**Exercise 1: Inventory Management System**

1. **Understand the Problem:**
   * **Explain why data structures and algorithms are essential in handling large inventories.**

**Ans:** Data structures and algorithms help in performing operations like insertion, deletion, searching and updating quickly which is very important for large inventories.

For the large inventories efficient data structures ensures that the system remains responsive and can handle large datasets.

Proper and suitable data structures ensures that resources are used efficiently and optimizes the use of memory.

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

**Ans:** The suitable data structure for this inventory management system are : ArrayList, HashMap, LinkedList. But, for this particular problem I prefer a HashMap is a suitable choice for it’s O(1) average time complexity for insertion, deletion, searching, updating.

1. **Analysis:**
   1. **Analyse the time complexity of each operation (add, update, delete) in your chosen data structure.**

**Ans:** Add Product : Average Case: O(1), Worst Case: O(n)

Update Product : Average Case: O(1), Worst Case: O(n)

Search Product :Average Case: O(1), Worst Case: O(n)

Delete Product :Average Case: O(1), Worst Case: O(n)

Display a product: Average Case: O(1), Worst Case: O(n)

Display all products: Average Case: O(n), Worst Case: O(n)

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

**Ans:** Using LinkedHashMap: It maintains the insertion order.

Lazy Deletion: Instead of direct removing, I can make them inactive and remove them periodically.

Batch Operation: Inserting multiple products at once as a batch.

Immutable Keys: Using Immutable keys to ensure consistent hashing and avoid issue with key mutation.