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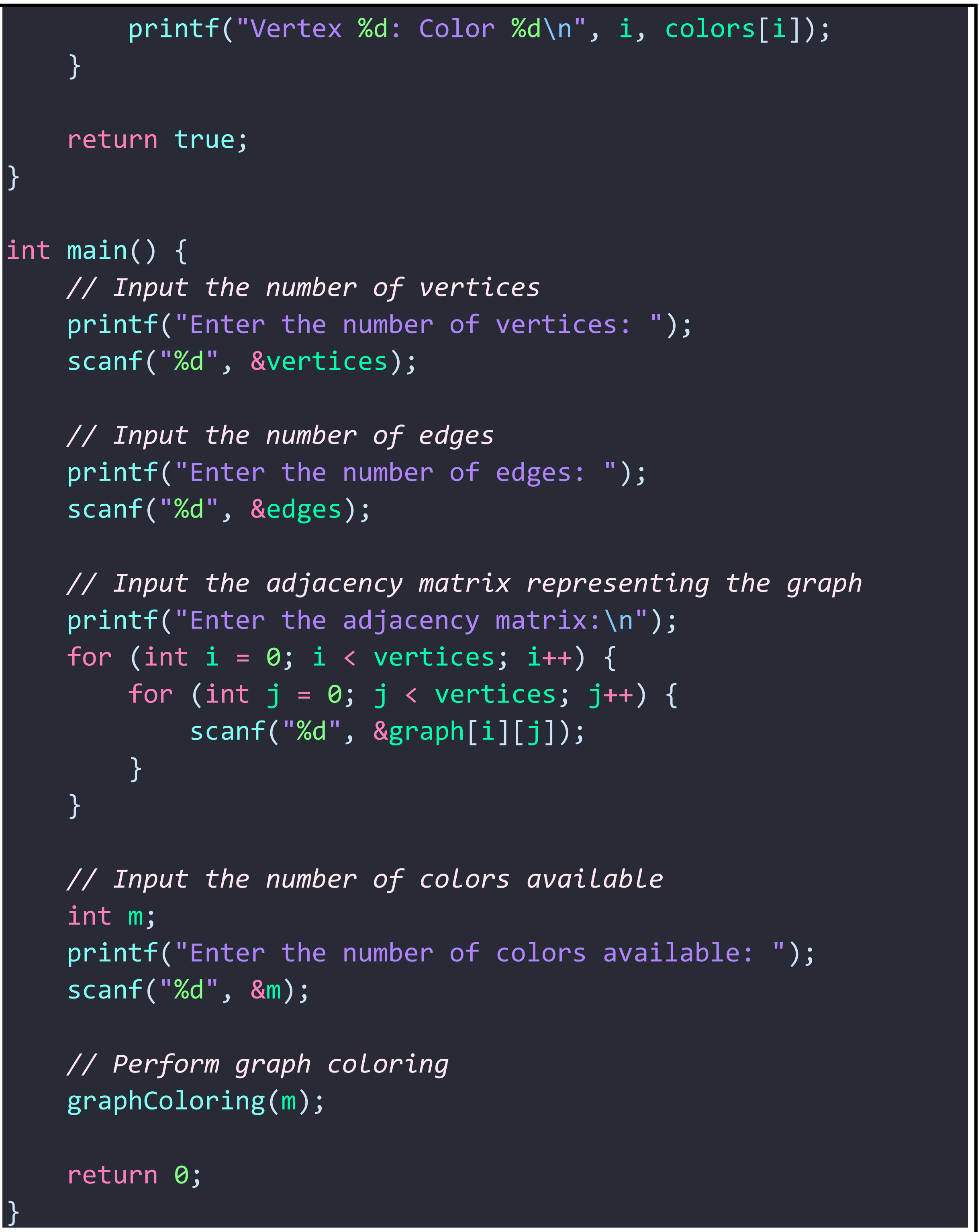
Subject	Design and Analysis of Algorithms (DAA)
Experiment No.	8
Aim	To implement Backtracking (Graph Coloring).

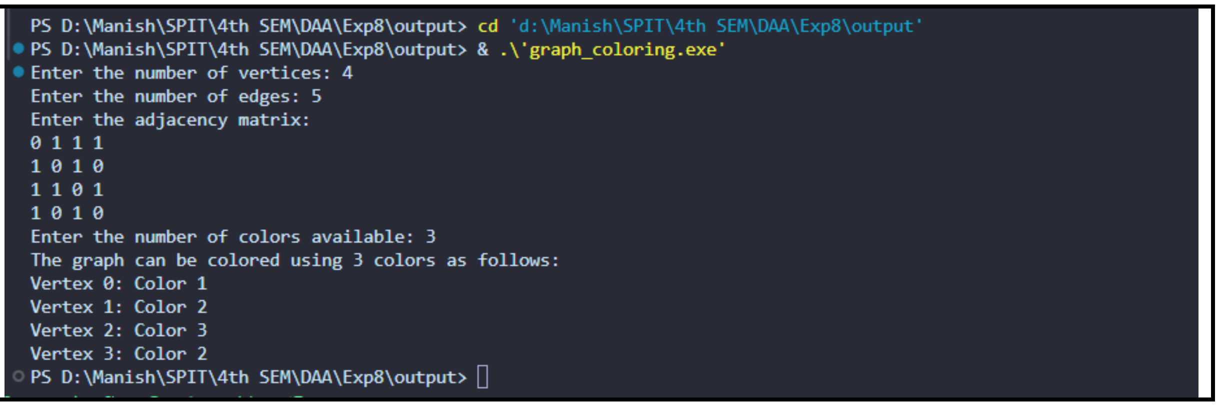
Code:

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

#define MAX_VERTICES 100

int vertices, edges;
int graph[MAX_VERTICES][MAX_VERTICES];
int colors[MAX_VERTICES];

// Function to check if it's safe to assign color 'c' to vertex 'v'
bool isSafe(int v, int c) {
    for (int i = 0; i < vertices; i++) {
        // Check if there is an edge between 'v' and 'i' and if the color of 'i' is 'c'
        if (graph[v][i] && c == colors[i]) {
            return false;  // If the condition is true, it's not safe to assign 'c' to 'v'
        }
    }
    return true;  // It's safe to assign 'c' to 'v'
}

// Recursive function to perform graph coloring using backtracking
bool graphColoringUtil(int v, int m) {
    // If all vertices are assigned colors, return true
    if (v == vertices) {
        return true;
    }

    // Try assigning colors to 'v'
    for (int c = 1; c <= m; c++) {
        // Check if it's safe to assign color 'c' to vertex
'v'
        if (isSafe(v, c)) {
            colors[v] = c;  // Assign color 'c' to vertex 'v'

            // Recur to assign colors to the rest of the
vertices
            if (graphColoringUtil(v + 1, m)) {
                return true;  // If coloring is possible,
return true
            }

            colors[v] = 0;  // Backtrack: Remove color
assignment if coloring is not possible
        }
    }

    return false;  // If no color can be assigned to this
vertex, return false
}

// Main function to perform graph coloring
bool graphColoring(int m) {
    // Call the utility function with vertex 0 and m colors
    if (!graphColoringUtil(0, m)) {
        printf("No solution exists\n");
        return false;
    }

    printf("The graph can be colored using %d colors as
follows:\n", m);
    for (int i = 0; i < vertices; i++) {
```



```
        printf("Vertex %d: Color %d\n", i, colors[i]);
    }

    return true;
}

int main() {
    // Input the number of vertices
    printf("Enter the number of vertices: ");
    scanf("%d", &vertices);

    // Input the number of edges
    printf("Enter the number of edges: ");
    scanf("%d", &edges);

    // Input the adjacency matrix representing the graph
    printf("Enter the adjacency matrix:\n");
    for (int i = 0; i < vertices; i++) {
        for (int j = 0; j < vertices; j++) {
            scanf("%d", &graph[i][j]);
        }
    }

    // Input the number of colors available
    int m;
    printf("Enter the number of colors available: ");
    scanf("%d", &m);

    // Perform graph coloring
    graphColoring(m);

    return 0;
}
```

Output



```
PS D:\Manish\SPIT\4th SEM\DAA\Exp8\output> cd 'd:\Manish\SPIT\4th SEM\DAA\Exp8\output'
PS D:\Manish\SPIT\4th SEM\DAA\Exp8\output> & .\'graph_coloring.exe'
Enter the number of vertices: 4
Enter the number of edges: 5
Enter the adjacency matrix:
0 1 1 1
1 0 1 0
1 1 0 1
1 0 1 0
Enter the number of colors available: 3
The graph can be colored using 3 colors as follows:
Vertex 0: Color 1
Vertex 1: Color 2
Vertex 2: Color 3
Vertex 3: Color 2
PS D:\Manish\SPIT\4th SEM\DAA\Exp8\output> 
```

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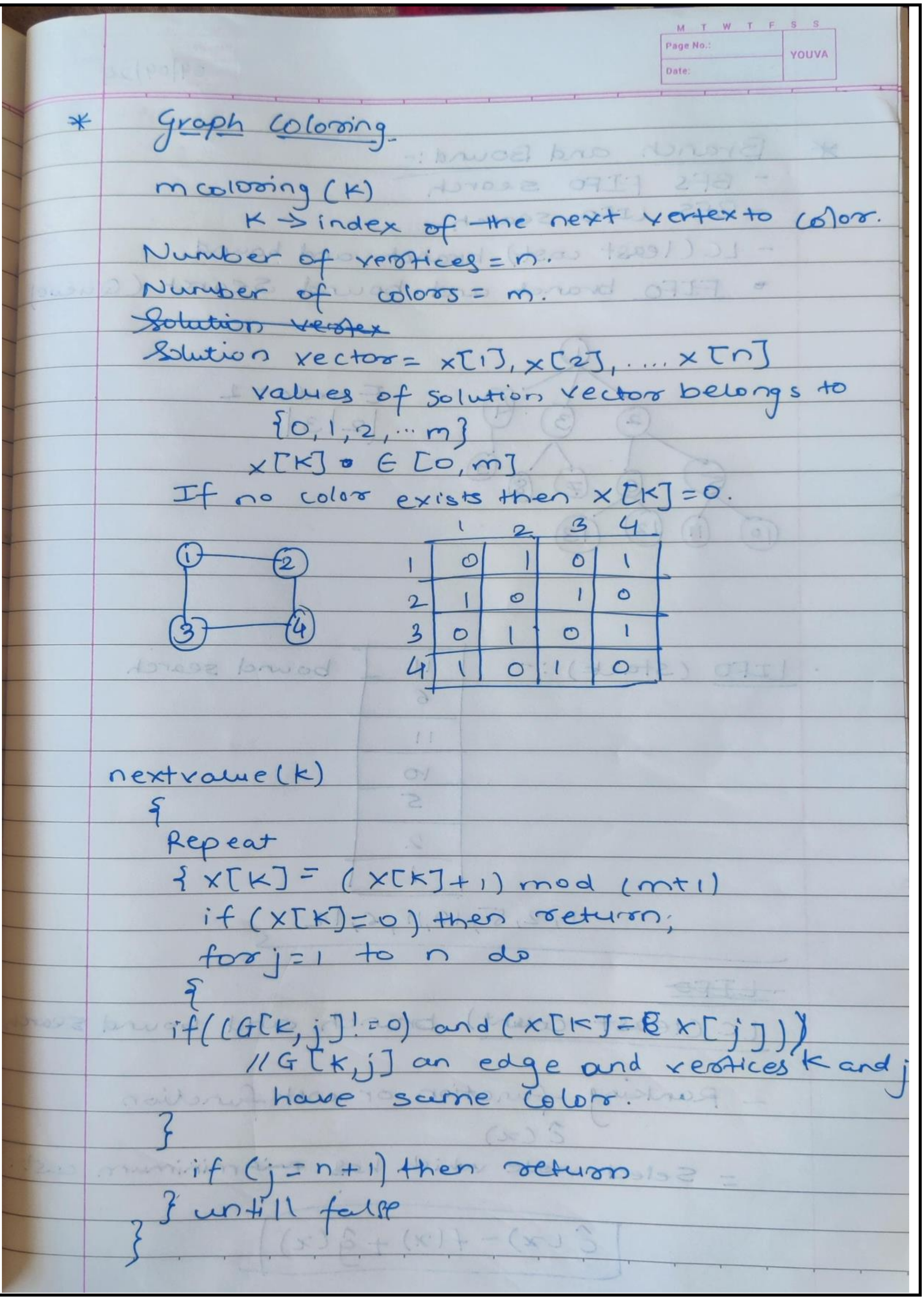
Pseudo Code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* Graph coloring

mcoloring (K)
K -> index of the next vertex to color.
Number of vertices = n.
Number of colors = m.
~~Solution vertex~~
Solution vector = x[1], x[2], ... x[n]
values of solution vector belongs to {0, 1, 2, ... m}
x[K] ∈ [0, m]
If no color exists then x[K] = 0.

	1	2	3	4
1	0	1	0	1
2	1	0	1	0
3	0	1	0	1
4	1	0	1	0

```
nextvalue(K)
{
  Repeat
  { x[K] = (x[K]+1) mod (m+1)
    if (x[K]=0) then return;
    for j=1 to n do
    {
    if((G[k,j]!=0) and (x[K]=B x[j]))
        // G[k,j] an edge and vertices k and j
           have same color.
    }
    if (j=n+1) then return
  } untill false
}
```

Conclusion	Hence, by completing this experiment I came to know about implementation of Graph Coloring using Backtracking.