**Exercise 1: Inventory Management System**

**Explain why data structures and algorithms are essential in handling large inventories.**

Data structures and algorithms are crucial in handling large inventories because:

1. **Efficiency**: They help in organizing and managing data efficiently, which is essential when dealing with large volumes of data.
2. **Performance**: Efficient data structures and algorithms ensure that operations such as adding, updating, and deleting products can be performed quickly, which is vital for maintaining system performance.
3. **Scalability**: Proper use of data structures and algorithms allows the system to scale and handle increasing amounts of data without a significant drop in performance.

**Discuss the types of data structures suitable for this problem.**

For an inventory management system, the following data structures are suitable:

1. ArrayList: Good for maintaining a dynamic list of products with fast access times.
2. HashMap: Ideal for quick retrieval, addition, and deletion of products using a unique key (productId).

**Analyze the time complexity of each operation (add, update, delete) in your chosen data structure.**

Time Complexity Analysis

1. Add Product: O(1) on average for HashMap.
2. Update Product: O(1) on average for HashMap.
3. Delete Product: O(1) on average for HashMap.

**Discuss how you can optimize these operations.**

* Batch Operations: Implement batch add, update, and delete operations to reduce the overhead of multiple operations.
* Indexing: Use indexing on attributes that are frequently searched or filtered to improve query performance.
* Concurrency Control: Implement concurrency control mechanisms if the inventory system is accessed by multiple threads to ensure data consistency and integrity.