**Exercise 1: Inventory Management System**

Efficient statistics storage and retrieval are important in an inventory management gadget, in particular whilst dealing with massive inventories. Data systems and algorithms play a important function in handling such structures, as they allow fast and green operations.

**Data Structures and Algorithms are Essential Because Of Its:**

• Scalability: Data structures and algorithms help handle large inventories by means of imparting efficient ways to store and retrieve statistics.

• Performance: They permit rapid operations, which includes looking, including, updating, and deleting merchandise, which is essential in an stock control machine.

• Organization: Data systems help prepare facts in a structured manner, making it less complicated to manipulate and examine inventory statistics.

**Types of Data Structures Suitable for this Problem are:**

• ArrayList: Suitable for storing a large series of products, bearing in mind green generation and indexing.

• HashMap: Ideal for storing merchandise with specific identifiers (e.G., product IDs), enabling rapid lookups and green storage.

• Tree-based totally Data Structures (e.G., AVL Tree, B-Tree): Suitable for storing huge inventories with common insertions, deletions, and searches.

**Implementation:**

Please refer the attached code.

**Analysis**

Time Complexity Analysis

• Add Operation: O(1) for ArrayList (amortized), O(log n) for HashMap (common case)

• Update Operation: O(n) for ArrayList, O(1) for HashMap (common case)

• Delete Operation: O(n) for ArrayList, O(1) for HashMap (common case)

Optimization Techniques

• Use a extra green facts shape: Consider the usage of a HashMap for fast lookups and efficient storage.

• Implement caching: Cache regularly accessed merchandise to lessen the quantity of searches.

• Use indexing: Implement indexing at the productId subject to speed up searches.

• Optimize seek algorithms: Use extra efficient seek algorithms, inclusive of binary seek, to lessen the time complexity of searches.