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

**Scenario:**

You are working on the search functionality of an e-commerce platform. The search needs to be optimized for fast performance.

**Steps:**

**1. Asymptotic Notation:**

Asymptotic notation is a mathematical concept used to describe the efficiency of algorithms. It provides a way to express the running time of an algorithm as a function of the input size. The most commonly used asymptotic notations are Big O, Big Ω, and Big Θ.

* **Big O Notation (O)**: Represents the upper bound of an algorithm's running time. It gives the worst-case scenario.
* **Big Ω Notation (Ω)**: Represents the lower bound of an algorithm's running time. It gives the best-case scenario.
* **Big Θ Notation (Θ)**: Represents both the upper and lower bounds of an algorithm's running time. It gives the average-case scenario.

**Search Operations Analysis**:

* **Best-case scenario**: The element to be found is at the beginning of the data structure.
* **Average-case scenario**: The element is somewhere in the middle.
* **Worst-case scenario**: The element is at the end or not present in the data structure.

**Analysis:**

Compare the time complexity of linear and binary search algorithms.

* **Linear Search**:
  + **Best-case time complexity**: O(1)
  + **Average-case time complexity**: O(n)
  + **Worst-case time complexity**: O(n)

Linear search iterates through the entire array until it finds the desired element or reaches the end of the array. It is simple to implement but not efficient for large datasets.

* **Binary Search**:
  + **Best-case time complexity**: O(1)
  + **Average-case time complexity**: O(log n)
  + **Worst-case time complexity**: O(log n)

Binary search divides the array into halves, repeatedly narrowing down the search range. It is more efficient than linear search but requires the array to be sorted beforehand.

**Conclusion**: For an e-commerce platform where search performance is crucial, **binary search** is generally more suitable due to its logarithmic time complexity. It offers significantly faster search times compared to linear search, especially for large datasets. However, it requires the product array to be sorted, which is an additional step but worthwhile for the performance gain.