Sudoku

How to become a Sudoku Ninja: Tips, Tricks and Strategies
Benefits

• Fun
• Exercises the Mind
• Improves Memory
• Improves Logical and Critical Reasoning
• Helps to decline the effects of aging
  – Can help halt the progress of Alzheimer’s disease
• Helps children learn
• Helps develop Patience, Focus and Creativity
History of Sudoku

- Magic squares were known to Chinese mathematicians as early as 650 BCE and Arab mathematicians as early as the 7th century.
- In the late 18th century the Swiss mathematician Leonhard Euler developed the concept of Latin squares.
- The puzzle was designed by Howard Garns and published by Dell Magazines in 1979 as Number Place.
- The puzzle was introduced in Japan by Nikoli in 1984 as Suuji wa dokushin ni kagiru, which can be translated as “the numbers must be single” and later abbreviated to Sudoku (“su = number, doku = single”).
- Around 1997, Wayne Gould discovered Sudoku in a Japanese bookstore. He later publicized the puzzle in Britain, which resulted in a widespread interest all over the world today.
Math of Sudoku

- In a 9x9 Sudoku, there are
  - 81 squares, 27 groups (9 rows, 9 columns, 9 (3x3) boxes)
  - Each square has 20 “buddies”
    - 5,524,751,496,156,892,842,531,225,600 different Latin squares.
    - 6,670,903,752,021,072,936,960 different Sudoku solution grids.
    - 5,472,730,538 unique Sudoku solution grids.
    - 9! = 362,880 versions of every grid available simply by rearranging the digits.
    - There are 3,359,232 different ways to renumber the puzzle.
  - Minimum 17 clues needed to guarantee a unique solution.
  - Minimum 18 clues needed for a symmetric puzzle.
  - Maximum 77 clues which does not give a unique solution.
Difficulty of Sudoku

• Two things are obvious when you look at a Sudoku
  – Number of clues
  – Placement of clues

• Two things are not as obvious when you look at a Sudoku
  – Time – How long it takes to complete the puzzle
  – Logic – Which techniques are needed when solving the puzzle

• The placement of the clues and the logic needed to solve are what really determine the difficulty, not the number of clues.

• There are no standard rules to rate a Sudoku puzzle.
  – The same puzzle may have a different difficulty name based on where it is published.
Terms to know

Groups
Rows
Columns
Boxes
Cells
Givens
The One Rule

Fill in all blank cells so that each group contains the numbers 1 through 9.

AND

Each group can not have any duplicate numbers.

AND

There is only one solution per puzzle.
Basic Skills
One and Only Choice
Scanning

Squeezing

Cross Hatching
Candidates

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Naked Singles
Hidden Single

Where is the other hidden single?
Intermediate Skills
Locked Candidates

Restricted to a row or column in a box

Restricted to a row or column
Locked Candidates 2
Naked Pairs

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Hidden Pairs
Advanced Skills
Naked Triples
Hidden Triples
Naked Quads
Hidden Quads
For the Addict
X Wing
Swordfish

Jellyfish – variation of the X Wing on four rows and columns
Squirmbag – variation of the X Wing on five rows and columns
XY Wing: Version 1
XY Wing: Version 2
XYZ Wing
Other Techniques
Special Fish (Shape and/or Quality)
Coloring
Chains/Loops
Uniqueness/BUG
ALS
Nishio (Trial and Error)
Review

Naked

- N cells contain N numbers
- Remove the N numbers from other cells in the group

Hidden

- N numbers are contained in N cells
- Remove other numbers from the N cells in the group

Hidden becomes Naked
Strategy

• If a puzzle is Easy, you should be able to use basic techniques without candidate lists.
• If the puzzle is Hard, use basic techniques to start, but be prepared to use candidate lists.
• Start with a difficulty level you are comfortable with. Once you feel you have mastered that level, then you may want to move up in difficulty. You may need some practice to get good at higher level puzzles.
Strategy

• Good idea to start with the number/group with the most givens, then cycle through the other numbers/groups.
• Once you fill in a cell, adjust all other cells (candidate lists) that are affected. Many times one technique can result in a chain of good things happening.
• Use elimination. It is easier to know where a number can’t go, then where it can go.
• Look for the Obvious!
• Don’t Guess! Use Logic Learned!
Strategy

• If you make a mistake, you have 2 choices:
  – Try to find and correct your mistake
    • You can see where you have duplicate numbers and by looking at other numbers determine which one is incorrect.
    • You can assume one of them is correct and hope you picked the right one. If you chose the one that didn’t work you know it must be the other choice.
  – Start over
    • Redo the current puzzle.
    • Recycle your puzzle and start a different one.
Any Questions?
The End?

Happy Sudoku-ing!
Links

- [http://www.sudopedia.org/wiki/Solving_Technique](http://www.sudopedia.org/wiki/Solving_Technique)
Sudoku Variations
Popular Variations
Diagonal Sudoku

In Diagonal Sudoku, fill in the grid so that every row, column, 3x3 box, and main diagonals contains the digits 1 through 9.

It is also called Sudoku–X.
In Hyper Sudoku, fill in the grid so that every row, column, 3x3 box, contains the digits 1 through 9. **Instead of 9 boxes, there are now 13.**

It is also called Windoku, NRC-Sudoku, and Four-Square Sudoku.
Killer Sudoku

The puzzle has no givens. The cells are placed into cages, where the number in the cage represents the sum of the digits. It is also called Sum Sudoku.
Killer Sudoku

Example

Example Solution
The puzzle has 5 grids, with the center grid overlapping exactly one corner box with each of the remaining grids. It is also called Gattai-5.
Jigsaw Sudoku

This puzzle is the same as Normal Sudoku, except in a Jigsaw Sudoku the boxes are irregular shapes. It is also called Irregular or Geometry Sudoku.
Other Variations
Greater Than Sudoku

The puzzle has no givens. Instead, there are greater-than (>) signs between some adjacent cells, which signify that the digit in one cell should be greater than another. All other ordinary Sudoku rules apply.
Odd/Even Sudoku

This puzzle is also called Tanto Sudoku.
The grey cells are even, then the white cells are odd.
(Smaller than Normal) Sudoku

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1 4 3
3 4
1
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3 4 3 4
3 6
4 1
2 1
1 2
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(Bigger than Normal) Sudoku

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2  3  14  8
10  17  6  18
15  24  13  7

1  21  4  10
19  13  3  14
18  22  2  6

5  20  7  25  19
21  17  18  2
6  12  22  9  15

11  22  8  24  7  1  5
13  16  17  26  23  2
14  9  12  17
18  21  20  6  13
7  22  18  2  21  3
19

4  6  5  2
12  11  7  3
21
15  25  13  20  8  12
14  10  9  16  15
6  4
24
22

16 11 8 1
1  6  4
23  15
14  12  9  10
21  3  17
15  25  20
4  10
16  11
20  2
16  5  8
6  19  25
3
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The center cell of each box makes an additional group, meaning the blue cells must contain digits 1-9.
Clueless Sudoku

Grid:

1. 3 9
   8 5 3
   1 7

2. 5 9
   7 3 6
   1 5

3. 2 7
   1 4 8
   3 5

4. 6 2
   3 5
   4 8

5. 3 4 8
   1 5 9
   7 6

6. 1 4
   9 5 2
   8 7

7. 7 4 5
   9 6
   3 4

8. 1 7 8 6
   2 3 9
   1 2

9. 4 2 9
   3 5 6
   4 8

Sudoku Grid Representation:

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Others Available

Wordoku
Progressive Sudoku
Skyscraper Sudoku
Battleship Sudoku
Consecutive Sudoku

.....Plus many many more
Other grid-based puzzles
Nonograms

This is also called Picross, Paint by numbers, and Griddlers.
Each bold-outlined group of cells is a cage containing digits which achieve the specified result using the specified mathematical operation: addition (+), subtraction (−), multiplication (×), and division (÷). (Unlike Killer Sudoku, digits may repeat within a cage).
Kakuro (Cross Sums)

Referred to a mathematical transliteration of the crossword.
Nurikabe (Islands in the Stream)
Akari (Light Up)
Hitori
# Fillimino

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63
Futoshiki (Unequal)
Tents
Logic Puzzle

THE PUZZLE:
Five sisters all have their birthday in a different month and each on a different day of the week. Using the clues below, determine the month and day of the week each sister's birthday falls.
1. Paula was born in March but not on Saturday. Abigail's birthday was not on Friday or Wednesday.
2. The girl whose birthday is on Monday was born earlier in the year than Brenda and Mary.
3. Tara wasn't born in February and her birthday was on the weekend.
4. Mary was not born in December nor was her birthday on a weekday.
The girl whose birthday was in June was born on Sunday.
5. Tara was born before Brenda, whose birthday wasn't on Friday. Mary wasn't born in July.

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<td>Sunday</td>
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<td>Friday</td>
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FINAL SOLUTION: