**Exercise 2: E-commerce Platform Search Function**

### ****1. Explain Big O Notation and How It Helps in Analyzing Algorithms****

**Big O Notation** is a mathematical notation used to describe the performance or complexity of an algorithm. It expresses how the running time or space requirements grow relative to the input size.

It helps in analyzing:

* How efficient an algorithm is as data size increases
* Which algorithm to choose based on performance
* Scalability and optimization of applications

Example:

* **O(1)**: Constant time (fastest)
* **O(n)**: Linear time
* **O(log n)**: Logarithmic time (very efficient for large inputs)

### ****2. Describe the Best, Average, and Worst-Case Scenarios for Search Operations****

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | **Case** | **Description** | | **Best Case** | The item is found at the first position (O(1) for linear search) | | **Average Case** | The item is somewhere in the middle of the collection (O(n/2) ≈ O(n)) | | **Worst Case** | The item is not found or is at the last position (O(n) for linear, O(log n) for binary search) | |  |

* For **linear search**, time increases linearly with the number of elements.
* For **binary search**, time increases logarithmically but only works on **sorted** data.

### ****Compare the Time Complexity of Linear and Binary Search Algorithms****

|  |  |  |
| --- | --- | --- |
| **Algorithm** | **Time Complexity** | **Requirements** |
| **Linear Search** | O(n) | Works on any list |
| **Binary Search** | O(log n) | Requires sorted list |

* Linear search scans each element one by one.
* Binary search divides the search range in half each time, making it much faster for large datasets.

### ****4. Which Algorithm Is More Suitable and Why?****

**Binary search** is more suitable for an e-commerce platform because:

1. Product catalogs are often large
2. Fast response time is critical
3. Binary search provides much better performance (O(log n)) than linear search (O(n))

However, binary search requires the product list to be **sorted**. If sorting is done once and reused, binary search becomes highly efficient and scalable. Binary search works faster and efficient pn larger datasets.