

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Experiment-9(A)

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Branch: CSE

Semester: 6

Subject Name: Advanced Programming Lab-2

UID: 22BCS16124

Section/Group: NTPP_602-A

Date of Performance: 15-03-25

Subject Code: 22CSH-359

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

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

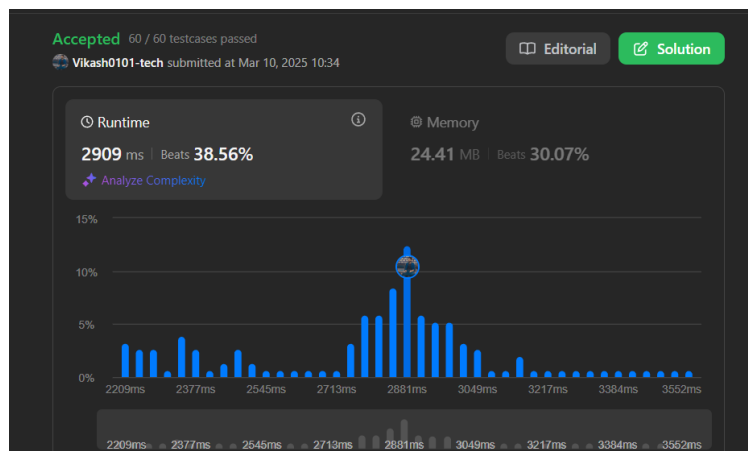
3. **Algorithm:**

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

4. **Implementation/Code:**

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

5. **Output:**



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

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



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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: $(\text{dividend} < 0) \wedge (\text{divisor} < 0)$.
 - **Convert to Positive:**
 - Take absolute values of dividend and divisor.
 - **Repeated Subtraction (Bitwise Shift):**
 - Iterate while dividend \geq 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;
```



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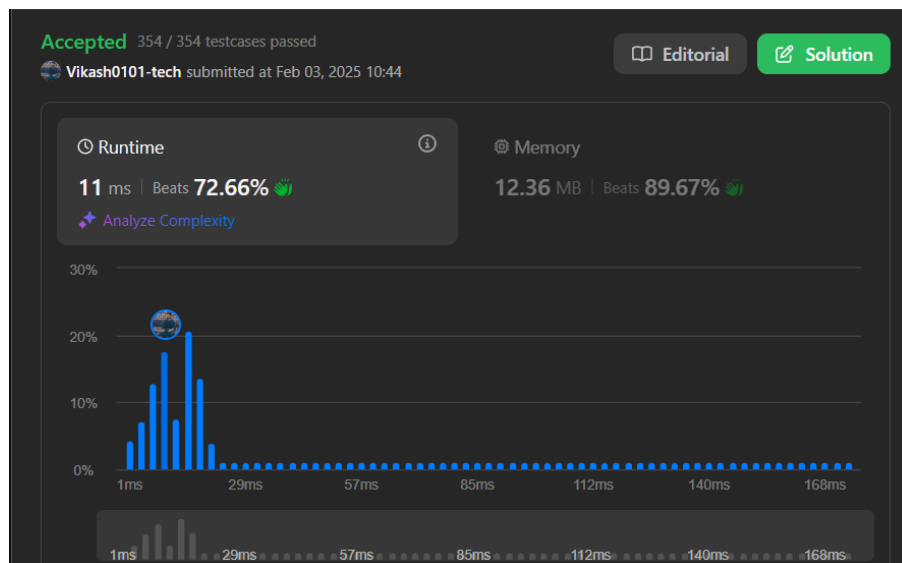
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```
        while (ldividend >= (temp << 1)) {
            temp <= 1;
            multiple <= 1;
        }

        ldividend -= temp;
        result += multiple;
    }

    return sign * result;
}
```

5. Output:

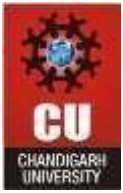


6. Time Complexity: $O(\log n)$

7. Space Complexity: $O(1)$

8. Learning Outcome:

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



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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:
 - Create a list with $i + 1$ elements, initialized to 1.
 - For each element j from index 1 to $i - 1$:
 - Set $\text{row}[j] = \text{triangle}[i-1][j-1] + \text{triangle}[i-1][j]$.
 - Append this row to triangle.
- **Output:** Return the triangle.

4. Implementation/Code:

```
import java.util.*;

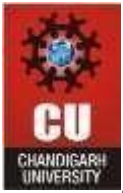
class Solution {
    public List<List<Integer>> generate(int numRows) {
        List<List<Integer>> triangle = new ArrayList<>();

        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);
        }

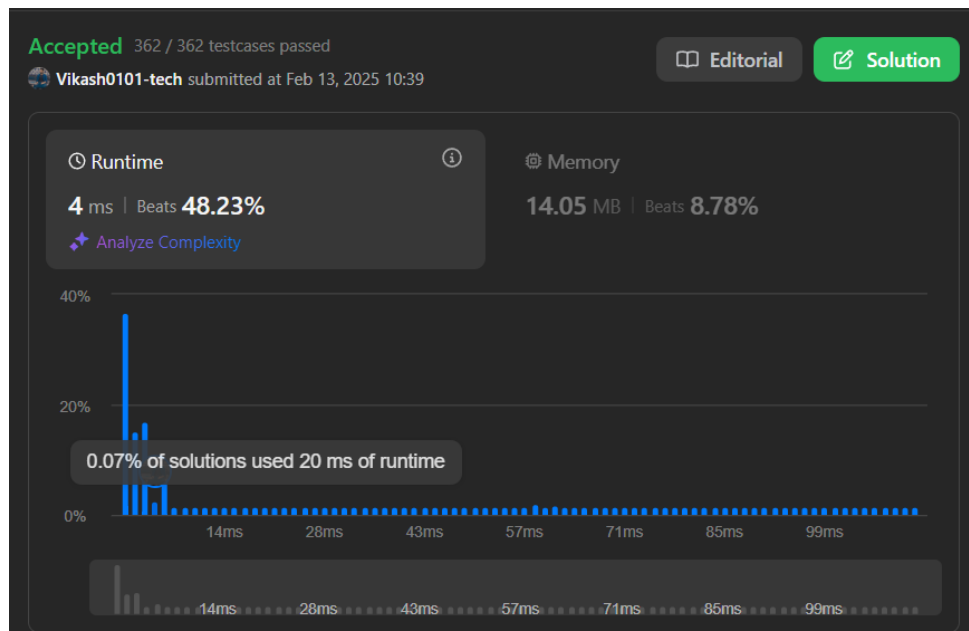
        return triangle;
    }
}
```



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5. Output:



8. Time Complexity: $O(n^2)$

9. Space Complexity: $O(n^2)$

10. Learning Outcomes:

- 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.