

Set Matrix Zeros

For this problem we must modify the matrix in place to set entire rows and columns to zero if any cell is zero.

The follow-up asks for a constant space solution.

Approach: Constant Space Using First Row and First Column.

Key Idea:

- Using first row and first column as markers:
 - If $\text{matrix}[i][j] == 0$, mark $\text{matrix}[i][0] = 0$ and $\text{matrix}[0][j] = 0$.
- Use two extra booleans to track if first row & first column itself should be zeroed.
- After marking:
 - Iterate matrix (excluding first row/column) to set zeros based on markers.
- Finally, zero out first row/column if needed.

Algorithm:

1. Check first row and first column for zeros and store flags firstRowZero and firstColZero.
2. Traverse matrix from (1,1):
 - If any cell is 0, mark $\text{matrix}[i][0]$ and $\text{matrix}[0][j]$ as 0.
3. Traverse again (excluding first row/col):
 - If $\text{matrix}[i][0] == 0$ or $\text{matrix}[0][j] == 0$, set $\text{matrix}[i][j] = 0$.
4. If firstRowZero is true, zero out first row.
5. If firstColZero is true, zero out first column.

Complexity:

- Time: $O(m \times n)$ - two passes through the matrix.
- Space: $O(1)$ - only boolean flags, markers stored in matrix itself.