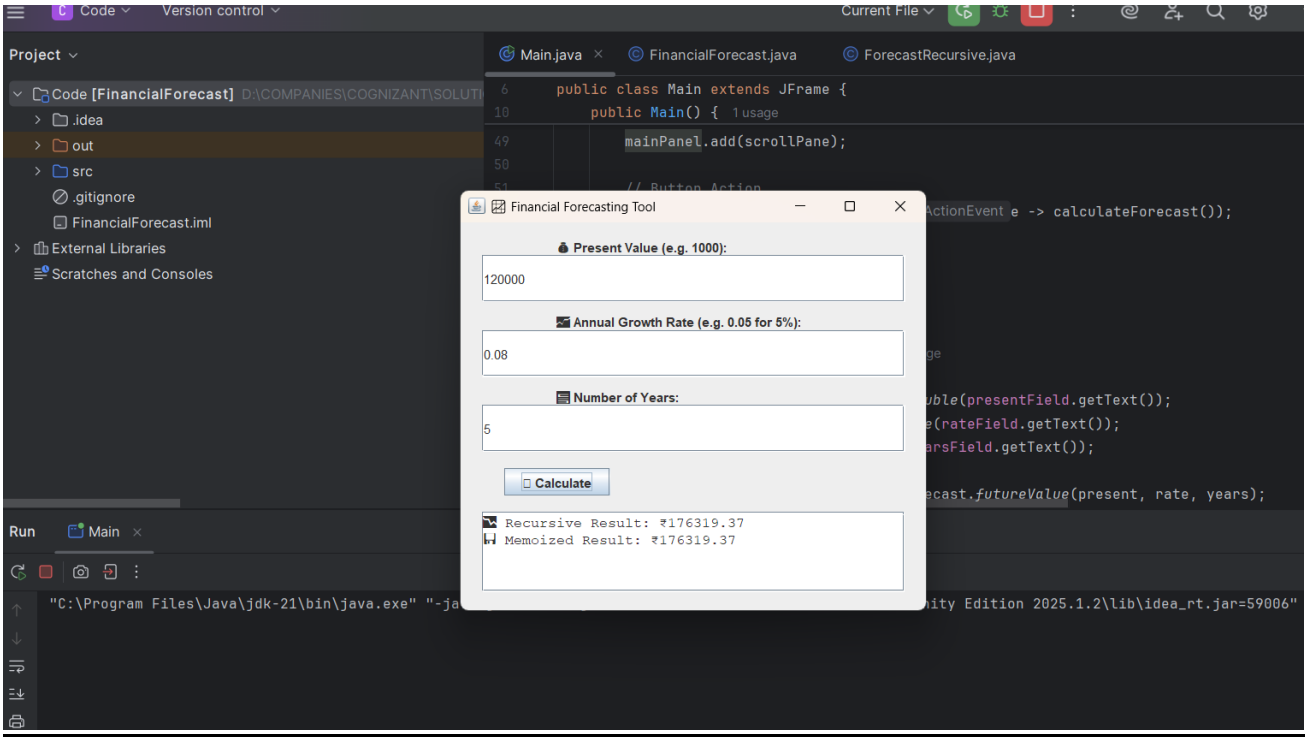
❖ Exercise 7: Financial Forecasting

Output :



1. Understanding Recursive Algorithms

Recursion is a programming concept where a function calls itself to solve smaller parts of a larger problem. It is useful when a problem can be broken down into simpler sub-problems of the same type. Recursion helps reduce code complexity and improves readability for certain problems like mathematical computations, tree structures, and forecasting models.

2. Setup: Calculating Future Value Using Recursion

In financial forecasting, recursion can be used to predict the future value of an investment based on a fixed growth rate. The idea is to start with a present value and apply the growth rate year by year. Each year's value is calculated based on the previous year's value. This process continues until we reach the target number of years.

3. Implementation Concept

The forecast starts with an initial amount called the present value. Each year, the value grows by a certain percentage known as the growth rate. Recursively, we apply the same calculation for each year until we reach the desired future year. This repetitive approach fits naturally with recursion, as each step depends on the result of the previous one.

4. Analysis

The recursive method is simple and easy to understand but can become inefficient for very large time periods due to repeated calculations. The time taken to compute increases with the number of years. To improve performance, the solution can be optimized using techniques like **memoization** (storing already calculated values) or using a **loop** instead of recursion for better efficiency.

Feature	Recursion	Memoization
Definition	A function that calls itself to solve smaller subproblems	An optimization technique that stores results of previous function calls
Repetition of Work	May repeat calculations many times	Avoids repetition by caching results
Speed	Slower for large inputs	Faster due to reuse of stored results
Memory Usage	Uses call stack memory	Uses extra memory to store results
Base Case Required	Yes	Yes
Time Complexity	Often exponential (e.g., $O(2^n)$)	Reduced to linear or polynomial time (e.g., $O(n)$)
Use Case	Simple problems, conceptual clarity	Performance-critical problems
Example Use	Fibonacci, factorial, tree traversals	Optimized Fibonacci, dynamic programming