**Exercise 1: Inventory Management System**

**Scenario:**

You are developing an inventory management system for a warehouse. Efficient data storage and retrieval are crucial.

**Steps:**

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

**Ans**. They are crucial for creating efficient, powerful algorithms and help in handling large amounts of data systematically. Data structures like arrays, linked lists, trees, and graphs each have unique qualities that make them suited for specific tasks.

Understanding data structures is a cornerstone of programming and computer science. They are vital for storing and organizing data, which is essential for writing efficient and effective code. This introduction paves the way for exploring more complex data structures and their applications in future discussions.

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

**Ans**. For this problem we use **ArrayList** And **HashMap**. Because we know the Arraylist is good for Maintaining a list of items are ordered matters and quick accessing by index is required. And the other side the hazmat is an excellent pass lookups like Edison Dutton and updates in based on a key. This is use particularly suitable for inventory management at each item is uniquely identified by the unique product ID.

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

**Time Complexity:**

* + - **Add Product:** O(1) on average cases because the HashMap data structure provide constant time complexity for add operation.
    - **Update Product:** O(1) On average cases since updating a value in a HashMap data structure involves replacing the value associated with key which is constant time operation
    - **Delete Product:** O(1) because it has made removing a key helophier it’s also a constant time operation
    - **Display Product:** O(n) Fire in is the number of products as all products needs to iterate over
  + Discuss how you can optimize these operations.

For a multi-threaded environment, we use concurrent hazmat to handle concurrent access. We also ensure that the hazmat is appropriately seized in initial state to avoid repeatedly resizing. It can be done by providing an initial capacity that is large enough to handle the expected number of products. Which providing a foundation for an efficient inventory management system using HashMap to handle operation efficiently.