Inventory Management Analysis

1 . ArrayList :

- ArrayList is a resizeable array implementation of List interface. It helps us to implement all List operations. It has fast index based data access. In the given scenario, we have multiple functions to add , update and delete the data. But arraylist requires linear search O(n) for updates and deletes. This makes it less efficient when compared to HashMap

2 . HashMap:

- HashMap uses Key value pair for faster retrival of data. It provides a constant time complexity of O(1) for add, update and delete. Therefore, it is more efficient than ArrayList.

3 . Time Complexities

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| --- | --- | --- |
| Operation | Data Structure | Time Complexity |
| Add Product | HashMap | O(1) |
| Update Product | HashMap | O(1) |
| Delete Product | HashMap | O(1) |

4 . How to Optimize ?

- Ensure `productId` is always unique and used as the key for fast lookups.  
- Avoid using ArrayList for frequent updates/deletes, as it requires linear search (O(n)).  
- Use `HashMap` for direct access using key.  
- For thread-safe operations, use `ConcurrentHashMap` instead of `HashMap`.  
- If sorted order is needed, consider using `TreeMap` (O(log n)) instead.