

## Sudokus – creating, solving and rating

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The simplest way to solve a sudoku puzzle is guessing. However, it is not a very efficient method, for humans. There are hundreds of solving methods developed. All these methods are based on the simple idea of avoiding conflicts. There are three kinds of conflicts which can appear during puzzle solving:

1. basic conflicts – there are only  $N - 1$  different candidates in  $N$  cells in the area
2. fish conflicts – when eliminating a number from  $N$  rows/columns, it will disappear also from  $N + 1$  columns/rows
3. unique conflicts – this pattern means multiple solutions.

In the hardest puzzles these conflicts do not appear immediately when a candidate number is eliminated from its row, column, and area. These effects must be linked, so that first we test a candidate and put it to a puzzle, then eliminating all candidates, which cause conflict in this situation. After that, we eliminate candidates, which cause conflict in the new situation and continue until no eliminations can be made or conflict exist.

The longest deduction chain is one method to assess the level of difficulty of the puzzle. Other possibilities are the average number of guesses needed or finding the hardest method needed from the selected set of solving techniques.

Puzzles can be created by adding given numbers to an empty grid until puzzle is valid. A more efficient way is to start from a solution and to eliminate givens until elimination is no more possible. These kinds of puzzles are called minimal sudokus. The most difficult puzzles are created with some presumptions about the locations of the givens.