Exercise 2: E-commerce Platform Search Function

Scenario

You are working on the search functionality of an e-commerce platform. The goal is to optimize the search feature for fast performance and accuracy when locating products based on their name.

Understand Asymptotic Notation

What is Big O Notation?

Big O notation is used to describe the **efficiency** of an algorithm in terms of **time** and **space** complexity as the input size increases. It provides a mathematical upper bound on the runtime, helping developers understand the **scalability** of the algorithm.

Importance in Search Algorithms

Big O helps analyze how the performance of search operations grows with the number of elements (n). It aids in selecting the right algorithm for large-scale applications like e-commerce platforms.

Best, Average, and Worst Case Scenarios

Search Algorithm	Best Case	Average Case	Worst Case
Linear Search	O(1)	O(n)	O(n)
Binary Search	O(1)	O(log n)	O(log n)

- **Best Case**: The item is found at the first (or middle) position.
- **Average Case**: The item is found somewhere in the middle.
- **Worst Case**: The item is at the last position or not present at all.

Analysis

Time Complexity Comparison

Metric	Linear Search	Binary Search
Time Complexity	O(n)	O(log n)
Sorting Needed	No	Yes
Space Complexity	O(1)	O(1)

Measured Execution Times

Search Type	Execution Time
Linear Search	12.0817 ms
Binary Search	0.1935 ms

Discussion and Suitability

- **Linear Search** is simple and works well for **small or unsorted datasets**.
- **Binary Search** is significantly **faster** and ideal for **large, sorted datasets**.
- For a real-world e-commerce platform handling thousands of products, **Binary Search (or a more advanced search system like hashing or indexing)** is more appropriate due to its efficient performance.

Conclusion

Based on theoretical analysis and practical implementation:

- **Binary Search** is the preferred choice for performance-critical applications where the data can be pre-sorted or maintained in sorted order.
- For small or temporary data loads, **Linear Search** remains a valid and simpler option.