**Exercise 1: Inventory Management System**

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

* 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.**
* 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.**

* **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.**
* **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.