SUDOKU SOLVER

Project Report

Subject: IT-205 Discrete Structures

BACHELOR OF TECHNOLOGY IN

INFORMATION TECHNOLOGY

3rd Semester

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CANDIDATE'S DECLARATION

We Varun Kumar, Roll No – 2K19/IT/140 & Yashit Kumar, Roll No - 2K19/IT/149, students of B.Tech. (INFORMATION TECHNOLOGY), hereby declare that the project Dissertation titled "Sudoku Solver" which is submitted by us to the Department of INFORMATION TECHNOLOGY, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the 3rd semester of the Bachelor of Technology, is made by us. This work has not previously formed the basis for the award of any Degree, Diploma Associateship, Fellowship or other similar title or recognition.

Place: Delhi

Date: 22-11-2020

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CERTIFICATE

I hereby certify that the Project: "**Sudoku Solver**" which is submitted by Varun Kumar, Roll No – 2K19/IT/140 & Yashit Kumar, Roll No – 2K19/IT/149, INFORMATION TECHNOLOGY, Delhi Technological University, Delhi in fulfillment of the requirement for the 3rd semester of Bachelor of Technology, is record of the project work carried out by the students under my supervision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Place: Delhi

Date: 22-November-2020

Supervisor : Ms.Swati Sharda

(Assistant Professor)

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ACKNOWLEDGEMENT

We would like to convey our heartfelt thanks to our supervisor Ms.Swati Sharda for his ingenious ideas, tremendous help and cooperation.

We are extremely grateful to our friends who gave valuable suggestions and guidance for completion of our project. The cooperation and healthy criticism came handy and useful with them.

Finally we would like to thank all the above mentioned people once again.

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INTRODUCTION

The Sudoku puzzle has become a very popular puzzle.

The puzzle consists of a 9×9 grid in which some of the entries of the grid have a number from 1 to 9.

Filling the table with the numbers must follow these rules:--

→Numbers in rows are not repeated

→Numbers in columns are not repeated

→Numbers in 3 × 3 blocks are not repeated

→Order of the numbers when filling is not important

SAMPLE SUDOKU PUZZLE

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

SOLVED SUDOKU PUZZLE

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9

WHY SUDOKU ?

→Keeps your brain alive and active, a useful break from your usual routine.

→Develops some logical thinking and patterns.

→Helps in improving your patience and concentration.

→Improves sharpness and strategy while approaching and solving problems since you need to be accurate while putting digits and aware of the placement of other digits.

→Gives you a sense of accomplishment on completing the grid within few minutes.

→It is one of the simplest sports/games/activities to learn, enjoy, play/solve, and even teach.

DISCRETE CONCEPT USED

→ Graph Theory

→ Graph Coloring Algorithm

→ BFS

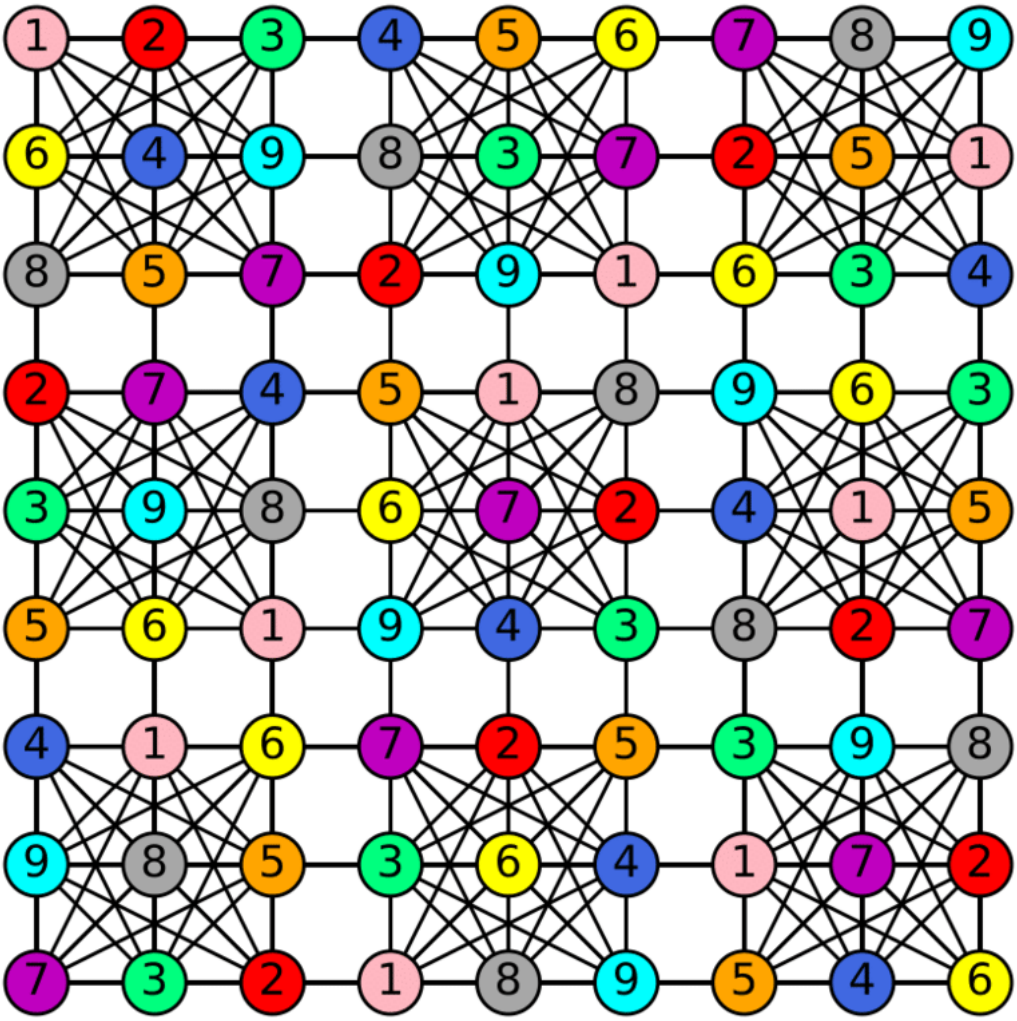
CONVERTING SUDOKU TO COLORING PROBLEM

Sudoku Graph is a graph with 81 vertices (or nodes) . Each cell in the Sudoku can be seen as a node of the graph. Each node (or cell) has an edge to every other node (cell) in its respective column, row, and 3 x 3 grid.

Sudoku Graph is an Undirected Graph .

A graph coloring of the Sudoku graph using this number of colors (the minimum possible number of colors for this graph) can be interpreted as a solution to the puzzle.

Graph will look like this : -



This is a simplified image. As there are a lot of edges that are hidden. Each vertex has an edge from it to every vertex in it’s column and row, but in this image, all of these edges are lying on top of each other.

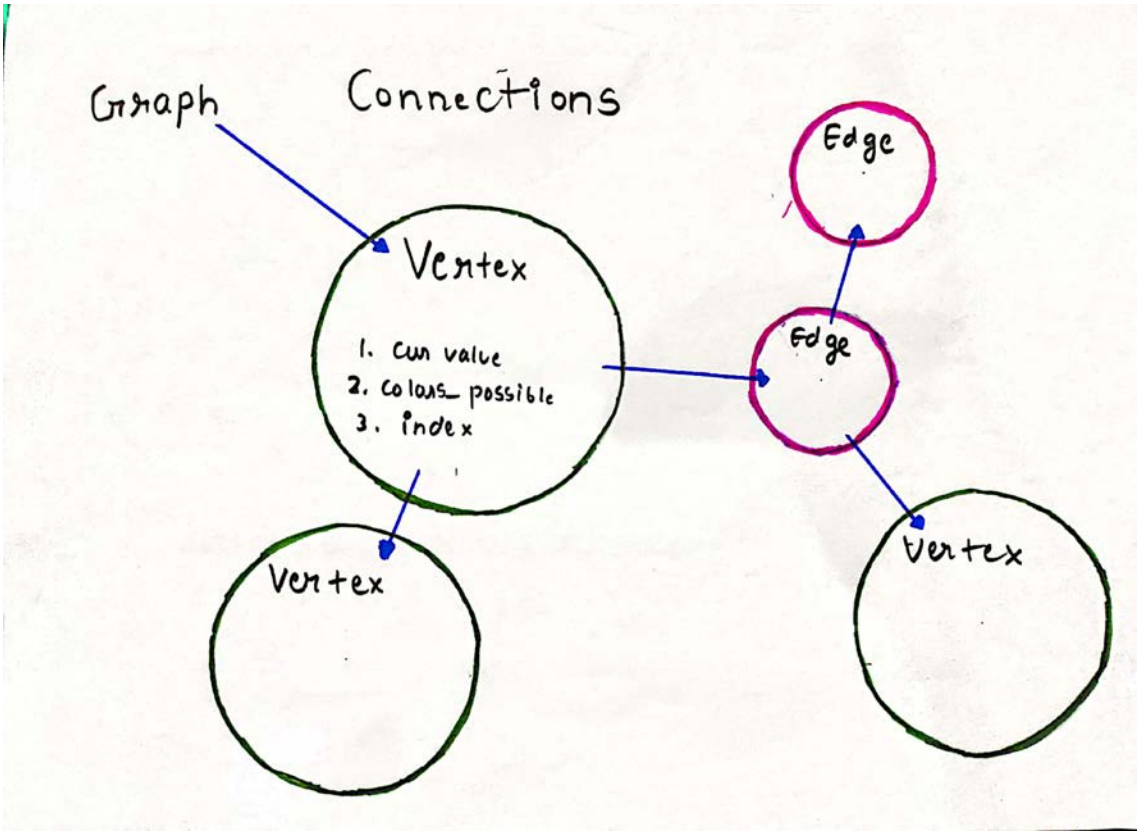
So we can say that Sudoku can be viewed as Graph and thus can be solved by Graph Coloring with a Chromatic Number, G = 9.

It is no different to using 9 different colors to color the vertices in a way that no two adjacent vertices have the same color.

ALGORITHM

1. The idea is to Create Sudoku Graph with Vertices and then Connecting them.

2. The connection should be like all the vertices in the same row and column should be connected . And also the vertices in 3*3 Sub grid should be connected .



4. After connecting vertices by edges , The idea is to assign colors one by one to different vertices, starting from last vertex .

5. Before assigning a color , check for safety by considering already assigned colors to the adjacent vertices .

6. Check if the adjacent vertices have the same color or not by traversing the edges connected to graph and reaching the vertex and checking the color of vertex i.e BFS .

7. If the vertex we reached by traversing has the same color as of the initial vertex then we have to assign different color to the initial vertex .

8. And if we are not able to assign any color to current vertex then we have to backtrack and change the color of previous vertex.

9. If we able to assign color to the vertex i.e no same color in the connected vertices then we will move to next vertex in the row.

10. If no assignment of color is possible then in that case we are not able to color Sudoku graph and hence puzzle is unsolvable.

FEATURES

1 . User can play the game and It can be played in Easy , Medium and Hard mode

2. User can solve its manually entered puzzle .

3. User can get the hint while solving the puzzle

4. User can erase its move.

5. User can unlock the row or column while playing.

6. User can get the complete solution if he wants.

WORKING DEMO

MAIN MENU

```
==================================================
###############::SUDOKU SOLVER !!!::############
==================================================


--------------------------------------------------
|       1. PLAY THE GAME                         |
--------------------------------------------------

--------------------------------------------------
|       2. ENTER PUZZLE TO SOLVE                 |
--------------------------------------------------

--------------------------------------------------
|       3. INSTRUCTIONS                          |
--------------------------------------------------

--------------------------------------------------
|       4. EXIT                                  |
--------------------------------------------------

Enter your choice:->
```

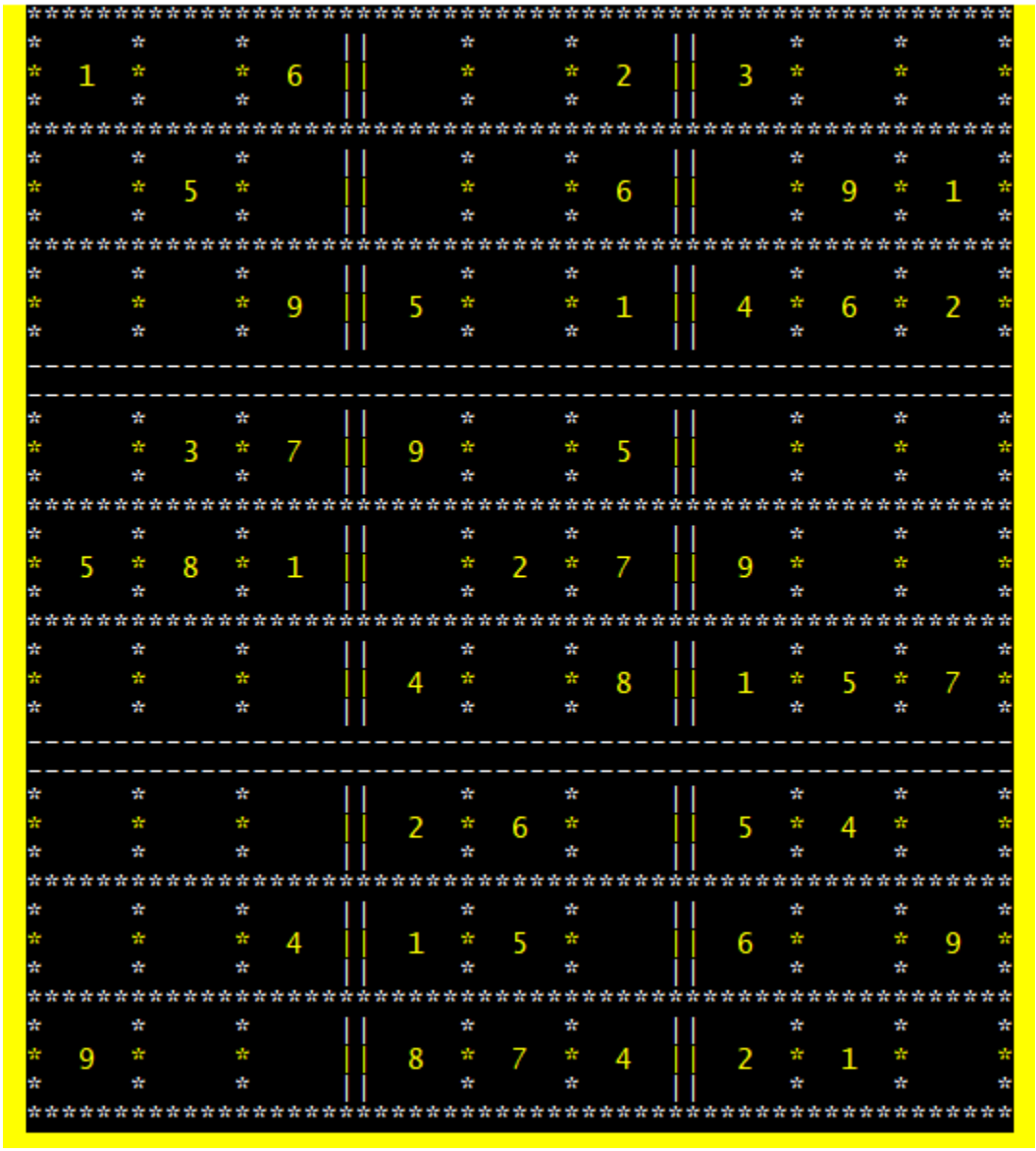
PLAY GAME MENU

```
================================================
################::PLAY  GAME !!!::#############
================================================

------------------------------------------------
|       1. EASY                                |
------------------------------------------------

------------------------------------------------
|       2. MEDIUM                              |
------------------------------------------------

------------------------------------------------
|       3. HARD                                |
------------------------------------------------

------------------------------------------------
|       4. BACK TO MAIN MENU                   |
------------------------------------------------

Enter your choice:-> _
```

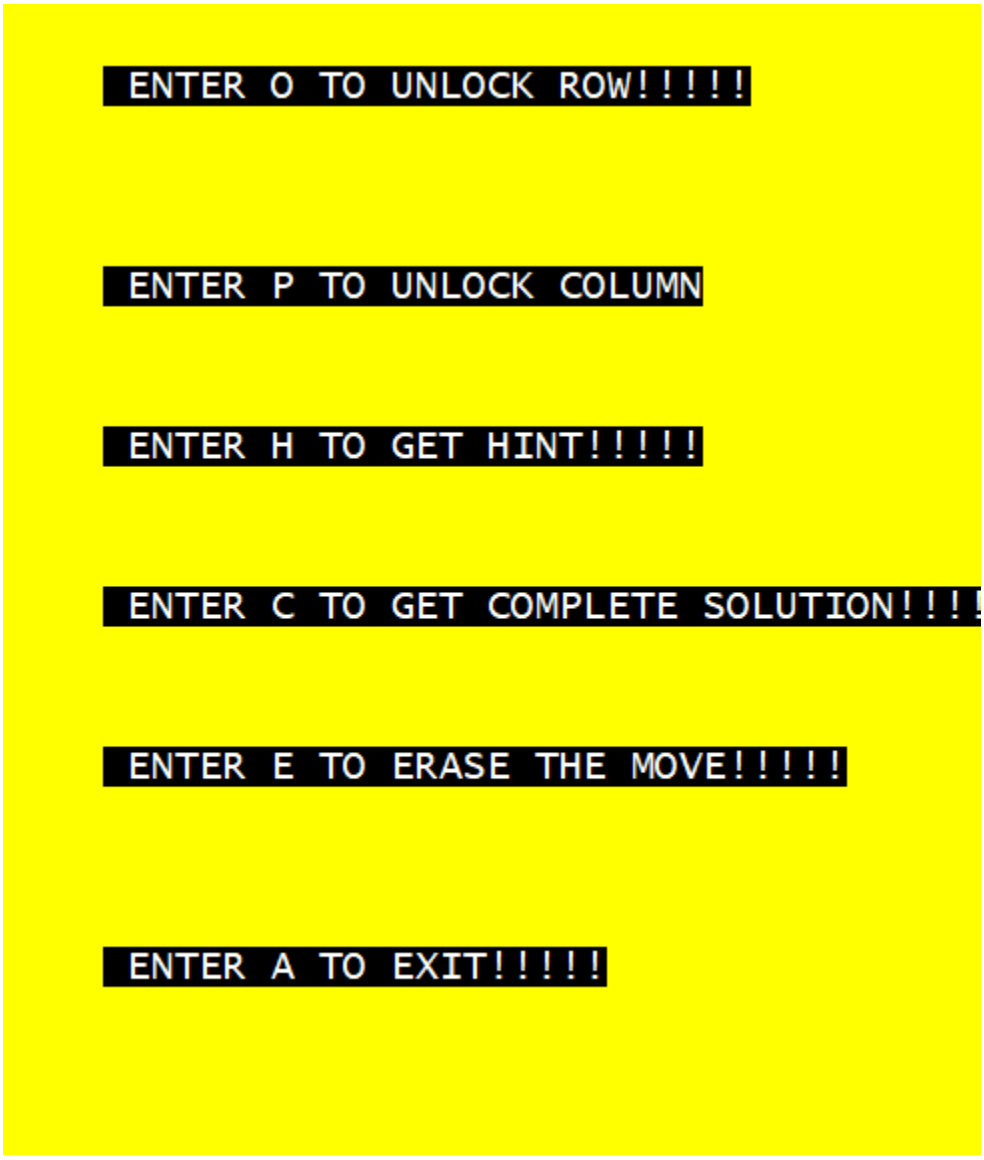
ENTER PUZZLE MENU

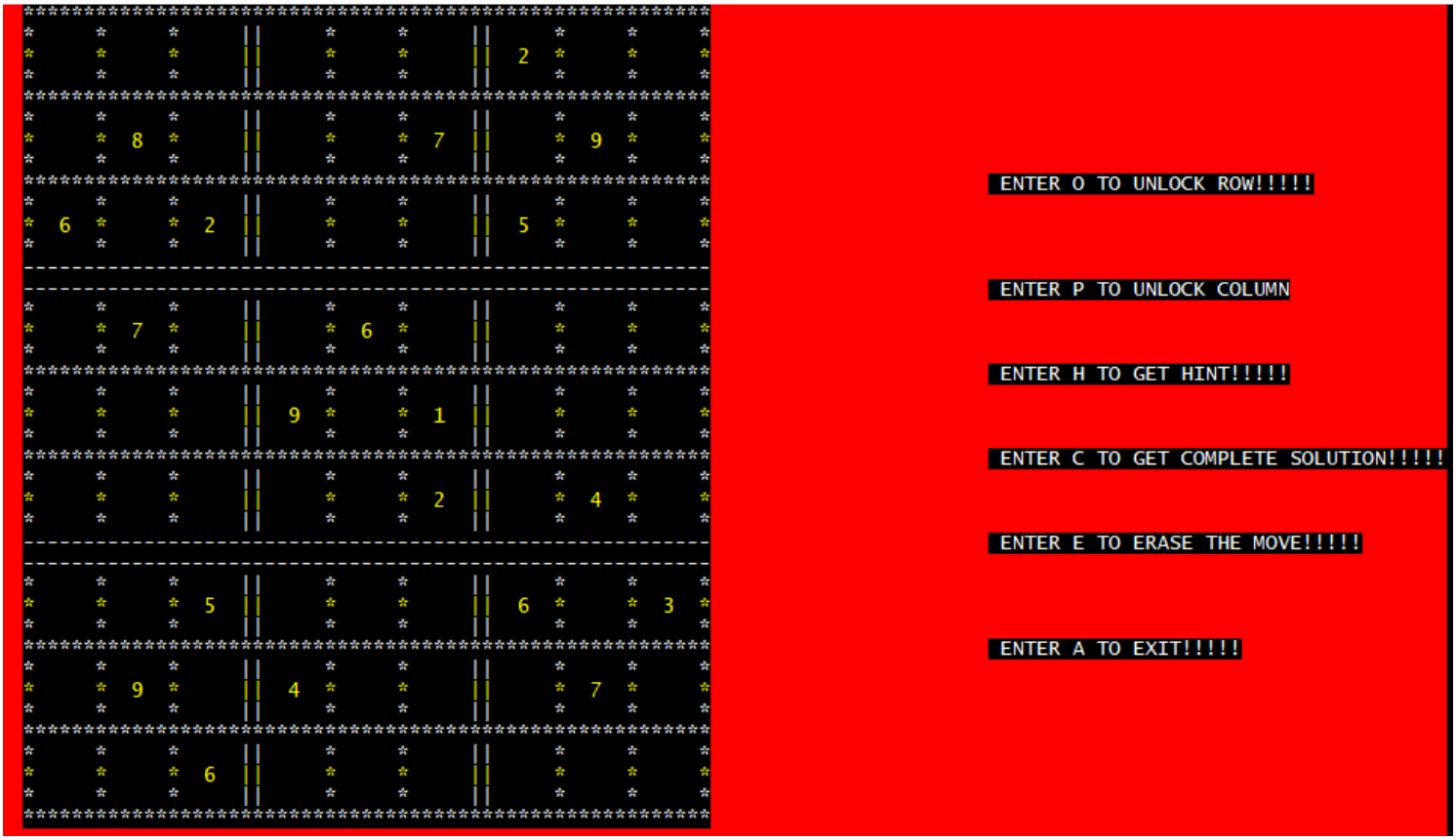
```
 ================================================
 ################::PUZZLE !!!::####################
 ================================================


-------------------------------------------------
|       1. ENTER PUZZLE BY ROW COLUMN            |
-------------------------------------------------

-------------------------------------------------
|       2. ENTER PUZZLE IN ONE LINE              |
-------------------------------------------------

-------------------------------------------------
|       3. BACK TO MAIN MENU                     |
-------------------------------------------------

Enter your choice:->
```

USER CAN SOLVE EASY , MEDIUM AND HARD PUZZLES

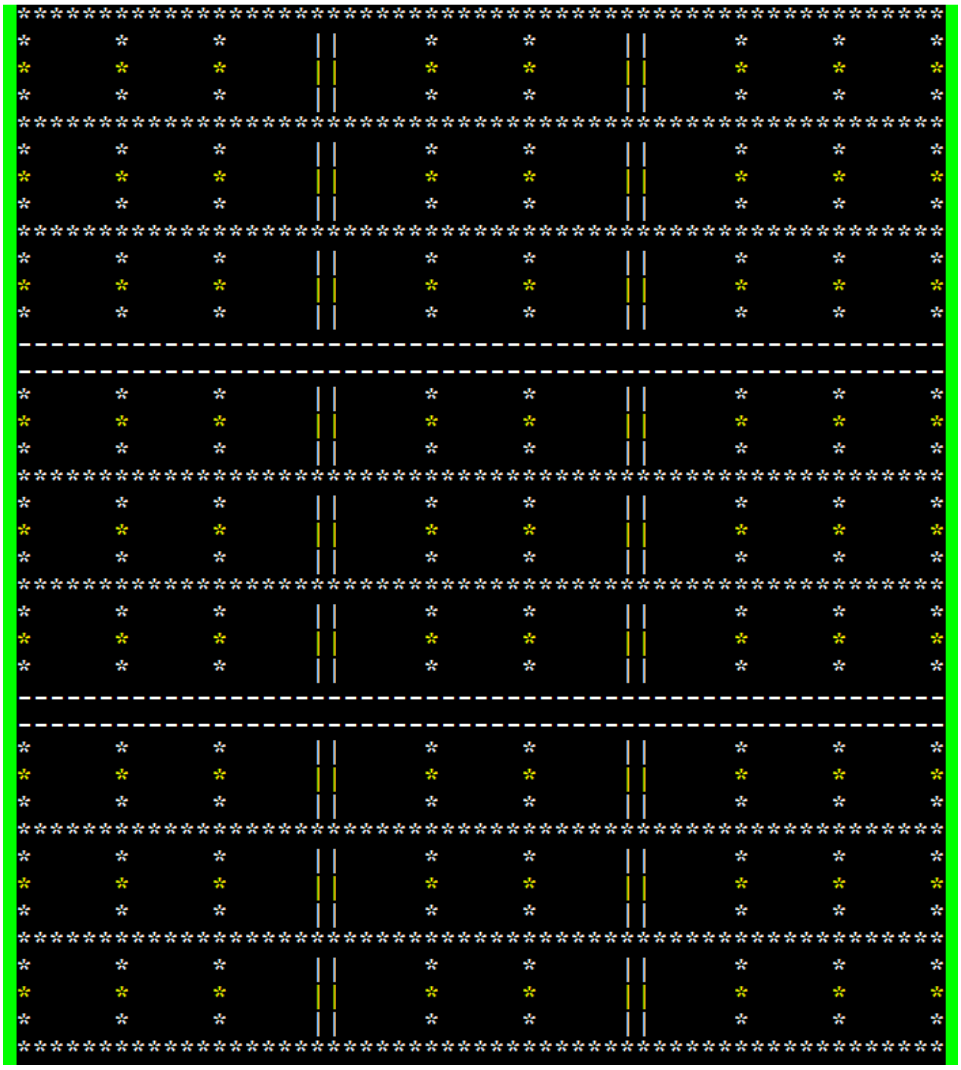


USER CAN USE THESE FEATURES WHILE PLAYING THE GAME



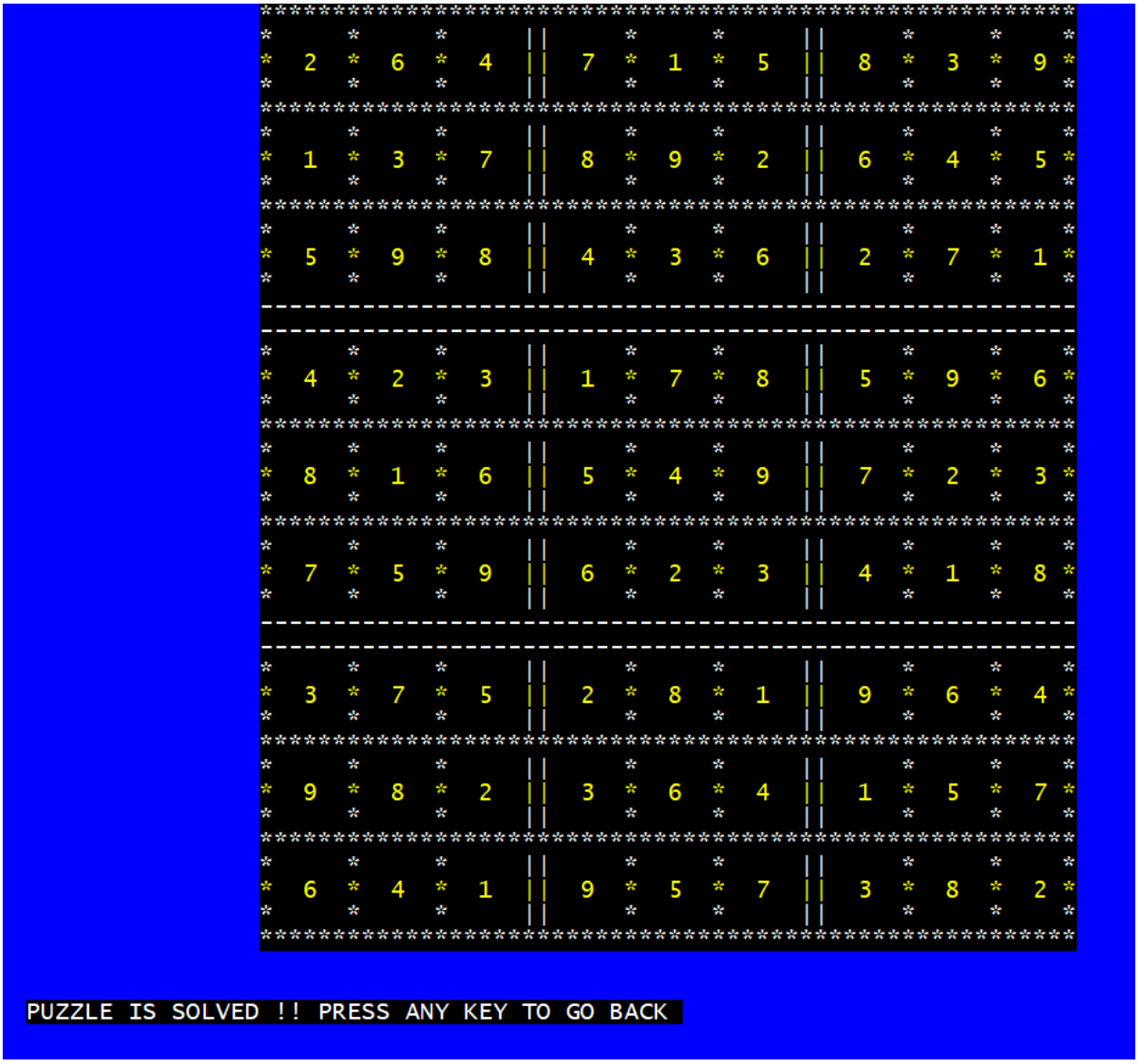

ENTER O TO UNLOCK ROW!!!!!
ENTER P TO UNLOCK COLUMN
ENTER H TO GET HINT!!!!!
ENTER C TO GET COMPLETE SOLUTION!!!!!
ENTER E TO ERASE THE MOVE!!!!!
ENTER A TO EXIT!!!!!

USER CAN USE ENTER THE PUZZLE MANUALLY AND PLAY IT



```
 ENTER E TO ERASE THE MOVE


 ENTER S TO STOP ENTERING!!!!!


 ENTER A TO EXIT!!!!!
```

USER CAN GET THE COMPLETE SOLUTION



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