Sudoku

User Manual

Sudoku Team

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Our program allows for the user to interact with the puzzle-based game known as Sudoku in a number of ways. The user of the program has the ability to manually enter a sudoku puzzle grid, or the user also has the option of letting the computer generate the board layout for them. If the user selects the latter option, the user must specify which level of difficulty they would like the program to generate for them. There are three computer generated levels of difficulty: easy, medium, and difficult.

Once the board is then generated, the user has the ability to choose whether or not they would like to be timed. If they specify that they would like to be timed, the current time elapsed is displayed at the top of the game window, and then again in a pop-up window after the board has been completed.

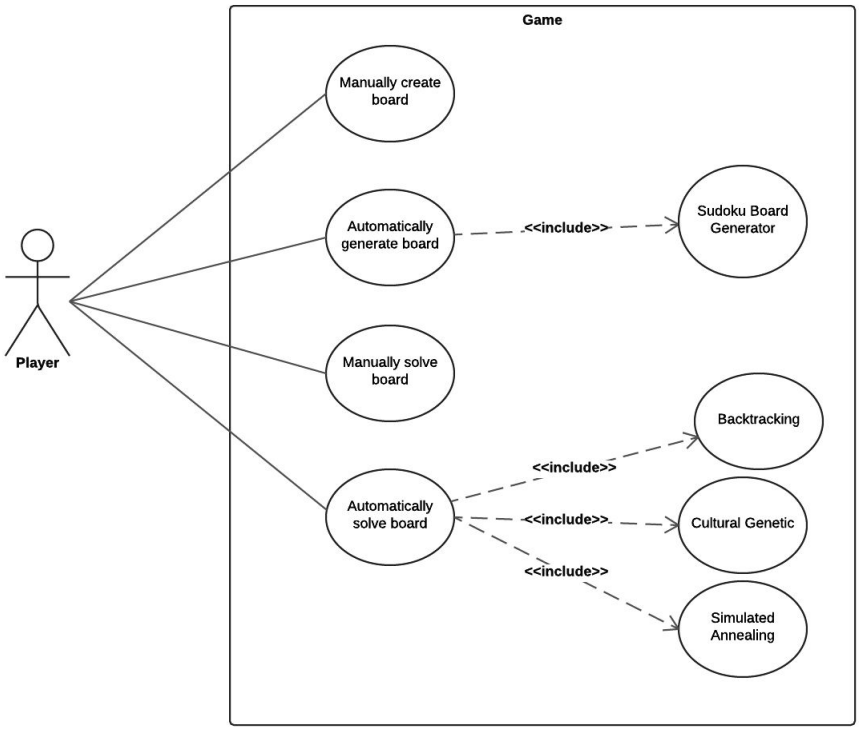
In order to complete the board, the user has a few choices. The user can manually solve the board, or the user can choose for the computer to solve the board using either the backtracking, simulated annealing, or cultural genetic algorithms.

The user will have real-time feedback as to the validity of their board. If a duplicated value is found in a row, a column, or a 3x3 square, then the cells which belong to that specific segment will have a background color of red. Once the user fixes the invalid cell(s), the background color of the cells will return back to normal. When the board is complete, the space surrounding the board will become green, and a pop-up will congratulate the user, telling them that the board is completed. As previously mentioned, if the user chose to have that game timed, then the pop-up will also display the time it took to solve the board.

Solving a Sudoku puzzle can be a very time consuming and difficult task. Creating a solvable Sudoku puzzle by hand can be even more difficult and time consuming. Ensuring that a Sudoku puzzle is solvable entails making sure that among the 81 boxes (9x9), the value in each box is not duplicated in every 3x3 square, row and column. In order to generate the solvable Sudoku board of varying difficulty, one does not only need to create a solvable board, but also they need to remove a varying number of cells depending on the level of desired difficulty.

As shown in the Use Case Diagram below, the player has the ability to manually enter the board or use the program's Sudoku Board Generator. We achieved this for the player by generating a fully solved 9x9 grid of values, and then varied the difficulty by removing a number of solved cells according to the specified difficulty. As the the difficulty increased, the number of cells removed also increased.

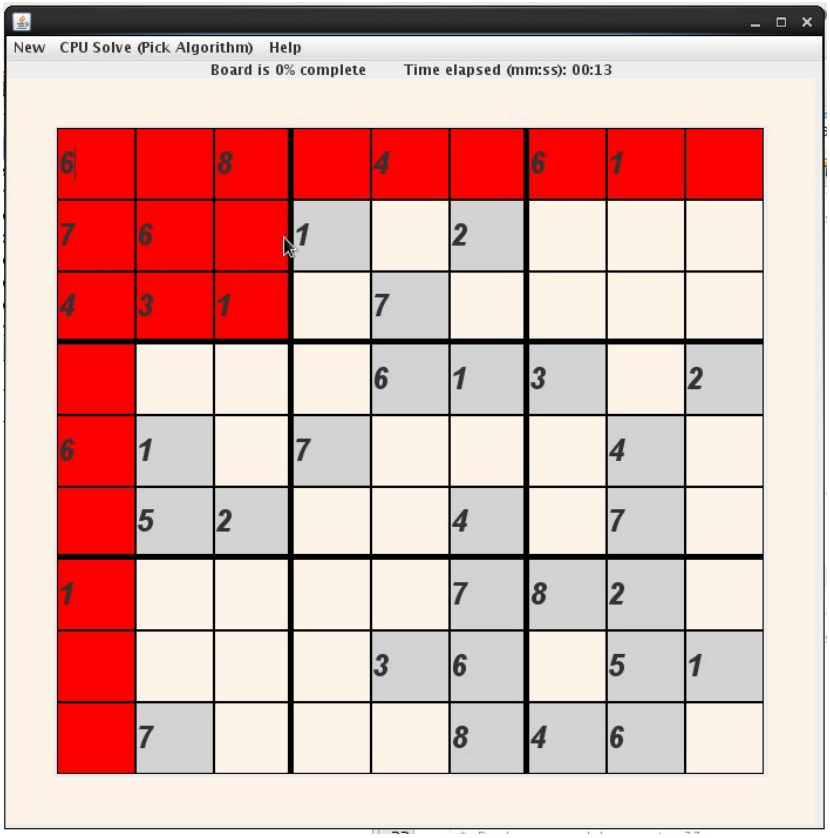
Also shown in the diagram below, the player can either solve the board manually or have the program solve the board using either the backtracking algorithm, the cultural genetic algorithm, or the simulated annealing algorithm.



The instructions for playing are as follows:

> "You must fill the board in such a manner that every column, row, and square has no duplicates or empty spaces, and contains every value from 1-9. If the color red is painted over a row, column or square, that means it is invalid and contains a duplicate."

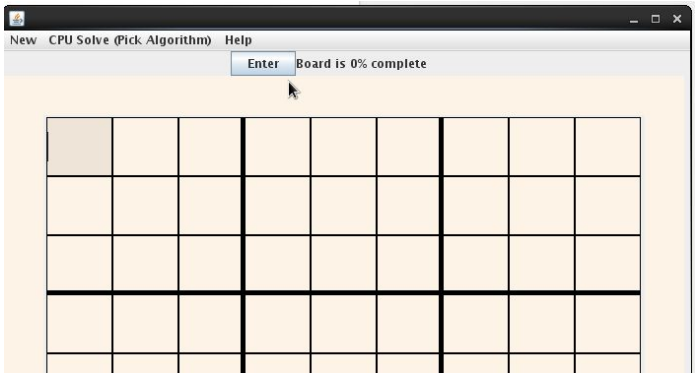
Those instructions are displayed to the user at the start of the program, before the first game. The same instructions are accessible to the user at all times through the "How to play?" option in the "Help" menu on the top menu bar, seen in the below screenshot.



A few other features are seen in the above screenshot. In the menu bar, there is also a menu for both "New" and "CPU Solve (Pick Algorithm)" The "New" menu gives the player the option at any time to create a new board through either manual entry, or to have the CPU generate the board with difficulty (easy, medium, or difficult). The "CPU Solve (Pick Algorithm)" menu will not complete it's function if the board is invalid, and will inform the user of this. This leads to the next feature of our Sudoku game, which paints all cells red if they are in an invalid 3x3 square, row, or column. This corrects itself once the proper segments are valid again. Another feature seen above is the "Time elapsed (mm:ss):" label. If the player decides before the game that they would like for the game to be timed, then this label will be present until the game is over. If the player at any time, would like to know what their progress is in terms of percentage of board segments completed (rows, columns, and 3x3 squares completed), this information is displayed at the top of the screen, underneath the menu bar.

The second screenshot shows the popup window that appears before every game. The drop down menu gives the player the option to select how they would like their board to be generated (Manually, CPU (easy), CPU (medium), CPU (difficult)). Once the player has selected, they should click the "OK" button.

If the player chooses to manually enter the board, they will see an empty, but editable grid like in the screenshot below on the left.



Once the user is done with entering their board, they should click the "Enter" button, which will then disappear, and the board will be set.
After the board is set, the player will be prompted as to whether or not they would like to be timed. This is seen in the screenshot below on the right.