



# Mathematical Game: Sudoku

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Scan the QR code  
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## Introduction

The first Sudoku puzzle was created in 1979 by Howard Garns. Sudoku puzzles became extremely popular in 21st century. The concept behind the Sudoku is extremely simple. Sudoku contains a 9x9 grid, divided into nine 3x3 blocks. The constraints behind Sudoku is to enter a numerical digit from 1 through 9 in each cell of a 9x9 grid made up of 3x3 sub squares or sub grids, so that each row, column, and sub squares region must contain each of the numbers 1 to 9 exactly once. Sudoku is a special case of Latin square. The number of Latin squares of sizes up to  $11 \times 11$  have been worked out, and the methods are broadly brute force calculations. It is known that the number of  $9 \times 9$  Latin squares is 5524751496156892842531225600. We have implemented this puzzle in android studio and the different libraries supported by android studio. The user interface is designed using android xml and all the coding part is done in java language. We have used Dancing Links Algorithm for solving Sudoku. Database part has been implemented in SQLite.

## Algorithm behind the app

First Sudoku grid of size (9x9) will be converted into the form of a cover matrix of size (729x324). Then below steps will be applied.

Dancing Link AlgorithmX():

If Matrix has no Columns

Terminate with the current solution

Assign C to the first column in Matrix

For each Row R in where Matrix[R][C] = 1

AddRowToSolution(R) and CoverRow(R)

Recursively call AlgorithmX() on the modified Matrix

RemoveRowFromSolution(R) and UncoverRow(R)

CoverRow(R):

For each Column C where Matrix[R][C] = 1

For each Row L where Matrix[L][C] = 1

For each Node N in L

Cover(N)

Remove C from Matrix

UncoverRow(R):

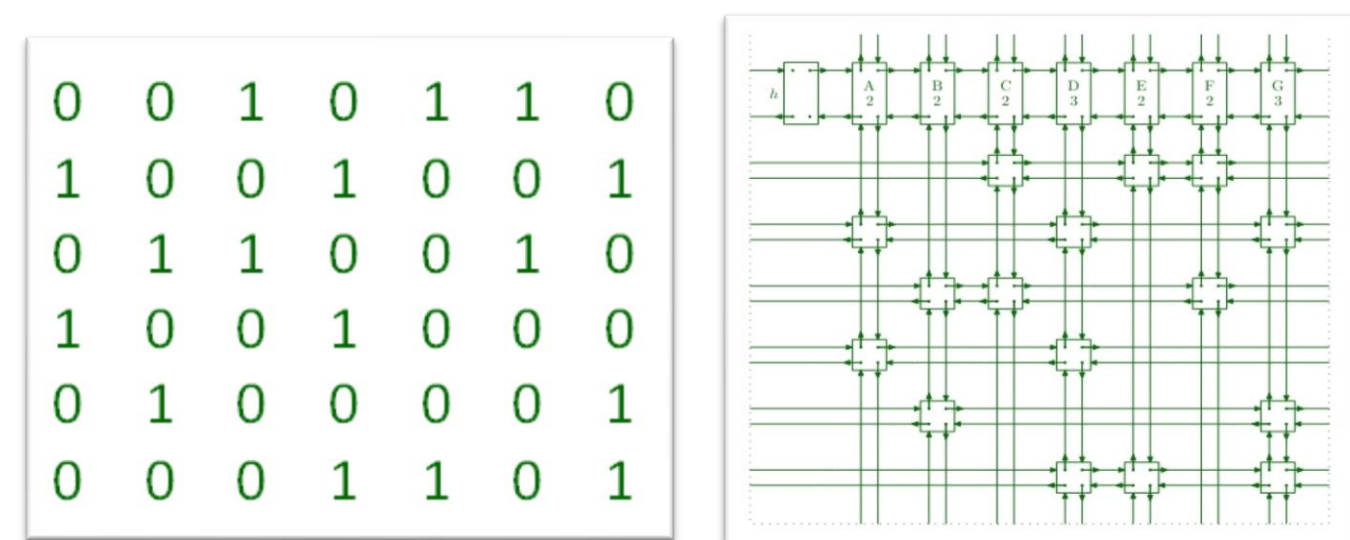
For each Column C where Matrix[R][C] = 1

For each Row L where Matrix[L][C] = 1

For each Node N in L

Uncover(N)

Un-remove C from Matrix



Transformation of exact cover problem into four way linked matrix

## Results and conclusion



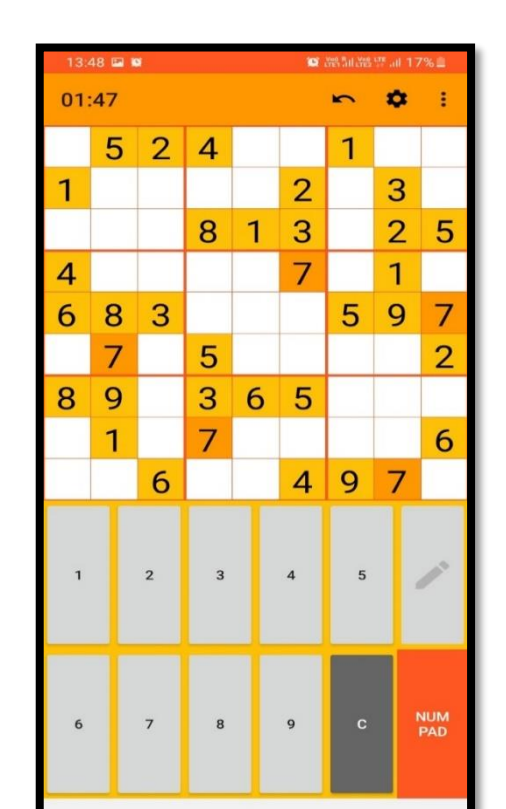
Home Screen



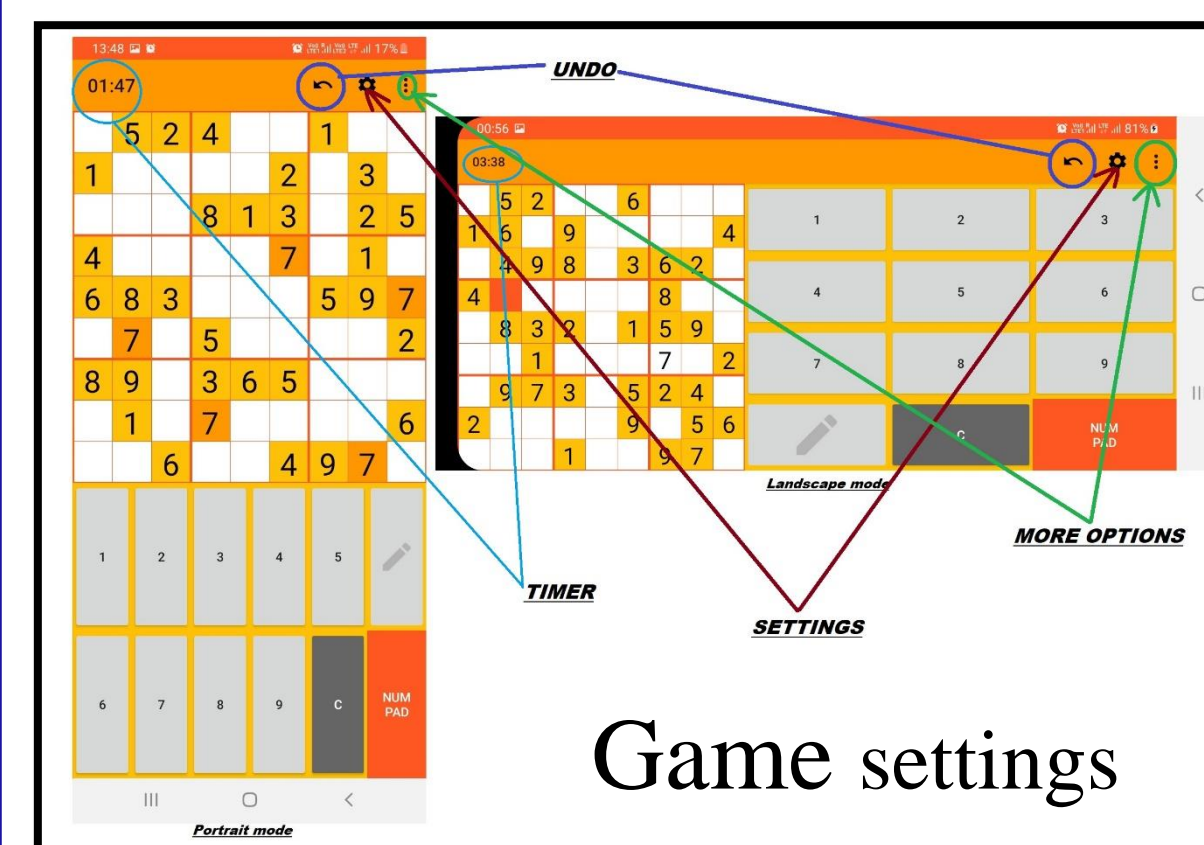
Sudoku selection



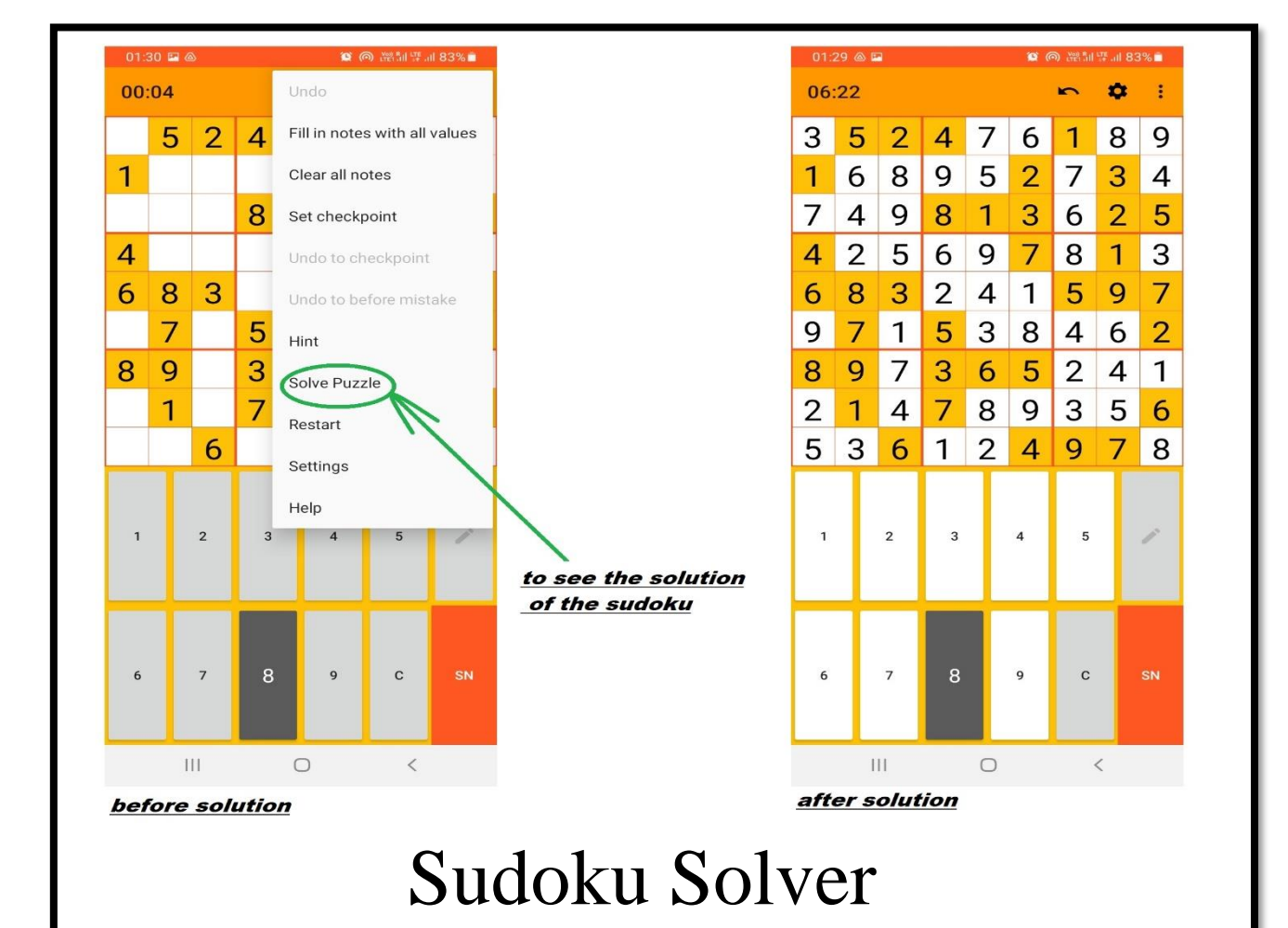
Sudoku list



Sudoku board

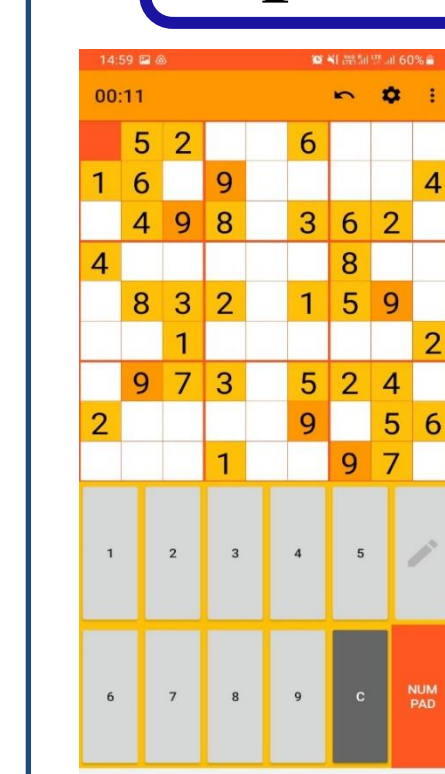


Game settings

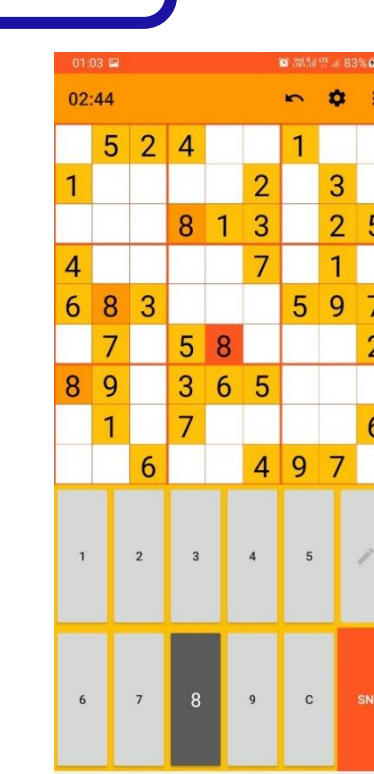


Sudoku Solver

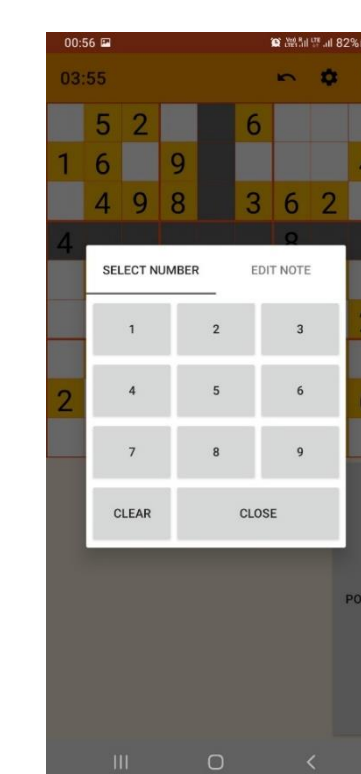
## Input methods



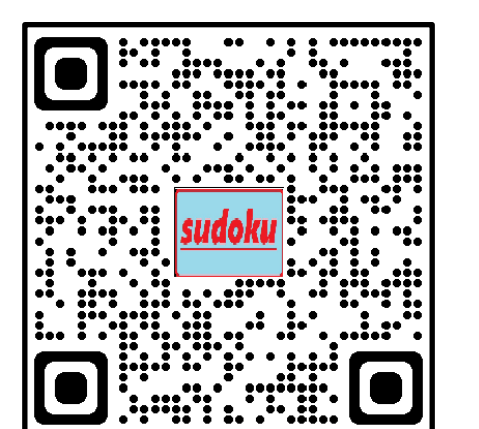
Single number input mode



Numpad input mode



Pop-up input mode



Scan QR code to install the app

## Database

We have used SQLite for creating databases. We have stored Sudoku under three tags i.e., Easy, Medium, Hard. We have also given functionality to update databases like adding or deleting Sudoku in the user database. SQLite comes in android by default. So that there is no need to perform any operations to set up any database or for doing administrative tasks.

## Future work

- Our app can be improved by including functionality like automatic generation of sudoku and making app multiplayer so that users can solve sudoku in a competitive environment.