N-Queens problem :

A chessboard of 4x4 is taken, consisting of 16 cells. (For easy understanding)

4 Queens are given, Q1,Q2,Q3,Q4.

The 4 Queens are to be places in the chessboard(4x4), such that no two Queens must be under attack.

They are under attack when they are in same row, same column, same diagonal. So, we have to avoid this and arrange them so that they aren’t under attack.

For all the possible arrangements of the 4 Queens, we use Backtracking.

4 Queens are to be placed in 16 cells, the possibilities are 16C4

To reduce the size of the problem(so as to avoid checking 16C4 possibilities), we take it like:

BOUNDING FUNCTION:

1) No two queens can be placed in same column.

2) No two queens can be placed in same row.

3) A Queen must not be placed in diagonal to the other.

Taking points 1 and 2 under consideration, we generate state space tree. Here, we do not check the diagonal attack condition (which is wrong), and place only one queen in its respective row and column.

|  |  |  |  |
| --- | --- | --- | --- |
| Q1 |  |  |  |
|  | Q2 |  |  |
|  |  | Q3 |  |
|  |  |  | Q4 |

Considering the bounding function:

Since Q4 does not have any other possibility to move, we backtrack to Q3 and place it where the diagonal attack can be avoided.

|  |  |  |  |
| --- | --- | --- | --- |
| Q1 |  |  |  |
|  | Q2 |  |  |
|  |  |  | Q3 |
|  |  | Q4 |  |

Now, since Q3, Q4 have no other way to move, we backtrack to Q2, to search for some other position.

|  |  |  |  |
| --- | --- | --- | --- |
| Q1 |  |  |  |
|  |  | Q3 |  |
|  | Q2 |  |  |
|  |  |  | Q4 |

Q4 cannot be moved, hence Q3 is moved.

|  |  |  |  |
| --- | --- | --- | --- |
| Q1 |  |  |  |
|  |  | Q2 |  |
|  |  |  | Q3 |
|  | Q4 |  |  |

Similarly, Q2 is placed in 4th row, Q3 in 2nd, and Q4 in 3rd.

Since, Q2 has no other place to move to, we backtrack to Q1, and search for another safe position for Q1.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Q1 |  |  |
|  |  | Q2 |  |
|  |  |  | Q3 |
| Q4 |  |  |  |

We follow the same process as above even for Q1. Since the total no. of positions that you have to check are 65, for a right solution, we do not expand that sub-tree and move on to the ones that can possibly give us a solution.

Taking the bounding function under action: (all the 3 conditions)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Q1 |  |  |
|  |  |  | Q2 |
| Q3 |  |  |  |
|  |  | Q4 |  |

The one solution is represented by their respective column no. as:

|  |  |  |  |
| --- | --- | --- | --- |
| 2 | 4 | 1 | 3 |

Similarly, all the other solutions can also be found.