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**Project 4 Test Cases – Largest Submatrix of Ones**

1. A matrix of all 0’s

0 0 0

0 0 0

0 0 0

Expected Output: Largest Submatrix of Ones has area: 0

Actual Output: Largest Submatrix of Ones has area: 0

1. A matrix of all 1’s

1 1 1

1 1 1

1 1 1

Expected Output: Largest Submatrix of Ones has area: 9

Actual Output: Largest Submatrix of Ones has area: 9

1. A matrix with single 1 as the greatest 1’s rectangle

0 0 0

0 1 0

0 0 0

Expected Output: Largest Submatrix of Ones has area: 1

Actual Output: Largest Submatrix of Ones has area: 1

1. A matrix with a greatest 1’s square

0 1 1

0 1 1

0 0 0

Expected Output: Largest Submatrix of Ones has area: 4

Actual Output: Largest Submatrix of Ones has area: 4

1. A matrix with a greatest 1’s rectangle

0 1 1

0 1 1

0 1 1

Expected Output: Largest Submatrix of Ones has area: 6

Actual Output: Largest Submatrix of Ones has area: 6

1. A matrix with a single column as its greatest submatrix:

1 0 0

1 0 0

1 0 0

Expected Output: Largest Submatrix of Ones has area: 3

Actual Output: Largest Submatrix of Ones has area: 3

1. A matrix with a single row as its greatest submatrix:

1 1 1

0 0 0

0 0 0

Expected Output: Largest Submatrix of Ones has area: 3

Actual Output: Largest Submatrix of Ones has area: 3

1. A matrix with a single greatest 1’s rectangle

1 1 0

1 1 0

0 0 1

Expected Output: Largest Submatrix of Ones has area: 4

Actual Output: Largest Submatrix of Ones has area: 4

1. A matrix with two or more equal greatest 1’s rectangles

1 1 0 0

1 1 0 0

0 0 1 1

0 0 1 1

Expected Output: Largest Submatrix of Ones has area: 4

Actual Output: Largest Submatrix of Ones has area: 4

1. A matrix with two or more equal, overlapping greatest 1’s rectangles

1 1 0

1 1 1

1 1 1

Expected Output: Largest Submatrix of Ones has area: 6

Actual Output: Largest Submatrix of Ones has area: 6

**Discussion of Test Cases**

All test cases worked as expected, outputting the expected area of the largest submatrix of 1’s. By using a histogram and stack of pairs scheme we were able to provide O(n^2) time complexity. The histogram indicates the number of contiguous 1’s in a row and the stack of pairs uses those values to find the rectangle of 1’s with the largest area The program was tested with randomly generated matrices up to \* by \* and maintained time complexity and output accuracy.

**Time Complexity Analysis**

\* Analysis only includes the steps taken in findLargestSubmatrix() function.