Algorithm Course Lab Report - Lab 1

Title: Lab 1
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1. Introduction

Objective. Analyze a algorithm for Domino and Tromino Tiling. The goal of this lab is to formalize the recurrence, argue correctness at a high level, implement the solution, and analyze complexity with small sanity checks.

Problem (summary). Given a $2 \times n$ board, count the tilings using 2×1 dominoes and L–shaped trominoes (rotations allowed). Return the answer modulo 10^9+7. Constraints: $1 \leq n \leq 1000$. Examples: n=1 $\Rightarrow$ 1, n=3 $\Rightarrow$ 5.

2. Results

All goals achieved: Yes **All sample tests passed:** Yes

Sample outputs.

n	ways
1	1
2	2
3	5
4	11
5	24
6	53
7	117
8	258
9	569
10	1255

3. Algorithm Framework

Let F(n) be the number of tilings for a $2 \times n$ board. Define G(n) as the number of *almost–filled* width configurations n ending with a single cell "stair" gap. This leads to the following transitions:

$$F(n) = F(n-1) + F(n-2) + 2\,G(n-2),$$
$$G(n) = F(n-1) + G(n-1).$$

Remove G to get $n \geq 3$:

$$\boxed{F(n) = 2F(n-1) + F(n-3)}$$

with 3 Base Cases - $F(0)$=1, $F(1)$=1, $F(2)$=2.

4. Complexity Analysis

The algorithm runs in **O(n) time** while requiring only **O(n) space**, or **O(1)** with optimization.

5. Lessons Learned, Feedback, and Conclusion

Since this was my first Lab, I spent extra time getting familiar with the tools/libraries. I enjoy this method of delivering assignments

6. References and Use of Tools

[List any other references you used in a standard citation format.]