Maximal Rectangle Area LeetCode

Given a binary matrix representing a grid of '0's and '1's, you need to find the area of the largest rectangle that can be formed by considering the '1's in the matrix.

Example: Consider the following binary matrix:

1 0 0 0 1

1 0 1 1 1

0 0 1 1 1

1 0 1 1 1

0 1 1 1 1

1 1 0 1 0

Output: The maximal rectangle area that can be formed using the '1's in the given matrix is 12.

1. The problem can be solved using the "Largest Rectangle in Histogram" approach applied to each row in the matrix.
2. For each row in the matrix:
    - Update a histogram array that represents the heights of columns based on the presence of '1's.
    - Apply the "Largest Rectangle in Histogram" algorithm to find the largest rectangle area for the histogram.
    - Update the maximum area if a larger rectangle is found.
3. Return the maximum area as the final answer.

Approach 1: Maximal Rectangle area using stack based approach

- For each row in the matrix:
    - Update the histogram array based on the presence of '1's.
    - Calculate the largest rectangle area for the current histogram using the "Largest Rectangle in Histogram" algorithm.
    - Update the maximum area if a larger rectangle is found.

Time Complexity:

- Let N be the number of rows and M be the number of columns in the matrix.

- For each row, the time complexity of calculating the largest rectangle area is O(M).
- **Overall time complexity: O(N * M).**

Space Complexity:

- We use extra space to store the histogram array.
- **Space complexity: O(M) (for storing histogram heights).**