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

**1. Understand Asymptotic Notation**

**Big O Notation**

* **Big O Notation**: A mathematical representation to describe the upper bound of an algorithm's runtime performance as the input size grows. It helps in understanding the worstcase scenario in terms of time and space complexity.
  + **Example**: O(n), O(log n), O(n^2), where n is the size of the input.

**Best, Average, and Worst-Case Scenarios for Search Operations**

* **Best Case**: The scenario where the algorithm performs the minimum number of operations.
  + **Example**: For linear search, finding the target at the first position, O(1).
* **Average Case**: The expected scenario where the algorithm performs an average number of operations over all possible inputs.
  + **Example**: For linear search, finding the target somewhere in the middle, O(n/2) which simplifies to O(n).
* **Worst Case**: The scenario where the algorithm performs the maximum number of operations.
  + **Example**: For linear search, not finding the target or finding it at the last position, O(n).

**4. Analysis**

**Compare the Time Complexity**

* **Linear Search**:
  + **Best Case**: O(1) - The target is found at the first position.
  + **Average Case**: O(n) - The target is found somewhere in the middle.
  + **Worst Case**: O(n) - The target is not found or found at the last position.
* **Binary Search**:
  + **Best Case**: O(1) - The target is found at the middle position in the first comparison.
  + **Average Case**: O(log n) - The target is found after log(n) comparisons.
  + **Worst Case**: O(log n) - The target is not found after log(n) comparisons.

**Suitable Algorithm for the Platform**

* **Binary Search** is more suitable for the e-commerce platform if:
  + The product list is sorted or can be maintained in a sorted order.
  + The cost of maintaining a sorted list is justified by the significant performance gains in search operations, especially for large datasets.
* **Linear Search** is more suitable if:
  + The product list is not sorted and sorting the list is impractical due to frequent insertions and deletions.
  + The dataset is small enough that the performance difference between O(n) and O(log n) is negligible.