Analysis of Data Structures for Inventory Management System

# 1. Introduction

An inventory management system needs to handle large amounts of data efficiently. Choosing the right data structure is crucial for operations such as adding, updating, deleting, and retrieving product information.

# 2. Data Structure Options

## 2.1 List (ArrayList)

A List allows storing objects in an ordered manner. However, searching for a specific product requires linear scanning, which becomes inefficient as the inventory grows.

## 2.2 Dictionary (HashMap)

A Dictionary uses key-value pairs and allows fast lookup, insertion, and deletion using the key (e.g., product ID). It is highly efficient for large datasets and is the preferred choice for inventory systems.

# 3. Time Complexity Comparison

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| --- | --- | --- | --- |
| Operation | List (O-notation) | Dictionary (O-notation) | Recommended |
| Add | O(1) | O(1) | Dictionary |
| Update | O(n) | O(1) | Dictionary |
| Delete | O(n) | O(1) | Dictionary |
| Search | O(n) | O(1) | Dictionary |

# 4. Recommendation

For real-time inventory systems where performance is critical, using a Dictionary (HashMap) provides efficient and scalable data access. It ensures constant-time performance for key operations, making it ideal for warehouse and retail inventory management.