Exercise 1: Inventory Management System

Analysis:

- Analyze the time complexity of each operation (add, update, delete) in your chosen data structure.
- Discuss how you can optimize these operations.

Time Complexity

Operation	**Time complexity**	**Explanation**
Add	O(1)	Inserting a new key-value pair into a hash map takes constant time.
Update	O(1)	Updating the value of an existing key is direct via the hash.
Delete	O(1)	Deleting an item by key from the map is a constant-time operation.

Optimization

a) Add Operation

- Use Hash Map: Allows fast checking if an item already exists (for preventing duplicates).
- Input validation: Check if item ID already exists before adding.
- Optimize duplicate checks: Store a unique item_id for each product to prevent linear scans.

b) Update Operation

- Direct access via key: HashMap allows fast item retrieval and update.
- Batch Updates: For large updates (e.g., restocking many items), use batch processing or a loop over a preprocessed list.

c) Delete Operation

- Delete by Key: Use the item's unique ID for O(1) deletion.
- Lazy deletion (if needed): Mark items as inactive and clean up later in bulk