Inventory Management System

1. Understand the Problem:

* Efficient data structures and algorithms are crucial for handling large inventories because they help in optimizing performance, reduce complexity, and enhance scalability.
* For an inventory management system, there are two data structures that will be suitable: ArrayList which are good for dynamic arrays where elements can be accessed by index; and; HashMap which are ideal for key-value pairs, allowing fast retrieval, insertion, and deletion based on unique keys.

1. Setup:

* A new Java Project was created in the IDE.

1. Implementation:

* The “Product” class was defined.
* The data structure used here is HashMap to store the products and the key is “productId”

1. Analysis:

* Time Complexity:
* Add Product: O(1)
* Update Product: O(1)
* Delete Product: O(1)
* Retrieve Product: O(1)
* Optimization can be done using batch operations where batch add/update/delete methods can be implemented to handle multiple products at once, reducing overhead. Another method to do this is indexing. If the inventory grows very large, additional indexing mechanisms or database solutions can be considered.