31/03/2023

Note → We can optimize the space used in merge sort, if we manually free the allocated space by the delete keyword but the space complexity remains same i.e. $O(n)$ but space used will be less.
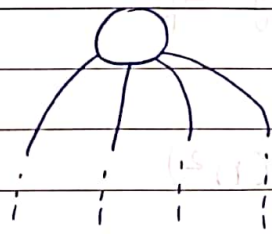
12) Rat in a maze + Sudoku Solver
rows = m
columns = n
Total cells = $m \times n$

To move to a particular cell, we have 4 options available.
Hence time complexity $= O\left(4^{(m*n)}\right)$

$\left. \begin{array}{l} \\ \\ \\ \end{array} \right\}$ $m \times n$ levels
(4 options available)

Space complexity $= O(m*n)$ } Both questions

Similarly in sudoku solver, there are 9 options available and total cells available $m*n$
$\quad$ TC $= O\left(9^{(m \times n)}\right)$

13) N-Queen Problem

(6 choices)

$n = 6$

Q2 (4 ways i.e. n-2 choices)

Q1 → n choices
Q2 → (n-1) choices, however (n-2) choices would be there. (Upper bound is considered)
Q3 → (n-3) choices
  ↳ Exact number would be different.

$$n \times (n-1) \times (n-2) \times \_\_ \times 1 = O(n!)$$

Note → If we place Q1, just remove that column. Now we can place Q2 in n ways.

$$n \times n \times n \times \_\_ = O(n^n).$$

Average case complexity of $O(n^n)$ lies near about $O(n!)$

Space complexity $= O(n^2)$
                    ↳ ans array

The above space complexity is for single solution. For multiple solutions, it will depend on the no. of solutions.

14) Phone keypad problem

We will assume for each character, 4 calls will go as we can see from the mappings. no. of characters $= n$ and hence time complexity is $O(4^n)$.

Space complexity $= O(4^n)$
We are storing the answers in vector <string> ans.

$$7 \rightarrow pqrs \left. \begin{array}{l} \\ \end{array} \right\} n = 2$$
$$9 \rightarrow wxyz$$

pw, px, py, pz, qw, qx, qy, qz, rw, rx, ry, rz, sw, sx, sy, sz

Total 16 combinations possible for 2 digits
$16 \rightarrow 4^2$

Hence we can write it as 4^n. Now we need to store 4^n combinations in the ans vector & hence space complexity is $O(4^n)$