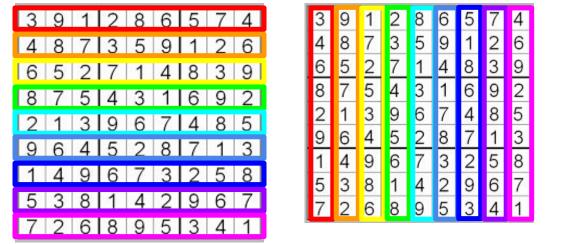
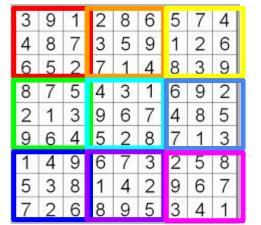
5	6	3	8	7	9	2	1	4	5	6	3	8	7	9	2	1	4
7	1	9	4	2	3	6	5	8	7	1	9	4	2	3	6	5	8
2	S	J	D	0	K	U	9	7	2	8	4	5	6	1	3	9	7
4	2	S	0	L	\	Ε	R	3	4	2	6	1	5	7	9	8	3
1	9	5	6	3	8	4	7	2	1	9	5	6	3	8	4	7	2
8	3	7	2	9	4	1	6	5	8	3	7	2	9	4	1	6	5
9	4	8	3	1	5	7	2	6	9	R	0	N	1	5	7	2	6
6	5	1	7	4	2	8	3	9	6	5	W	0	0	D	8	3	9
3	7	2	9	8	6	5	4	1	3	7	2	9	8	6	5	4	1
6	5	1	7	4	2	8	3	9	6	5	1	7	4	2	8	3	9
2000	100 PG 00	INCOCOUM	20000000	2000	(A/A/A)	HUNGS	200	223	2507	500000	Pared and	33960	2000	8/2/83	THE REAL PROPERTY.	727	20

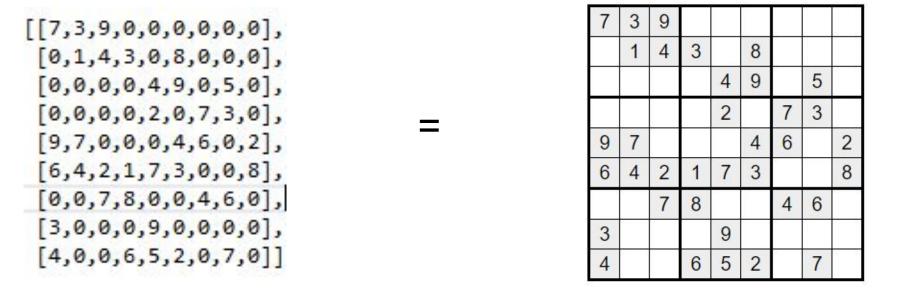




Each Row needs to have 1-9

Each column needs to have 1-9

Each 3x3 box needs to have 1-9



A 9x9 sudoku board can be represented by a list of lists of integers.

0 Can be used to represent a blank cell.

Single Threaded Solution

There are two parts to the Solve Function.

1. Generate Possible Options

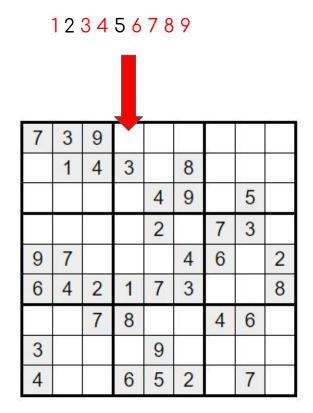
2. Solve Each Option

1. Generate Possible Options

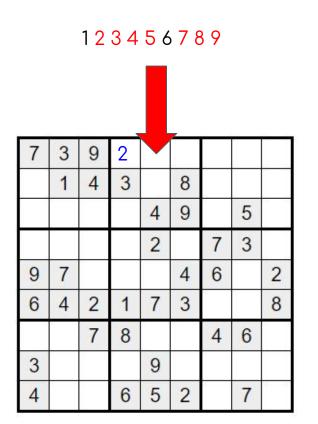
The function finds the first empty cell.

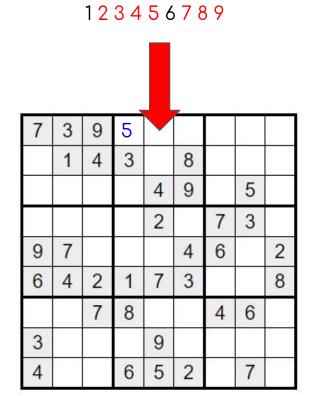
It then tests each value 1-9.

If the value is not in the same row, column, or box, then it is a valid option.



2. Solve Each Option





This continues until there are no more valid options, or a solution is found

Optimizing the Solve Function

Instead of choosing the first empty cell, explore the cell with the least amount of available options.

4

123456789

Multi Threaded Solution

The multi threaded solution generates options the same way as the single threaded solution.

For each option generated, the function starts a thread dedicated to solving that option.

The threads have access to shared data

solution - This is where the solution is stored (originally null)

num_threads - The current number of alive worker
threads

max_threads - The maximum number of threads we allow to exist

mutex - used to control access to shared datacv - used to alert master thread when solution is found

Master Thread

- Creates the first worker thread
- Listens on cv to check if a solution was found
- Ends all threads if a solution is found
- Ends if all worker threads are terminated (no solution)

Worker Thread

- Solves input board
- When generating options, if num_threads < max_threads, the worker thread can start another worker thread
- Thread ends when it has explored all options or found a solution.
- Every time a thread ends or starts another thread, it updates num_threads.