

**CS69011: Computing Lab**  
**Task : Linear Programming and Integer Programming**

**September 4, 2023**

=====Instructions=====

1. In the case of user input, assume only valid values will be passed as input.
2. Regarding submission: Create a separate Python file for each task : **<RollNo>\_T1.py**  
**<RollNo>\_T2.py** **<RollNo>\_T3.py**
3. Create a zipped file of all these Python files with the name:  
**<RollNo>\_LP\_TS.zip** and submit it to Moodle.

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**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

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