CS69011: Computing Lab
Task : Linear Programming and Integer Programming

September 4, 2023

T3: Find a solution for the n-queens problem using Python OR-Tools (pywraplp).

N-Queens problem - Place n number of queens in a nXn chessboard (or grid) such that no two queens attack each other.

Sample Input-

4

Sample Output-

```
_ Q _ _
_ _ _ Q
Q _ _ _
_ _ Q _
```

Hint-
1. Take variables subject to the position of queens wrt each square in the chessboard to see if a queen can occupy that square.
$$0 \leq c_{ij} \leq 1, \text{where } 0 \leq i, j \leq n - 1$$
2. Define Constraints for the same queens placed in each row and column.
    a. Row Constraint:-
$$0 \leq \sum_{0 \leq j \leq n-1} c_{kj} \leq 1, \text{where } 0 \leq k \leq n - 1$$
    b. Column Constraint:-

$$0 \leq \sum_{0 \leq i \leq n-1} c_{ik} \leq 1, \text{where } 0 \leq k \leq n-1$$

3. Define Constraints for the same queens placed along the right and left diagonals.

    a. Left Diagonal Constraint:-

$$0 \leq \sum_{i-j=k} c_{ij} \leq 1, \text{where } -(n-1) \leq k \leq n-1$$

    b. Right Diagonal Constraint:-

$$0 \leq \sum_{i+j=k} c_{ij} \leq 1, \text{where } 0 \leq k \leq 2n-2$$

4. Maximize

$$\sum_{0 \leq i,j \leq n-1} c_{ij}$$