# Exercise 2: E-commerce Platform – Search Function (Theory Answers)

## 🔹 Step 1: Understand Asymptotic Notation

### 🔸 What is Big O notation and how does it help in analyzing algorithms?

Big O notation describes the upper bound of an algorithm's running time as a function of the input size n. It helps in analyzing:  
- How an algorithm scales with large data  
- Performance comparison between algorithms  
- Identifying bottlenecks and areas for optimization  
  
For example:  
- O(n): time increases linearly with input size  
- O(log n): time increases slowly even with large input

### 🔸 What are the best, average, and worst-case scenarios for search operations?

Best Case: The target is found immediately (e.g., first element) → fastest outcome  
Average Case: The target is somewhere in the middle → realistic performance estimate  
Worst Case: The target is not found or at the last position → slowest outcome  
  
Examples:  
Linear Search:  
- Best: O(1)  
- Average: O(n/2) ≈ O(n)  
- Worst: O(n)  
  
Binary Search (sorted data):  
- Best: O(1)  
- Average: O(log n)  
- Worst: O(log n)

## 🔹 Step 4: Analysis

### 🔸 Compare the time complexity of linear search and binary search algorithms.

Algorithm | Time Complexity | Data Requirement  
----------------|----------------------|----------------------  
Linear Search | O(n) – linear time | Works on unsorted data  
Binary Search | O(log n) – logarithmic time | Requires sorted data

### 🔸 Which algorithm is more suitable for this e-commerce platform, and why?

Binary Search is more suitable if the product data is sorted (e.g., by product ID or name), because it:  
- Performs much faster (O(log n)) on large datasets  
- Scales better as the number of products grows  
  
However, if data is unsorted and cannot be sorted beforehand (due to real-time changes), Linear Search may be used but at the cost of performance.  
  
✅ Conclusion: Use Binary Search with sorted product data to ensure faster search performance, which is crucial in an e-commerce platform with potentially millions of products.