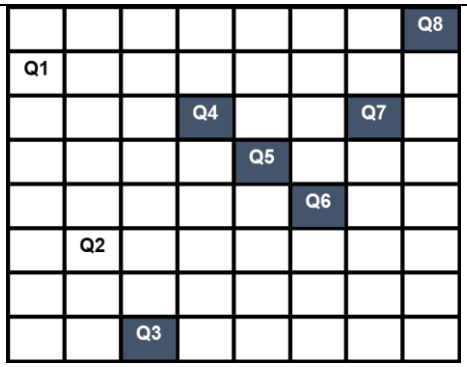
**2 6 8 3 4 5 3 1**



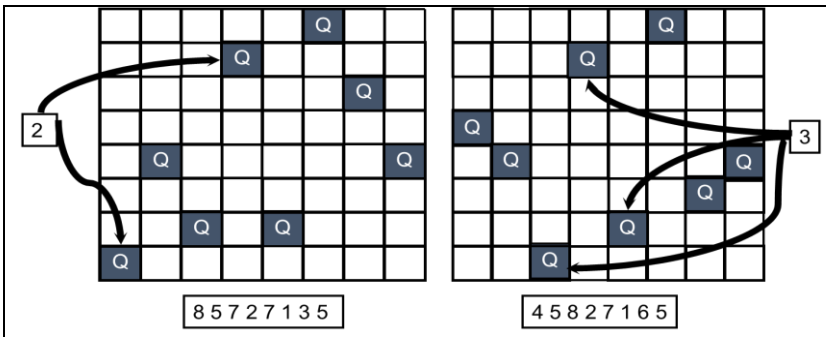

Shaded cells represent queen movement path.

Consider the following steps for the genetic algorithm to solve the n-queen problem?
Step 1: Initialize the population randomly or with potentially good ***solutions***.
Step 2: Compute the ***fitness*** of each individual in the population.
Step 3: Select parents using a ***parent selection procedure***.
Step 4: Create offspring by ***crossover*** and ***mutation*** operators.
Step 5: Compute the ***fitness*** of the new offspring.
Step 6: Select members of population to die using a ***Survival selection procedure***.
Step 7: Go to Step 2 until termination criteria are met.

## Fitness Function:

| | |
|---|---|
| Q1 can attack NONE<br>Q2 can attack NONE<br>Q3 can attack Q6<br>Q4 can attack Q5<br>Q5 can attack Q4<br>Q6 can attack Q5<br>Q7 can attack Q4<br>Q8 can attack Q5<br><br>Fitness = No of. Queens that can attack none<br>Fitness = 2 |  |

## Cross over




Generate children (new population) using crossover

| Parents | children |
|---|---|
| 8 5 7 2 7 1 3 5 | 8 5 7 2 7 1 6 5 |
| 4 5 8 2 7 1 6 5 | 4 5 8 2 7 1 3 5 |

## Mutation

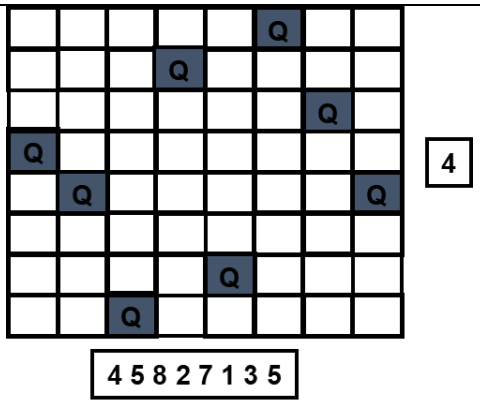
Mutation, flip bits at random, this change fitness value from 3 to 4

4 5 8 2 7 1 6 5

0100 0101 1000 0010 0111 0001 0110 0101

0100 0101 1000 0010 0111 0001 0011 0101

4 5 8 2 7 1 3 5




Note:

- This process is repeated until an individual with required fitness level is found.
- If no such individual is found, then the process is repeated further until the overall fitness of the population or any of its individuals gets very close to the required fitness level.
- An upper limit on the number of iterations is usually put to end the process in finite time.

## Solution