

## 2048 game

- In get\_current\_state function  $\Rightarrow$

8	16	4	12
8	32	4	32
4	2	4	64
4	4	4	84

Up  
Move

16	16	8	12
0	4	0	32
8	0	8	128
0	4	0	0

Down  
Move

0	16	0	12
16	0	8	32
0	4	0	0
8	4	8	128

$\therefore$  if consecutive elms are equal, they can combine, creating a vacancy (i.e. 0)  $\Rightarrow$  Game Not over

To avoid index error in  $i+1/j+1 \Rightarrow$

PTO

1st check for 3x3

	0	1	2	3
0	2	4	8	2
1	16	32	64	2
2	128	256	512	2
3	2	4	4	2

← Last ~~Row~~ Column

Now check for Last Row and

Compress func<sup>n</sup> ⇒[Combine ~~ele~~ Pure end  
~~ele~~ tak jayenge]

2	0	0	2
2	0	4	4
2	2	2	2
0	0	4	4

If I  
make a  
left  
move

4	0	0	0
2	8	0	0
4	4	0	0
8	0	0	0

↓ Compress

2	2	0	0
2	4	4	0
2	2	2	2
4	4	0	0

Much easier  
to Reach

[Fir Combine Karo]

∴ Group Non-zero ele's together

[End tak le jao]

Execution  $\Rightarrow$ 

	pos=0	pos=1	pos=2	
i=0	2	2	0	0
i=1	2	4	4	0
i=2	2	2	2	2
i=3	4	4	0	0

pos=0 pos=1 pos=2 pos=3 pos=4 pos=1 pos=2 pos=3 pos=4

	j	j	j	j
i=0	2	0	0	2
i=1	2	0	4	4
i=2	2	2	2	2
i=3	0	0	4	4

[By default, all the values of new-mat were zero]

Merge fun<sup>n</sup>  $\Rightarrow$  Logic

2	2	4	0
4	4	4	4
2	0	0	0
4	2	2	0

 $\Rightarrow$ 

4	0	4	0
8	0	8	0
2	0	0	0
4	4	0	0

$\therefore$  Ye keval left move ke 194e banaya hai

[~~2, 2, 4, 0~~, ~~4, 4, 4, 4~~, ~~2, 0, 0, 0~~, ~~4, 2, 2, 0~~]

Comp ress Some Merge

[~~2, 2, 4, 0~~, ~~4, 0, 4, 0~~, ~~8, 0, 8, 0~~, ~~2, 0, 0, 0~~, ~~4, 4, 0, 0~~]

Comp ress

[~~2, 2, 4, 0~~, ~~4, 0, 4, 0~~, ~~8, 0, 8, 0~~, ~~2, 0, 0, 0~~, ~~4, 4, 0, 0~~]

Comp ress

[~~2, 2, 4, 0~~, ~~4, 0, 4, 0~~, ~~8, 0, 8, 0~~, ~~2, 0, 0, 0~~, ~~4, 4, 0, 0~~]

## Reverse func<sup>n</sup> Logic →

$$\begin{bmatrix} 2 & 4 & 2 & 0 \\ 0 & 4 & 4 & 2 \\ 2 & 2 & 4 & 4 \\ 4 & 2 & 4 & 2 \end{bmatrix} \rightarrow \begin{bmatrix} 0 & 2 & 4 & 2 \\ 2 & 4 & 4 & 0 \\ 4 & 4 & 2 & 2 \\ 2 & 4 & 2 & 4 \end{bmatrix}$$

$$\therefore \text{Same } i \text{ } \& \text{ } j \Rightarrow \left. \begin{array}{l} j=0 \leftrightarrow j=3 \\ j=1 \leftrightarrow j=2 \\ j=2 \leftrightarrow j=1 \\ j=3 \leftrightarrow j=0 \end{array} \right\} \Rightarrow j \leftrightarrow (4-j-1)$$

For each row, we add a new list and when we are working on the column, we append elements into the list

$[ [], [], [], [] ]$   
↑  
[Append elements while working on column]



Transpose Func<sup>n</sup> $i = 0$  $j = 3$ 

$$\begin{bmatrix} 2 & 4 & 2 & 0 \\ 0 & 4 & 4 & 2 \\ 2 & 2 & 4 & 4 \\ \boxed{4} & 2 & \textcircled{4} & 2 \end{bmatrix} \Rightarrow \begin{bmatrix} 2 & 0 & 2 & \boxed{4} \\ 4 & 4 & 2 & 2 \\ 2 & 4 & 4 & \textcircled{4} \\ 0 & 2 & 4 & 2 \end{bmatrix}$$

$i = 3, j = 0$        $i = 3, j = 2$        $i = 0, j = 3$        $i = 2, j = 3$

$$\Rightarrow \text{mat}[i][j] \rightarrow \text{mat}[j][i]$$

$$\text{new\_mat} = [ [], [], [], [] ]$$

new\_mat[i]  $\Rightarrow$  Append elems when you are going through, each column

$$\begin{bmatrix} 2 & 2 & 4 & 0 \\ 4 & 4 & 4 & 4 \\ 2 & 0 & 0 & 0 \\ 4 & 2 & 2 & 0 \end{bmatrix} \xrightarrow{\text{Left Move}} \begin{bmatrix} 4 & 4 & 0 & 0 \\ 8 & 8 & 0 & 0 \\ 2 & 0 & 0 & 0 \\ 4 & 4 & 0 & 0 \end{bmatrix}$$

Right  
Move

$$\begin{bmatrix} 0 & 0 & 4 & 4 \\ 0 & 0 & 8 & 8 \\ 0 & 0 & 0 & 2 \\ 0 & 0 & 4 & 4 \end{bmatrix}$$

$\therefore$  Mat  $\xrightarrow{\text{Rev. erse}} \text{Left Move} \xrightarrow{\text{Rev. erse}} \text{Right Move}$   
 Ans  
 Prapt

$$\begin{bmatrix} 2 & 2 & 4 & 0 \\ 4 & 4 & 4 & 4 \\ 2 & 0 & 0 & 0 \\ 4 & 2 & 2 & 0 \end{bmatrix} \xrightarrow{\text{Transpose}} \begin{bmatrix} 2 & 4 & 2 & 4 \\ 2 & 4 & 0 & 2 \\ 4 & 4 & 0 & 2 \\ 0 & 4 & 0 & 0 \end{bmatrix} \xrightarrow{\text{Left Move}}$$

UP  
Move

$$\begin{bmatrix} 2 & 2 & 8 & 4 \\ 4 & 4 & 0 & 0 \\ 2 & 2 & 2 & 0 \\ 4 & 2 & 2 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 2 & 4 & 2 & 4 \\ 2 & 4 & 2 & 0 \\ 8 & 2 & 0 & 0 \\ 4 & 0 & 0 & 0 \end{bmatrix} \xrightarrow{\text{Transpose}}$$

$$\begin{bmatrix} 2 & 2 & 8 & 4 \\ 4 & 4 & 2 & 0 \\ 2 & 2 & 0 & 0 \\ 4 & 0 & 0 & 0 \end{bmatrix}$$

 $\equiv$ 

$$\begin{bmatrix} 2 & 2 & 8 & 4 \\ 4 & 4 & 2 & 0 \\ 2 & 2 & 0 & 0 \\ 4 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 2 & 2 & 4 & 0 \\ 4 & 4 & 4 & 4 \\ 2 & 0 & 0 & 0 \\ 4 & 2 & 2 & 0 \end{bmatrix} \xrightarrow{\text{Transpose}} \begin{bmatrix} 2 & 4 & 2 & 4 \\ 2 & 4 & 0 & 2 \\ 4 & 4 & 0 & 2 \\ 0 & 4 & 0 & 0 \end{bmatrix} \xrightarrow{\text{Reverse}} \begin{bmatrix} 2 & 4 & 2 & 4 \\ 2 & 0 & 4 & 2 \\ 4 & 4 & 0 & 2 \\ 0 & 4 & 0 & 0 \end{bmatrix}$$

Down  
Move

$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 4 & 2 & 0 & 0 \\ 2 & 4 & 8 & 0 \\ 4 & 2 & 2 & 4 \end{bmatrix}$$

PTO

Reverse

$$\begin{bmatrix} 4 & 2 & 4 & 2 \\ 2 & 0 & 4 & 2 \\ 2 & 0 & 4 & 4 \\ 0 & 0 & 4 & 0 \end{bmatrix} \xrightarrow[\text{Move}]{\text{Left}} \begin{bmatrix} 4 & 2 & 4 & 2 \\ 2 & 4 & 2 & 0 \\ 2 & 8 & 0 & 0 \\ 4 & 0 & 0 & 0 \end{bmatrix} \xrightarrow[\text{Reverse}]{\text{Rev}}$$

$$\begin{bmatrix} 2 & 4 & 2 & 4 \\ 0 & 2 & 4 & 2 \\ 0 & 0 & 8 & 2 \\ 0 & 0 & 0 & 4 \end{bmatrix} \xrightarrow[\text{Pose}]{\text{Trans}} \begin{bmatrix} 2 & 0 & 0 & 0 \\ 4 & 2 & 0 & 0 \\ 2 & 4 & 8 & 0 \\ 4 & 2 & 2 & 4 \end{bmatrix}$$

(1st Page)  
(Down Move)

(Last Pages) (Up Move)Left Move  $\star \rightarrow$ 

$$\begin{bmatrix} 2 & 0 & 0 & 2 \\ 2 & 0 & 4 & 4 \\ 2 & 2 & 2 & 2 \\ 0 & 0 & 4 & 4 \end{bmatrix} \xrightarrow[\text{ress}]{\text{Comp}} \begin{bmatrix} 2 & 2 & 0 & 0 \\ 2 & 4 & 4 & 0 \\ 2 & 2 & 2 & 2 \\ 4 & 4 & 0 & 0 \end{bmatrix} \xrightarrow[\text{ge}]{\text{Mer}} \begin{bmatrix} 4 & 0 & 0 & 0 \\ 2 & 8 & 0 & 0 \\ 4 & 0 & 4 & 0 \\ 8 & 0 & 0 & 0 \end{bmatrix}$$

Left Move

$$\begin{bmatrix} 4 & 0 & 0 & 0 \\ 2 & 8 & 0 & 0 \\ 4 & 4 & 0 & 0 \\ 8 & 0 & 0 & 0 \end{bmatrix}$$

=

compress

$$\begin{bmatrix} 4 & 0 & 0 & 0 \\ 2 & 8 & 0 & 0 \\ 4 & 4 & 0 & 0 \\ 8 & 0 & 0 & 0 \end{bmatrix}$$

## A hand-drawn diagram in blue ink on lined paper. It features a square with an inscribed five-pointed star (pentagram). From each of the four corners of the square, a line radiates outwards, ending near the edges of the drawing area.

↓ Transpose

Down  
→  
Move

0			
0			
0			
8			

[illegible]



We need to do all this because Merge func<sup>n</sup> can only merge consecutive elements  $\Rightarrow$  1<sup>st</sup> Put all non-zero elements at one place so that Merge can func<sup>n</sup> properly, now apply Merge but now zeroes bich me create ho gaye but actual game  $\hat{A}$  left move karne ke baad non-zero no. extreme left pe chala jata hai  $\therefore$  compress again so that non-zero no. extreme left pe chala jaye

### Change or Not

0	0	0	0
0	0	0	2
0	0	0	2
0	0	0	0

Right

Move



Nothing Will Change  
 $\therefore$  New 2 doesn't come

Down  
MoveLeft  
Move

0 0 0 0  
 0 0 0 0  
 0 0 0 4  
 0 0 2 0

0 0 0 0  
 2 0 0 0  
 2 0 0 0  
 0 0 2 0

New 2 Comes at Random Pos<sup>n</sup>

Here Merging  
cant' happen  
but Compress

Move left change

i.e. Ye compress  
hogaya

0	0	0	2
0	0	0	2
0	0	0	0
0	0	0	0

Move  
Left

2	0	0	0
2	0	0	0
0	0	0	0
0	2	0	0

but yaha  
Merging nahi hui

~~→ Merge happened~~

→ Change happened  
in form of compression

[2 inserted at Random loc<sup>n</sup>]

~~0 0 2 2~~

2	2	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Move  
Left

4	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

change happened  
in form of Merging

0	0	2	2
0	0	0	0
0	0	0	0
0	0	0	0

Compress  
→

2	2	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Merge  
→

4	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

change happened in  
form of (M and C) both

Compress  $\xrightarrow{\text{change}}$

$$j = 2$$



2	0	2	0
2	4	2	2
2	2	2	2
4	2	0	4



2	2	0	0
2	4	2	2
2	2	2	2
4	2	4	0

$$\text{pos} = 1 \rightarrow \text{pos} \neq j$$

⇒ change happened