**Exercise 7: Financial Forecasting**

**Scenario:**

You are developing a financial forecasting tool that predicts future values based on past data.

1. **Understand Recursive Algorithms:**

**Concept of Recursion**

**Recursion** is a programming technique where a function calls itself to solve a problem. The recursive approach involves breaking down a problem into smaller subproblems, solving each subproblem, and combining their solutions to solve the original problem. Each recursive call typically works on a smaller instance of the original problem, with the process continuing until it reaches a base case, which can be solved directly without further recursion.

**Key Components of Recursion:**

1. **Base Case:** The condition under which the recursion ends. Without a base case, the recursion would continue indefinitely, leading to a stack overflow.
2. **Recursive Case:** The part of the function where the function calls itself with a smaller or simpler input.

**Benefits of Recursion:**

* **Simplicity and Elegance:** Recursion can simplify the implementation of complex problems by breaking them down into simpler subproblems.
* **Natural Fit:** Certain problems, such as those involving hierarchical structures (e.g., tree traversal) or problems defined by recurrence relations, are naturally suited for recursive solutions.

**4. Analysis:**

**Time Complexity of the Recursive Algorithm**

In the given recursive algorithm for predicting future values, the time complexity can be analyzed as follows:

* Base Case: When n == 0, the function returns immediately. This takes constant time, O(1).
* Recursive Case: Each call to predictFutureValue results in exactly one additional call until n reaches 0.

For an input size of n, the function makes n recursive calls. Therefore, the time complexity is O(n).

**Optimizing the Recursive Solution**

**Memoization** is a technique used to optimize recursive algorithms by storing the results of expensive function calls and reusing them when the same inputs occur again. This avoids redundant computations, significantly improving efficiency.

Here’s how memoization can be applied to the recursive financial forecasting algorithm:

1. **Use a HashMap or an Array:** Store the results of each recursive call.
2. **Check Before Computing:** Before performing a recursive call, check if the result for the current period is already computed and stored.