

# Valid sudoku - using bitmask

class Solution:

def is\_valid\_sudoku(self, board: list[list[str]]) -> bool:

rows = [0] \* 9

cols = [0] \* 9

squares = [0] \* 9

for r in range(9):

for c in range(9):

if board[r][c] == ".":

continue

val = int(board[r][c]) - 1

if (1 <= val) & rows[r]:

return False

if (1 <= val) & cols[c]:

return False

if (1 <= val) & squares[(r//3)\*3 + (c//3)]:

return False

rows[r] 1 = (1 <= val)

cols[c] 1 = (1 <= val)

squares[(r//3)\*3 + (c//3)] 1 = (1 <= val)

return True

```
print(Solution().is_valid_sudoku(board =
[[1, 2, 3, ., ., ., ., ., .],
[4, 5, ., ., ., ., ., ., .],
[. , 9, 8, ., ., ., ., ., 3],
[5, ., ., ., 6, ., ., ., 4],
[. , ., ., 8, ., 3, ., ., 5],
[7, ., ., ., 2, ., ., ., 6],
[. , ., ., ., ., 2, ., ., .],
[. , ., ., 4, 1, 9, ., ., 8],
[. , ., ., 8, ., ., 7, 9, .]]))
```

This exercise is using bitmask algorithm and is running in approximately 431 steps.

Step 1:

rows → [0, 0, 0, 0, 0, 0, 0, 0, 0]

cols  $\rightarrow [0, 0, 0, 0, 0, 0, 0, 0, 0]$   
 squares  $\rightarrow [0, 0, 0, 0, 0, 0, 0, 0, 0]$

Info: recap bitmask operators:

formula:

- left shift ( $\ll$ ):  $a \ll n = a * 2^n$

for exp:  $a=5, n=3$

$$5 \ll 3 = 5 * 2^3 = 40$$

$$\begin{array}{l} 100111 \Rightarrow 32+0+0+4+2+1 = 39 \ll 1 \Rightarrow 1001110 \Rightarrow 78 \\ \begin{array}{c} 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\ \hline \end{array} \qquad \begin{array}{c} 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\ \hline \end{array} \end{array}$$

- Bitwise OR ( $|$ ):  $(a | b)_i = a_i + b_i - (a_i \times b_i)$

for exp:  $3 = \begin{array}{c} 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\ 1001 \end{array}$

$$14 = \begin{array}{c} 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\ 1110 \end{array}$$

$$15 = 1111$$

- Bitwise AND ( $\&$ ):  $(a \& b)_i = a_i \times b_i$

Step 2:

$$r \rightarrow 0$$

$$c \rightarrow 0$$

for  $r$  in range( $q$ ):  
 for  $c$  in range( $s$ ):

Step 3:  $val = \text{int}(\text{board}[r][c]) - 1$   
 $val \rightarrow \text{int}("1") - 1 \Rightarrow 1 - 1 = 0$

Step 4: if  $(1 \leq val)$  &  $\text{rows}[r]$ :  
return False

$$1 \leq val = 1 * 2^0 = 1$$