DAA Assignment 6

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Q1.
Bruteforce:

```
int fib(int n)
{
    if (n <= 1)
        return n;
    return fib(n - 1) + fib(n - 2);
}

int countWays(int s) { return fib(s + 1); }
```

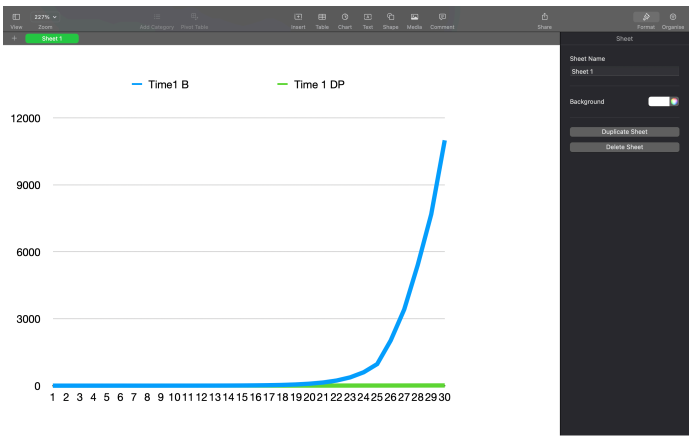
Complexity: **Time:O(2^n)**
Space:O(n)

Optimized (DP):

```
int countWays(int n, vector<int> &dp)
{
    if (n <= 1)
        return dp[n] = 1;

    if (dp[n] != -1) {
        return dp[n];
    }
    dp[n] = countWays(n - 1, dp) + countWays(n - 2, dp);
    return dp[n];
}
```

Complexity: **Time:O(n)**
Space:O(n)

Graph:



Analysis:

- —>Bruteforce Approach:
  - In this method, we explore all possible ways of climbing stairs, trying out every combination.
  - It involves a recursive approach, where we consider all possible combinations and calculate the total number of ways to climb stairs.
  - The main drawback is that it can be highly inefficient, especially for larger numbers of stairs, as it recalculates values for the same subproblems multiple times.
- —>Dynamic Programming Approach:
  - DP involves breaking down the problem into smaller subproblems and solving each subproblem only once, storing the solutions to avoid redundant calculations.
  - For climbing stairs, we use a DP table to store the number of ways to climb each step based on the solutions to subproblems.
  - This approach is more efficient as it eliminates redundant calculations, leading to a significant improvement in runtime.

Q2.

Bruteforce:

```
int numberOfPaths(int m, int n)
{
      if (m == 1 || n == 1)
      return 1;
      return numberOfPaths(m - 1, n)
          + numberOfPaths(m, n - 1);
   // + numberOfPaths(m-1, n-1);
}
```

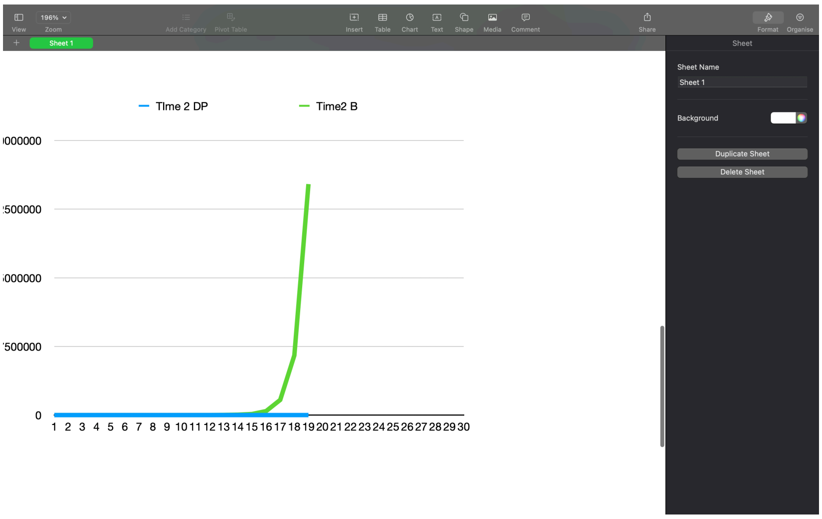
Complexity: Time:O(2^n)
Space:O(n+m)

Optimized(DP):

```
int numberOfPaths(int n, int m, vector<vector<int>> &DP)
{

   if (n == 1 || m == 1)
       return DP[n][m] = 1;

   // Add the element in the DP table
   // If it was not computed before
   if (DP[n][m] == 0)
       DP[n][m] = numberOfPaths(n - 1, m, DP)
                + numberOfPaths(n, m - 1, DP);

   return DP[n][m];
}
```

Complexity: **Time:O(n*m)**
Space:O(n*m)

Graph:



Analysis:

- —>Bruteforce Approach:
  - In this case, the bruteforce approach involves recursively exploring all possible paths from the top-left corner to the bottom-right corner of a grid.
  - We consider moving either right or down at each step, exploring all combinations until you reach the destination.
  - Similar to the stairs problem, this approach can become inefficient for larger grid sizes due to redundant calculations for the same subproblems.
- —>Dynamic Programming Approach:
  - The DP approach for the unique grid path problem involves building a table to store the number of unique paths to reach each cell in the grid.
  - Starting from the top-left corner, we iteratively fill in the table by summing up the number of paths from the cell above and the cell to the left.
  - By the time we reach the bottom-right corner, the DP table will contain the total number of unique paths, and we avoid recalculating the same subproblems.