Practical 7
8-Queen Problem using Back Tracking

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I. Introduction

Aim of this practical is to perform chain matrix multiplication using Dynamic Programming.

- A 8 x 8 chess board and 8 queens where Queens can move horizontally, vertically and diagonally.
- A chessboard with N queens arranged on the board in such a way that no two queens can attack each other.
- use backtracking each time we got bounded by constraints i.e, when we have no more place valid to place the new queens in the board.
- Also, before placing a new queen to the board, at first the position in the board should be throughly checked and if the place is valid then we could place a new queen on the board.

II. Implementation

I. Main Program - *8queen.c*

```
//
 ↪ ----------------------------------------------------------------------------------------
// Author: Gahan Saraiya
// GiT: http://github.com/gahan9/
// StackOverflow: https://stackoverflow.com/users/story/7664524
// Website: http://gahan9.github.io/
//
 ↪ ----------------------------------------------------------------------------------------
// Implementing 8-queen Problem

#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <math.h>

int counter = 1;

int placeQueen(int *board, int row_no) {
    for (register int i = 0; i < row_no; i++) {
        if (board[i] == board[row_no])
            return false; // same column
```

```c
        if ((board[i] - board[row_no]) == (row_no - i))
            return false; // same major diagonal
        if ((board[row_no] - board[i]) == (row_no - i))
            return false; // same minor diagonal
    }
    return true;
}

void pretty_print(int q[], int board_size) {
    printf("\n");
    for (int i = 0; i < board_size; i++) {
        for (int j = 0; j < board_size; j++) {
            if (q[i] == j)
                printf("Q ");
            else
                printf("* ");
        }
        printf("\n");
    }
}

void queenLogic(int *queens, int row_no, int board_size) {
    if (row_no == board_size) {
        pretty_print(queens, board_size);
        if (counter % 10 == 1)
            printf("%dst solution found...\n", counter);
        else if (counter % 10 == 2)
            printf("%dnd solution found...\n", counter);
        else if (counter % 10 == 3)
            printf("%drd solution found...\n", counter);
        else
            printf("%dth solution found...\n", counter);
        counter++;
    } else {
        for (int i = 0; i < board_size; i++) {
            queens[row_no] = i;
            if (placeQueen(queens, row_no))
                queenLogic(queens, row_no + 1, board_size);
        }
    }
}

int main() {
    int board_size = 8;
    int *queens = malloc(board_size * sizeof(int));
    printf("###########------------------############\n"
           "#---------- %d queen Problem -----------#\n"
           "#---------------------------------------#\n", board_size);
    queenLogic(queens, 0, board_size);
    return 1;
}
```

I.1 Output

```
###########------------------############
#---------- 08 queen Problem -----------#
#--------------------------------------#

Q * * * * * * *
* * * * Q * * *
* * * * * * * Q
* * * * * Q * *
* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
* * * Q * * * *
1st solution found...

Q * * * * * * *
* * * * * Q * *
* * * * * * * Q
* * Q * * * * *
* * * * * * Q *
* * * Q * * * *
* Q * * * * * *
* * * * Q * * *
2nd solution found...

Q * * * * * * *
* * * * * * Q *
* * * Q * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * * Q * * *
* * Q * * * * *
3rd solution found...

Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
* * * * * Q * *
* * Q * * * * *
4th solution found...

* Q * * * * * *
* * * Q * * * *
* * * * * Q * *
* * * * * * * Q
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
5th solution found...

* Q * * * * * *
* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * * * * Q
* * * * * Q * *
* * * Q * * * *
6th solution found...

* Q * * * * * *
* * * * Q * * *
* * * * * * Q *
* * * Q * * * *
Q * * * * * * *
* * * * * * * Q
* * * * * Q * *
* * Q * * * * *
7th solution found...

* Q * * * * * *
* * * * * Q * *
Q * * * * * * *
```

```
* * * * * * Q *
* * * Q * * * *
* * * * * * * Q
* * Q * * * * *
* * * * Q * * *
8th solution found...

* Q * * * * * *
* * * * * Q * *
* * * * * * * Q
* * Q * * * * *
Q * * * * * * *
* * * Q * * * *
* * * * * * Q *
* * * * Q * * *
9th solution found...

* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * Q * *
* * * * * * * Q
* * * * Q * * *
Q * * * * * * *
* * * Q * * * *
10th solution found...

* Q * * * * * *
* * * * * * Q *
* * * * Q * * *
* * * * * * * Q
Q * * * * * * *
* * * Q * * * *
* * * * * Q * *
* * Q * * * * *
11st solution found...

* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
Q * * * * * * *
```

```
* * Q * * * * *
* * * * Q * * *
* * * * * * Q *
* * * Q * * * *
12nd solution found...

* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
* * * * * Q * *
13rd solution found...

* * Q * * * * *
* * * * Q * * *
* Q * * * * * *
* * * * * * * Q
Q * * * * * * *
* * * * * * Q *
* * * Q * * * *
* * * * * Q * *
14th solution found...

* * Q * * * * *
* * * * Q * * *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
* * * Q * * * *
* * * * * * Q *
Q * * * * * * *
15th solution found...

* * Q * * * * *
* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
16th solution found...

* * Q * * * * *
* * * * Q * * *
* * * * * * * Q
* * * Q * * * *
Q * * * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
17th solution found...

* * Q * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * Q * * *
* * * * * * * Q
Q * * * * * * *
* * * * * * Q *
* * * Q * * * *
18th solution found...

* * Q * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
Q * * * * * * *
* * * Q * * * *
* * * * * * * Q
* * * * Q * * *
19th solution found...

* * Q * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
* * * * Q * * *
Q * * * * * * *
```

```
* * * * * * * Q
* * * Q * * * *
20th solution found...

* * Q * * * * *
* * * * * Q * *
* * * Q * * * *
Q * * * * * * *
* * * * * * * Q
* * * * Q * * *
* * * * * * Q *
* Q * * * * * *
21st solution found...

* * Q * * * * *
* * * * * Q * *
* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
22nd solution found...

* * Q * * * * *
* * * * * Q * *
* * * * * * * Q
Q * * * * * * *
* * * Q * * * *
* * * * * * Q *
* * * * Q * * *
* Q * * * * * *
23rd solution found...

* * Q * * * * *
* * * * * Q * *
* * * * * * * Q
Q * * * * * * *
* * * * Q * * *
* * * * * * Q *
* Q * * * * * *
* * * Q * * * *
24th solution found...

* * Q * * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
25th solution found...

* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * * * Q
* * * * Q * * *
Q * * * * * * *
* * * Q * * * *
* * * * * Q * *
26th solution found...

* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
* * * Q * * * *
Q * * * * * * *
* * * * Q * * *
27th solution found...

* * Q * * * * *
* * * * * * * Q
* * * Q * * * *
* * * * * * Q *
Q * * * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * Q * * *
```

```
28th solution found...

* * * Q * * * *
Q * * * * * * *
* * * * Q * * *
* * * * * * * Q
* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * Q * *
29th solution found...

* * * Q * * * *
Q * * * * * * *
* * * * Q * * *
* * * * * * * Q
* * * * * Q * *
* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
30th solution found...

* * * Q * * * *
* Q * * * * * *
* * * * Q * * *
* * * * * * * Q
* * * * * Q * *
Q * * * * * * *
* * Q * * * * *
* * * * * * Q *
31st solution found...

* * * Q * * * *
* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * Q * *
* * * * * * * Q
Q * * * * * * *
* * * * Q * * *
32nd solution found...
```

```

* * * Q * * * *
* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * Q * *
* * * * * * * Q
* * * * Q * * *
Q * * * * * * *
33rd solution found...

* * * Q * * * *
* Q * * * * * *
* * * * * * Q *
* * * * Q * * *
Q * * * * * * *
* * * * * * * Q
* * * * * Q * *
* * Q * * * * *
34th solution found...

* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * * Q * *
35th solution found...

* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
Q * * * * * * *
* * Q * * * * *
* * * * Q * * *
* * * * * * Q *
36th solution found...

```

```
* * * Q * * * *
* * * * * Q * *
Q * * * * * * *
* * * * Q * * *
* Q * * * * * *
* * * * * * * Q
* * Q * * * * *
* * * * * * Q *
37th solution found...

* * * Q * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * Q * * *
38th solution found...

* * * Q * * * *
* * * * * Q * *
* * * * * * * Q
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
* Q * * * * * *
39th solution found...

* * * Q * * * *
* * * * * * Q *
Q * * * * * * *
* * * * * * * Q
* * * * Q * * *
* Q * * * * * *
* * * * * Q * *
* * Q * * * * *
40th solution found...

* * * Q * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * * * Q
* Q * * * * * *
* * * * Q * * *
Q * * * * * * *
* * * * * Q * *
41st solution found...

* * * Q * * * *
* * * * * * Q *
* * * * Q * * *
* Q * * * * * *
* * * * * Q * *
Q * * * * * * *
* * Q * * * * *
* * * * * * * Q
42nd solution found...

* * * Q * * * *
* * * * * * Q *
* * * * Q * * *
* * Q * * * * *
Q * * * * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
43rd solution found...

* * * Q * * * *
* * * * * * * Q
Q * * * * * * *
* * Q * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
* * * * Q * * *
44th solution found...

* * * Q * * * *
* * * * * * * Q
```

```
Q * * * * * * *
* * * * Q * * *
* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
* * Q * * * * *
45th solution found...

* * * Q * * * *
* * * * * * * Q
* * * * Q * * *
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
46th solution found...

* * * * Q * * *
Q * * * * * * *
* * * Q * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
47th solution found...

* * * * Q * * *
Q * * * * * * *
* * * * * * * Q
* * * Q * * * *
* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * Q * *
48th solution found...

* * * * Q * * *
Q * * * * * * *
* * * * * * * Q
* * * * * Q * *
* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
* * * Q * * * *
49th solution found...

* * * * Q * * *
* Q * * * * * *
* * * Q * * * *
* * * * * Q * *
* * * * * * * Q
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
50th solution found...

* * * * Q * * *
* Q * * * * * *
* * * Q * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * * * Q
* * * * * Q * *
Q * * * * * * *
51st solution found...

* * * * Q * * *
* Q * * * * * *
* * * * * Q * *
Q * * * * * * *
* * * * * * Q *
* * * Q * * * *
* * * * * * * Q
* * Q * * * * *
52nd solution found...

* * * * Q * * *
* Q * * * * * *
* * * * * * * Q
Q * * * * * * *
```

```
* * * Q * * * *
* * * * * * Q *
* * Q * * * * *
* * * * * Q * *
53rd solution found...

* * * * Q * * *
* * Q * * * * *
Q * * * * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
* * * * * * Q *
54th solution found...

* * * * Q * * *
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
* * * Q * * * *
55th solution found...

* * * * Q * * *
* * Q * * * * *
* * * * * * * Q
* * * Q * * * *
* * * * * * Q *
Q * * * * * * *
* * * * * Q * *
* Q * * * * * *
56th solution found...

* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * * * * Q
* * * * * Q * *
* * * Q * * * *
* Q * * * * * *
57th solution found...

* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
* * Q * * * * *
58th solution found...

* * * * Q * * *
* * * * * * Q *
* Q * * * * * *
* * * Q * * * *
* * * * * * * Q
Q * * * * * * *
* * Q * * * * *
* * * * * Q * *
59th solution found...

* * * * Q * * *
* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
* * Q * * * * *
Q * * * * * * *
* * * Q * * * *
* * * * * * * Q
60th solution found...

* * * * Q * * *
* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
* * Q * * * * *
Q * * * * * * *
```

```
* * * * * * * Q
* * * Q * * * *
61st solution found...

* * * * Q * * *
* * * * * * Q *
* * * Q * * * *
Q * * * * * * *
* * Q * * * * *
* * * * * * * Q
* * * * * Q * *
* Q * * * * * *
62nd solution found...

* * * * Q * * *
* * * * * * * Q
* * * Q * * * *
Q * * * * * * *
* * Q * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
63rd solution found...

* * * * Q * * *
* * * * * * * Q
* * * Q * * * *
Q * * * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
* * Q * * * * *
64th solution found...

* * * * * Q * *
Q * * * * * * *
* * * * Q * * *
* Q * * * * * *
* * * * * * * Q
* * Q * * * * *
* * * * * * Q *
* * * Q * * * *
65th solution found...

* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * Q * * *
* * * * * * * Q
* * * Q * * * *
66th solution found...

* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
Q * * * * * * *
* * * Q * * * *
* * * * * * * Q
* * * * Q * * *
* * Q * * * * *
67th solution found...

* * * * * Q * *
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
68th solution found...

* * * * * Q * *
* * Q * * * * *
Q * * * * * * *
* * * * * * * Q
* * * Q * * * *
* Q * * * * * *
* * * * * * Q *
* * * * Q * * *
```

```
69th solution found...

* * * * * Q * *
* * Q * * * * *
Q * * * * * * *
* * * * * * * Q
* * * * Q * * *
* Q * * * * * *
* * * Q * * * *
* * * * * * Q *
70th solution found...

* * * * * Q * *
* * Q * * * * *
* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
71st solution found...

* * * * * Q * *
* * Q * * * * *
* * * * Q * * *
* * * * * * * Q
Q * * * * * * *
* * * Q * * * *
* Q * * * * * *
* * * * * * Q *
72nd solution found...

* * * * * Q * *
* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
* * * Q * * * *
* * * * * * * Q
Q * * * * * * *
* * * * Q * * *
73rd solution found...
```

```

* * * * * Q * *
* * Q * * * * *
* * * * * * Q *
* Q * * * * * *
* * * * * * * Q
* * * * Q * * *
Q * * * * * * *
* * * Q * * * *
74th solution found...

* * * * * Q * *
* * Q * * * * *
* * * * * * Q *
* * * Q * * * *
Q * * * * * * *
* * * * * * * Q
* Q * * * * * *
* * * * Q * * *
75th solution found...

* * * * * Q * *
* * * Q * * * *
Q * * * * * * *
* * * * Q * * *
* * * * * * * Q
* Q * * * * * *
* * * * * * Q *
* * Q * * * * *
76th solution found...

* * * * * Q * *
* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * Q * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
77th solution found...

```

```
* * * * * Q * *
* * * Q * * * *
* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * Q * * *
* Q * * * * * *
* * * * * * * Q
78th solution found...

* * * * * Q * *
* * * Q * * * *
* * * * * * Q *
Q * * * * * * *
* * * * * * * Q
* Q * * * * * *
* * * * Q * * *
* * Q * * * * *
79th solution found...

* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
* * Q * * * * *
80th solution found...

* * * * * * Q *
Q * * * * * * *
* * Q * * * * *
* * * * * * * Q
* * * * * Q * *
* * * Q * * * *
* Q * * * * * *
* * * * Q * * *
81st solution found...

* * * * * * Q *
* Q * * * * * *
* * * Q * * * *
Q * * * * * * *
* * * * * * * Q
* * * * Q * * *
* * Q * * * * *
* * * * * Q * *
82nd solution found...

* * * * * * Q *
* Q * * * * * *
* * * * * Q * *
* * Q * * * * *
Q * * * * * * *
* * * Q * * * *
* * * * * * * Q
* * * * Q * * *
83rd solution found...

* * * * * * Q *
* * Q * * * * *
Q * * * * * * *
* * * * * Q * *
* * * * * * * Q
* * * * Q * * *
* Q * * * * * *
* * * Q * * * *
84th solution found...

* * * * * * Q *
* * Q * * * * *
* * * * * * * Q
* Q * * * * * *
* * * * Q * * *
Q * * * * * * *
* * * * * Q * *
* * * Q * * * *
85th solution found...

* * * * * * Q *
* * * Q * * * *
* Q * * * * * *
* * * * Q * * *
* * * * * * * Q
Q * * * * * * *
* * Q * * * * *
* * * * * Q * *
86th solution found...

* * * * * * Q *
* * * Q * * * *
* Q * * * * * *
* * * * * * * Q
* * * * * Q * *
Q * * * * * * *
* * Q * * * * *
* * * * Q * * *
87th solution found...

* * * * * * Q *
* * * * Q * * *
* * Q * * * * *
Q * * * * * * *
* * * * * Q * *
* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
88th solution found...

* * * * * * * Q
* Q * * * * * *
* * * Q * * * *
Q * * * * * * *
* * * * * * Q *
* * * * Q * * *
* * Q * * * * *
* * * * * Q * *
89th solution found...

* * * * * * * Q
* Q * * * * * *
* * * * Q * * *
* * Q * * * * *
Q * * * * * * *
* * * * * * Q *
* * * Q * * * *
* * * * * Q * *
90th solution found...

* * * * * * * Q
* * Q * * * * *
Q * * * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * Q * * *
* * * * * * Q *
* * * Q * * * *
91st solution found...

* * * * * * * Q
* * * Q * * * *
Q * * * * * * *
* * Q * * * * *
* * * * * Q * *
* Q * * * * * *
* * * * * * Q *
* * * * Q * * *
92nd solution found...
```