Exercise 1: Inventory Management System

1. Understanding the Problem:

Why Data Structures and Algorithms Are Essential in Inventory Management:

1. Efficient Data Handling:

- A warehouse inventory system deals with potentially thousands of products.

- Efficient data structures ensure operations like searching for a product, updating quantity, or removing a discontinued item are fast and reliable.

2. Scalability:

- As the warehouse grows, the data structure must support an increasing number of products without performance degradation.

3. Real-Time Operations:

- In modern inventory systems, changes must reflect in real-time across sales, procurement, and warehouse operations.

- Algorithms and data structures enable consistent and fast updates across the system.

4. Memory Optimization:

- A good data structure minimizes memory usage while maintaining access speed.

Suitable Data Structures for Inventory:

1. ArrayList:

- Stores data in an ordered collection.

- Easy to iterate and display all products.

- However, search, update, and delete operations are O(n) in the worst case.

2. HashMap:

- Provides constant-time complexity (O(1)) for search, insert, and delete operations using keys (e.g., productId).

- Suitable when products are accessed frequently by ID.

3. TreeMap:

- Maintains order based on keys.

- Useful when sorted data is needed (e.g., by productId).

- Operations are O(log n).

4. LinkedList:

- Not ideal for inventory unless operations require frequent insertions/deletions in the middle of the list.

5. Database (Beyond Scope of In-Memory Structures):

- For persistent, scalable inventory systems, integration with databases like MySQL, PostgreSQL, or NoSQL is recommended.

- However, for in-memory operations, HashMap is the most optimal choice.