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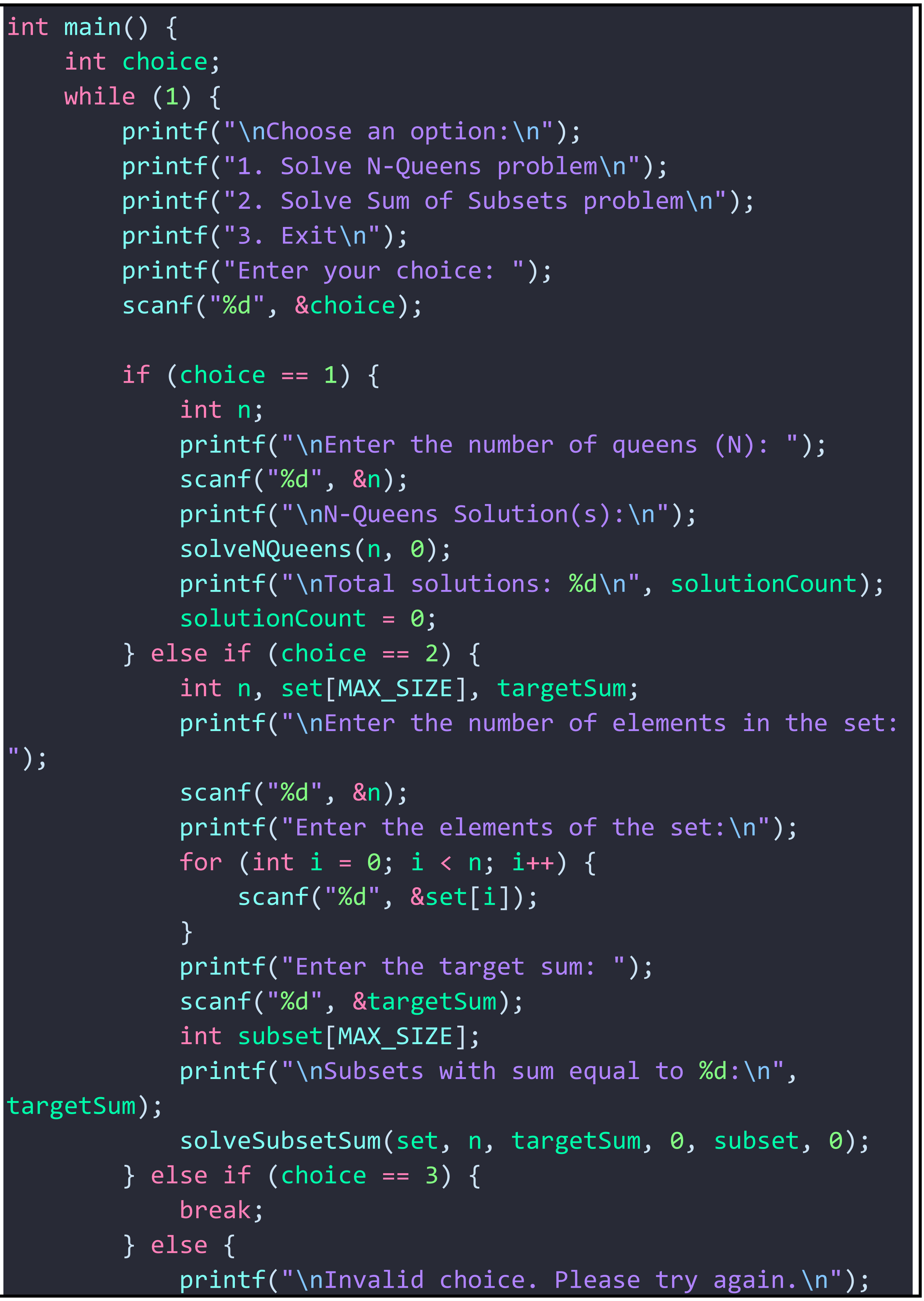
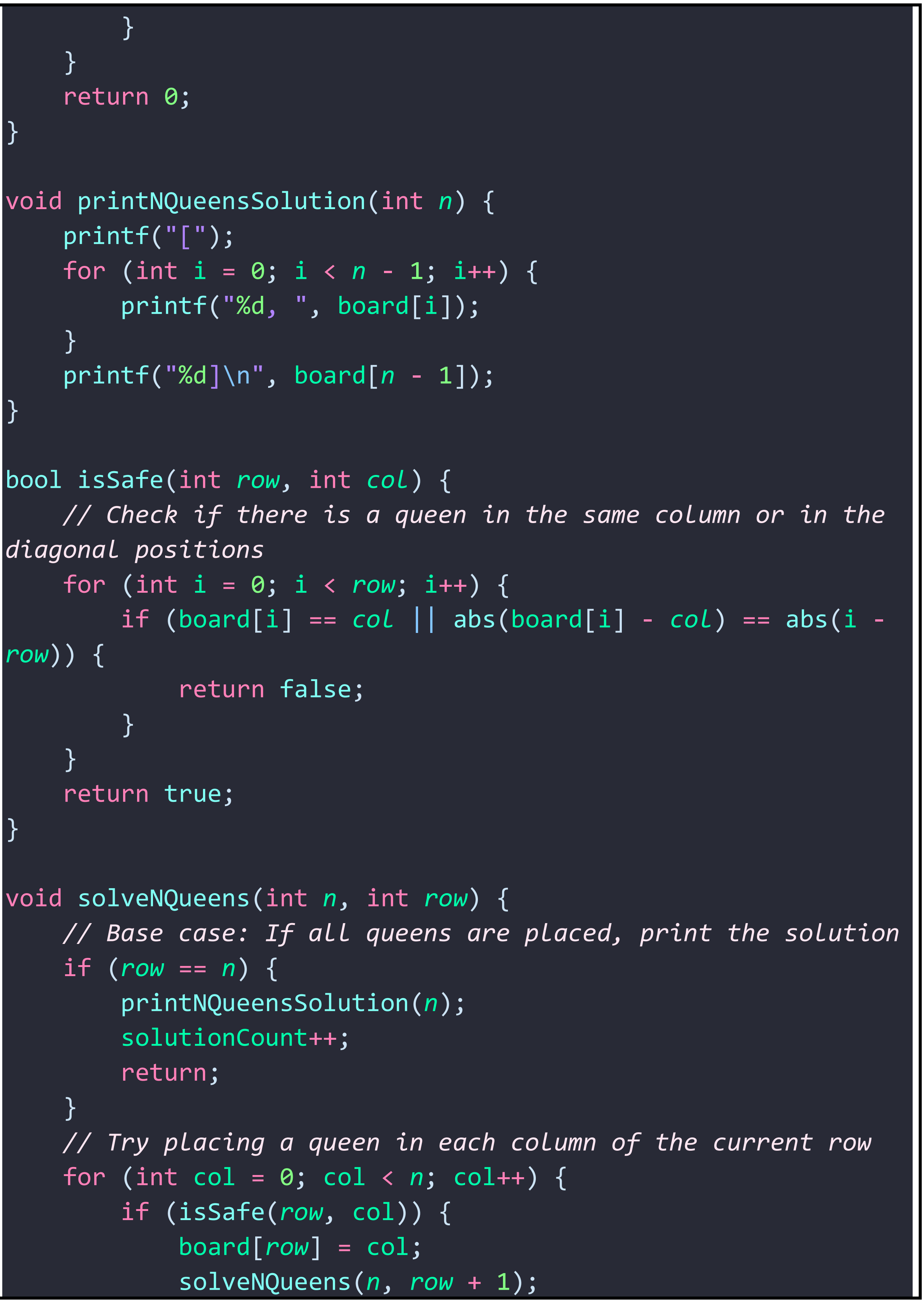
Subject	Design and Analysis of Algorithms (DAA)
Experiment No.	7
Aim	To implement Backtracking (N-Queen's problem and sum of subsets).

Code:

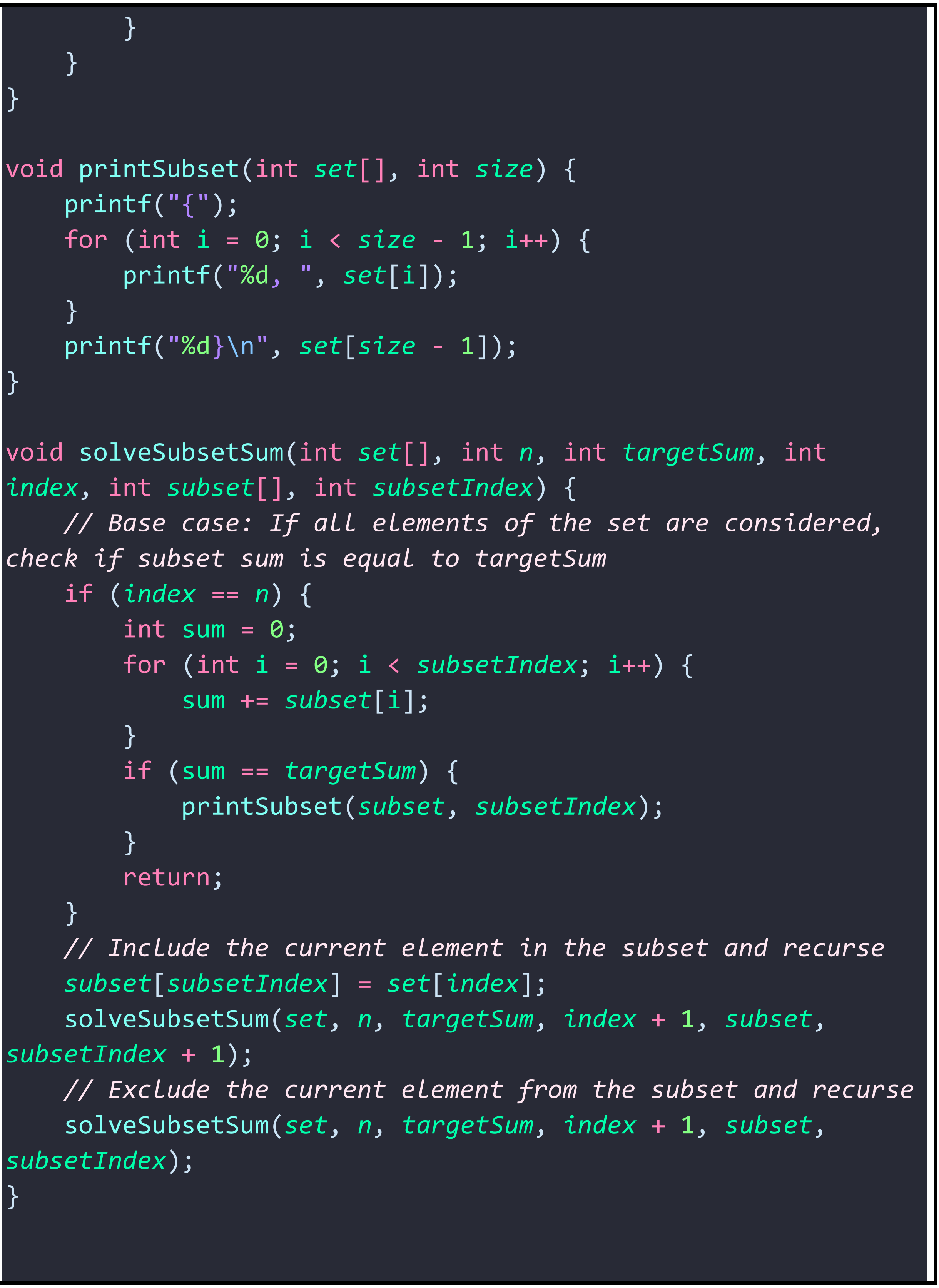
```
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>

#define MAX_SIZE 20

int board[MAX_SIZE]; // Array to store the positions of queens
in N-Queens problem
int solutionCount = 0; // Counter to keep track of the number
of solutions found

// Function to print a solution to the N-Queens problem
void printNQueensSolution(int n);

// Function to check if placing a queen at position (row, col)
is safe
bool isSafe(int row, int col);

// Recursive function to solve the N-Queens problem
void solveNQueens(int n, int row);

// Function to print a subset of a set
void printSubset(int set[], int size);

// Recursive function to solve the Sum of Subsets problem
void solveSubsetSum(int set[], int n, int targetSum, int
index, int subset[], int subsetIndex);
```



```
int main() {
    int choice;
    while (1) {
        printf("\nChoose an option:\n");
        printf("1. Solve N-Queens problem\n");
        printf("2. Solve Sum of Subsets problem\n");
        printf("3. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        if (choice == 1) {
            int n;
            printf("\nEnter the number of queens (N): ");
            scanf("%d", &n);
            printf("\nN-Queens Solution(s):\n");
            solveNQueens(n, 0);
            printf("\nTotal solutions: %d\n", solutionCount);
            solutionCount = 0;
        } else if (choice == 2) {
            int n, set[MAX_SIZE], targetSum;
            printf("\nEnter the number of elements in the set:
");

            scanf("%d", &n);
            printf("Enter the elements of the set:\n");
            for (int i = 0; i < n; i++) {
                scanf("%d", &set[i]);
            }
            printf("Enter the target sum: ");
            scanf("%d", &targetSum);
            int subset[MAX_SIZE];
            printf("\nSubsets with sum equal to %d:\n",
targetSum);
            solveSubsetSum(set, n, targetSum, 0, subset, 0);
        } else if (choice == 3) {
            break;
        } else {
            printf("\nInvalid choice. Please try again.\n");
```

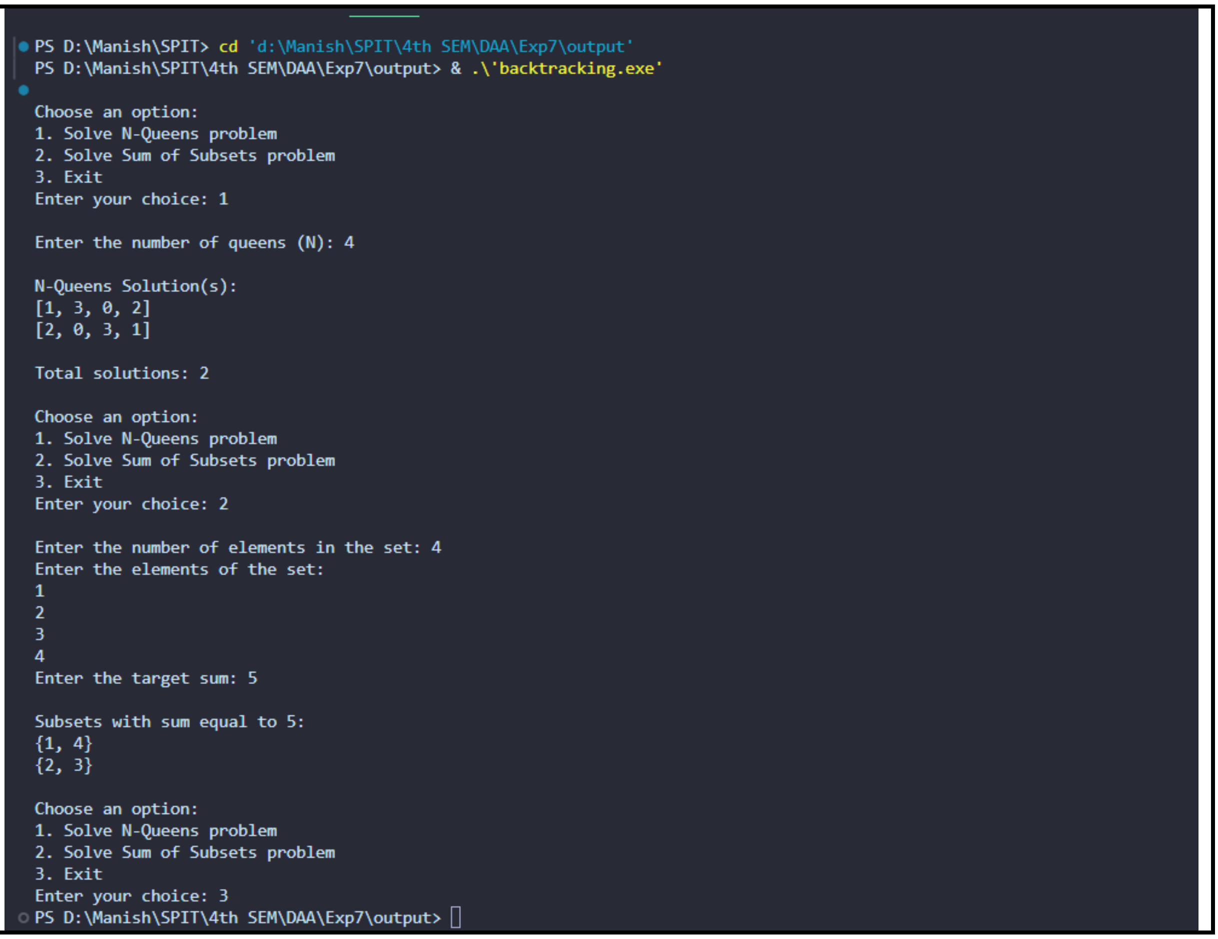


```
        }
    }
    return 0;
}

void printNQueensSolution(int n) {
    printf("[");
    for (int i = 0; i < n - 1; i++) {
        printf("%d, ", board[i]);
    }
    printf("%d]\n", board[n - 1]);
}

bool isSafe(int row, int col) {
    // Check if there is a queen in the same column or in the
diagonal positions
    for (int i = 0; i < row; i++) {
        if (board[i] == col || abs(board[i] - col) == abs(i -
row)) {
            return false;
        }
    }
    return true;
}

void solveNQueens(int n, int row) {
    // Base case: If all queens are placed, print the solution
    if (row == n) {
        printNQueensSolution(n);
        solutionCount++;
        return;
    }
    // Try placing a queen in each column of the current row
    for (int col = 0; col < n; col++) {
        if (isSafe(row, col)) {
            board[row] = col;
            solveNQueens(n, row + 1);
```



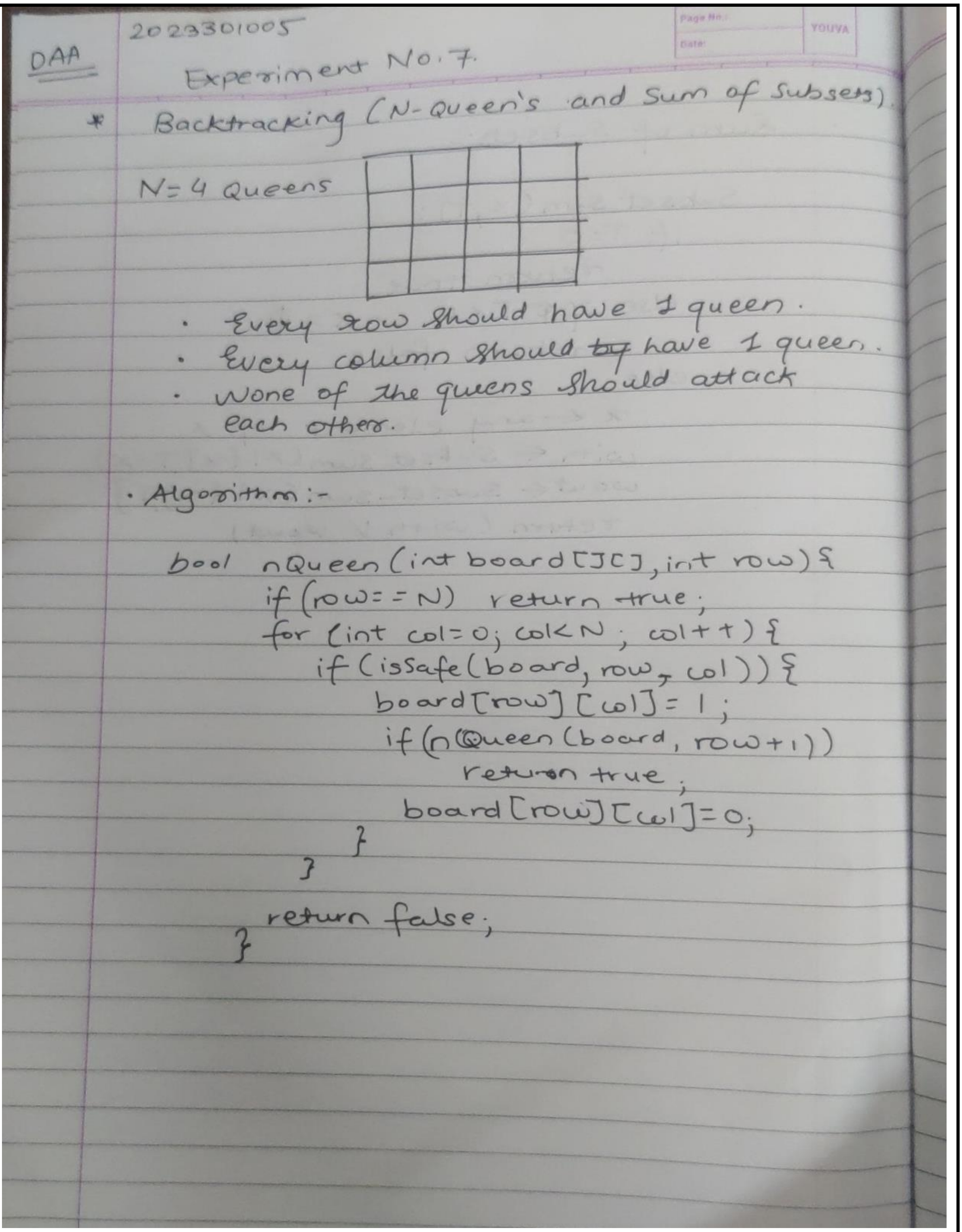
```
        }
    }
}

void printSubset(int set[], int size) {
    printf("{");
    for (int i = 0; i < size - 1; i++) {
        printf("%d, ", set[i]);
    }
    printf("%d}\n", set[size - 1]);
}

void solveSubsetSum(int set[], int n, int targetSum, int
index, int subset[], int subsetIndex) {
    // Base case: If all elements of the set are considered,
check if subset sum is equal to targetSum
    if (index == n) {
        int sum = 0;
        for (int i = 0; i < subsetIndex; i++) {
            sum += subset[i];
        }
        if (sum == targetSum) {
            printSubset(subset, subsetIndex);
        }
        return;
    }
    // Include the current element in the subset and recurse
    subset[subsetIndex] = set[index];
    solveSubsetSum(set, n, targetSum, index + 1, subset,
subsetIndex + 1);
    // Exclude the current element from the subset and recurse
    solveSubsetSum(set, n, targetSum, index + 1, subset,
subsetIndex);
}
```

Output



```
PS D:\Manish\SPIT> cd 'd:\Manish\SPIT\4th SEM\DAA\Exp7\output'
PS D:\Manish\SPIT\4th SEM\DAA\Exp7\output> & .\'backtracking.exe'

Choose an option:
1. Solve N-Queens problem
2. Solve Sum of Subsets problem
3. Exit
Enter your choice: 1

Enter the number of queens (N): 4

N-Queens Solution(s):
[1, 3, 0, 2]
[2, 0, 3, 1]

Total solutions: 2

Choose an option:
1. Solve N-Queens problem
2. Solve Sum of Subsets problem
3. Exit
Enter your choice: 2

Enter the number of elements in the set: 4
Enter the elements of the set:
1
2
3
4
Enter the target sum: 5

Subsets with sum equal to 5:
{1, 4}
{2, 3}

Choose an option:
1. Solve N-Queens problem
2. Solve Sum of Subsets problem
3. Exit
Enter your choice: 3
PS D:\Manish\SPIT\4th SEM\DAA\Exp7\output>
```

Pseudo Code



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DAA

Experiment No. 7.

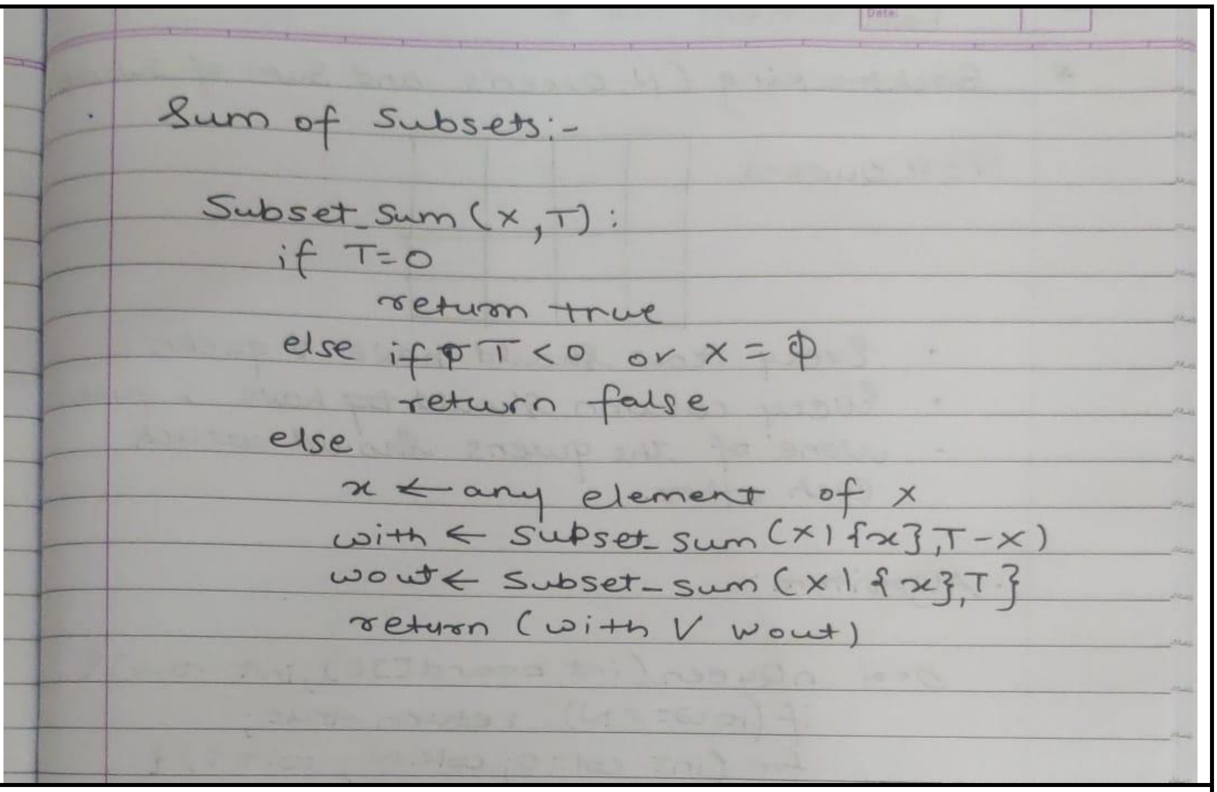
* Backtracking (N-Queen's and Sum of Subsets).

N=4 Queens

- Every row should have 1 queen.
- Every column should ~~by~~ have 1 queen.
- None of the queens should attack each other.

- Algorithm:-

```
bool nQueen(int board[][], int row){
    if(row==N) return true;
    for(int col=0; col<N; col++){
        if(isSafe(board, row, col)){
            board[row][col]=1;
            if(nQueen(board, row+1))
                return true;
            board[row][col]=0;
        }
    }
    return false;
}
```

	
	Sum of Subsets:-
	Subset_Sum(X,T):
	  if T=0
	    return true
	  else if φ T < 0 or X = Φ
	    return false
	  else
	    x ← any element of X
	    with ← Subset_sum(X \ {x}, T − x)
	    wout ← Subset_sum(X \ {x}, T}
	    return (with ∨ wout)

Conclusion	Hence, by completing this experiment I came to know about implementation of Backtracking (N-Queen's problem and sum of subsets).