DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING

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Experiment-9(A)

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Semester: 6 **Date of Performance:** 15-03-25
Subject Name: Advanced Programming Lab-2 **Subject Code:** 22CSH-359

1. **Title:** Miscellaneous (Hamming Distance)

2. **Objective:** To calculate the number of differing bits between two integers.

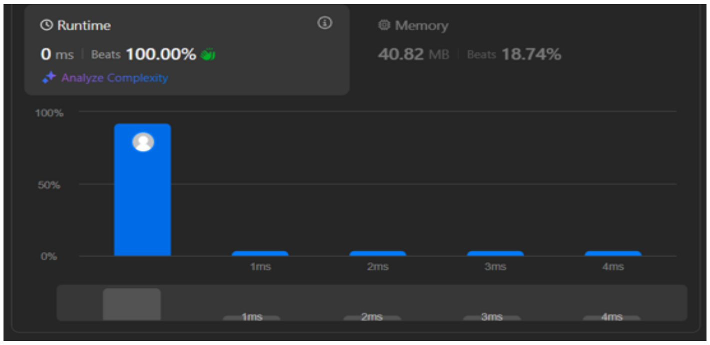
3. **Algorithm:**

- **Input:** Two integers `x` and `y`.
- **XOR Operation:**
  - XOR the two numbers to identify differing bits.
- **Bit Count:**
  - Count the number of `1`s in the XOR result.

4. **Implementation/Code:**

```
class Solution {
    public int hammingDistance(int x, int y) {
        return Integer.bitCount(x ^ y);
    }
}
```

5. **Output:**



Runtime
0 ms | Beats 100.00%
Analyze Complexity

Memory
40.82 MB | Beats 18.74%

1. **Time Complexity:** O (1)

7. **Space Complexity:** O(1)

Experiment 9(B)

1. **Title:** Divide Two Integers

2. **Objective:** To perform integer division without using multiplication, division, or modulo operators.

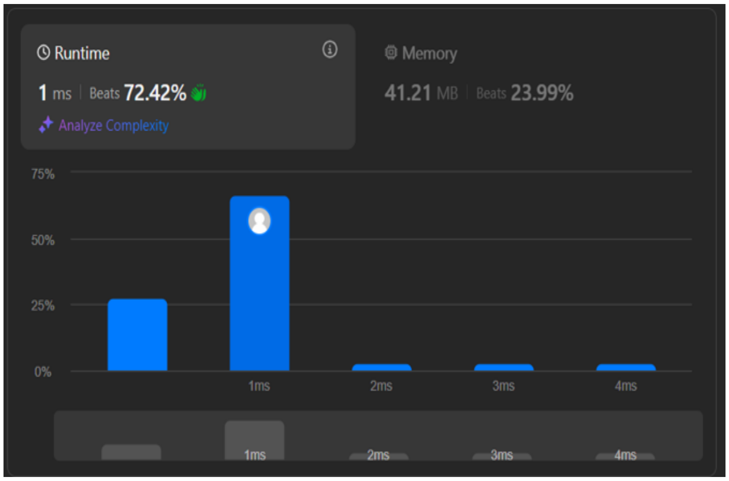
3. **Algorithm:**

- **Input:** Two integers `dividend` and `divisor`.
- **Handle Edge Cases:**
  - If `dividend = Integer.MIN_VALUE` and `divisor = -1`, return `Integer.MAX_VALUE`.
- **Sign Calculation:**
  - Calculate the sign using XOR: `(dividend < 0) ^ (divisor < 0)`.
- **Convert to Positive:**
  - Take absolute values of `dividend` and `divisor`.
- **Repeated Subtraction (Bitwise Shift):**
  - Iterate while `dividend >= divisor`.
  - Continuously shift the divisor left by 1 and subtract to accumulate the result.
- **Output:** Return the result with the calculated sign.

4. **Implementation/Code:**

```
class Solution {
    public int divide(int dividend, int divisor) {
        if (dividend == Integer.MIN_VALUE && divisor == -1)
            return Integer.MAX_VALUE;

        int sign = (dividend < 0) ^ (divisor < 0) ? -1 : 1;

        long ldividend = Math.abs((long) dividend);
        long ldivisor = Math.abs((long) divisor);

        int result = 0;
        while (ldividend >= ldivisor) {
            long temp = ldivisor, multiple = 1;
            while (ldividend >= (temp << 1)) {
                temp <<= 1;
                multiple <<= 1;
            }

            ldividend -= temp;
            result += multiple;
        }

        return sign * result;
    }
}
```

5. Output:



Runtime

1 ms | Beats 72.42%

Analyze Complexity

Memory

41.21 MB | Beats 23.99%

6. Time Complexity: O(log n)

7. Space Complexity: O(1)

8. Learning Outcome:

- Learned efficient bitwise operations for arithmetic calculations.
- Mastered handling of integer limits and edge cases.

Experiment 9(C)

1. Title: Pascal's Triangle

2. Objective: To generate the first numRows of Pascal's Triangle.

3. Algorithm:

- **Input:** An integer numRows.
- **Initialization:** Create an empty list triangle to store the rows.
- **Iteration:**

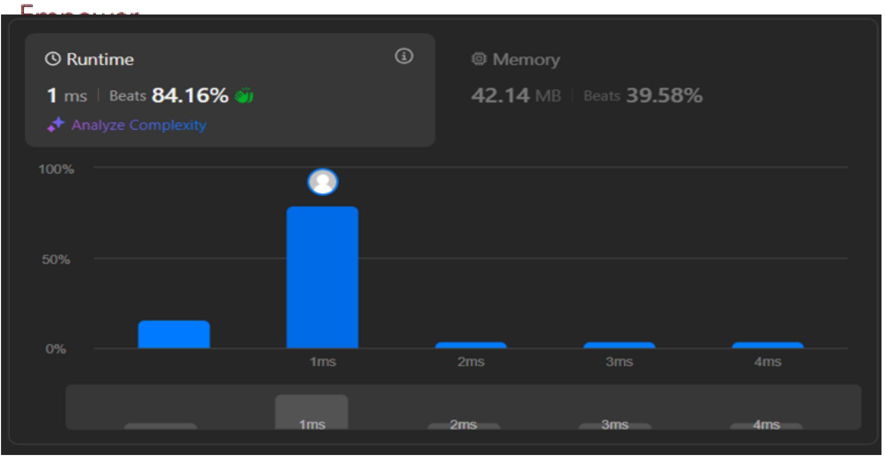
```
• For each row i:
    o Create a list with i + 1 elements, initialized to 1.
    o For each element j from index 1 to i - 1:
        ▪ Set row[j] = triangle[i-1][j-1] + triangle[i-1][j].
    o Append this row to triangle.
```

- **Output:** Return the triangle.

4. Implementation/Code:

```
import java.util.*;

class Solution {
    public List<List<Integer>> generate(int numRows) {
        List<List<Integer>> triangle = new ArrayList<>();

        for (int i = 0; i < numRows; i++) {
            List<Integer> row = new ArrayList<>(Collections.nCopies(i + 1,
1));

            for (int j = 1; j < i; j++) {
                row.set(j, triangle.get(i - 1).get(j - 1) + triangle.get(i -
1).get(j));
            }

            triangle.add(row);
        }

        return triangle;
    }
}
```

5. Output:



Runtime

1 ms | Beats 84.16%

Analyze Complexity

Memory

42.14 MB | Beats 39.58%

8. Time Complexity: O(n^2) **9. Space Complexity:** O(n^2)

10. LearningOutcomes:

- Learned efficient bit manipulation techniques.
- Understood the XOR operation for identifying differing bits.
- Gained a better understanding of combinatorial mathematics.
- Practiced 2D array manipulation in Java.