**Exercise 1: Inventory Management System**

**Why Data Structures and Algorithms are Essential in Handling Large Inventories:**

* **Efficiency:** Efficient data structures and algorithms ensure that operations like adding, updating, and deleting products are performed quickly, which is crucial for maintaining a smooth workflow in a large warehouse.
* **Scalability:** As the inventory grows, the system must handle larger datasets without significant performance degradation.
* **Resource Management:** Proper use of data structures helps in optimal use of memory and processing power.
* **Search and Retrieval:** Efficient searching and retrieval mechanisms are essential for quick access to product information.

**Types of Data Structures Suitable for This Problem:**

* **ArrayList:** Useful for storing elements in a sequential manner. It provides fast access but can be slow for insertion and deletion in the middle of the list.
* **HashMap:** Provides average O(1) time complexity for insertions, deletions, and lookups, making it ideal for inventory management where quick access to products based on their IDs is required.
* **LinkedList:** Useful for scenarios where insertions and deletions are frequent and can occur at any position.
* **Binary Search Tree (BST):** Useful for maintaining a sorted order of elements and provides average O(log n) time complexity for insertions, deletions, and lookups.

**Time Complexity Analysis:**

* **Add Operation:**
  + **Average Case:** O(1)
  + **Worst Case:** O(n)
* **Update Operation:**
  + **Average Case:** O(1)
  + **Worst Case:** O(n)
* **Delete Operation:**
  + **Average Case:** O(1)
  + **Worst Case:** O(n)