Valid Sudoku

Created	@2025年4月12日 下午1:52
Question Type	Array
Difficulty	Medium
LeetCode Question Link	https://leetcode.com/problems/valid-sudoku/description/

1. Question Self-understanding:

1.1 Description:

Based on my understanding, I need to ensure that each row, column, and 3x3 sub-grid of the Sudoku board contains numbers from 1 to 9 with no duplicates.

1.2 Input:

The input type will be a list of lists of strings, where the outer list represents the entire 9x9 Sudoku board, and each inner list represents a single row.

1.3 Input Assumption

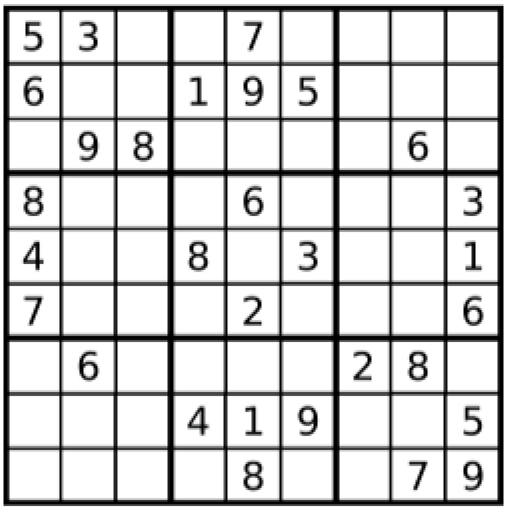
Each cell will contain either a number from 1 to 9 as a string or a '.' character representing an empty cell.

- This means we don't need to validate if the given string contains numbers outside the range 1-9, simplifying the identification of empty cells.

1.4 Output:

The output should be a boolean.

1.5 Example:



5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

```
Input: board =
[["5","3",".",".","7",".",".",".","."]
,["6",".",".","1","9","5",".",".","."]
,[".","9","8",".",".",".",".","6","."]
,["8",".",".",".","6",".",".",".","3"]
,["4",".",".","8",".","3",".",".","1"]
,["7",".",".",".","2",".",".",".","6"]
,[".","6",".",".",".",".","2","8","."]
,[".",".",".","4","1","9",".",".","5"]
,[".",".",".",".","8",".",".","7","9"]]
Output: true
```

1.6 Other Q&A:

- None for this question.

2. Attempt 1:

2.1 Thought:

- We must primarily ensure there are no duplicates in rows, columns, and sub-grids. Using sets is the most efficient way to check duplicates. We'll need three sets: one for rows, one for columns, and one for sub-grids. Checking rows and columns is straightforward, but sub-grids require nested loops. Each 3x3 sub-grid can be identified by row and column indices multiplied by 3. For instance, the central cell of the sub-grid at index (0,1) can be identified by row `0 * 3 + 1` and column `1 * 3 + 1`.

2.2 Pseudo-Code: (Ignore this part. Only for myself to code)

```
class Solution:
    def isValidSudoku(self, board: List[List[str]]) → bool:
        # Let's initial three sets.
        row_set = set();
        col_set = set();
        sub_Suduko_set = set();

          # check row part
          for-loop through the row:
              for-loop through the column:
                  check if the current value in the column in the row_set
                         if yes:
                             return false
                    reset the row_set

                for-loop through the column:
              for-loop through the row:
                  check if the current value in the column in the col_set
```

```
         if yes:
             return false
    reset the col_set



row_index = 0
col_index = 0

while-loop the row_index until row_index equal 3.
    while-loop the col_index until col_index equal 3

            check the ceel whether inside the sub_suduko_set:
                if yes:
                    return false




        add 1 to the column index
    add 1 to the row_index
    reset_sub_suduko_set

return true
```

2.3 Implementation through python:

```
from typing import List

class Solution:
    def isValidSudoku(self, board: List[List[str]]) → bool:
        # Check each row for duplicate numbers.
        for i in range(9):
            seen = set()
            for j in range(9):
                if board[i][j] != '.':
                    if board[i][j] in seen:
                        return False
                    seen.add(board[i][j])

        # Check each column for duplicate numbers.
        for j in range(9):
            seen = set()
            for i in range(9):
                if board[i][j] != '.':
                    if board[i][j] in seen:
                        return False
                    seen.add(board[i][j])

        # Check each 3×3 sub-box for duplicate numbers.
        for box_row in range(3):
            for box_col in range(3):
                seen = set()
                for i in range(box_row * 3, box_row * 3 + 3):
                    for j in range(box_col * 3, box_col * 3 + 3):
                        if board[i][j] != '.':
                            if board[i][j] in seen:
                                return False
                            seen.add(board[i][j])
        return True
```

2.4 Time Complexity and Space Complexity

2.4.1 Time Complexity:

- Each cell is checked exactly three times (row, column, subgrid), giving a time complexity of $O(3n)$, simplified to $O(n)$.

2.4.2 Space Complexity:

- Each cell is temporarily stored three times (row, column, sub-grid), resulting in a space complexity of $O(3n)$, simplified to $O(n)$.