1. Understanding Asymptotic Notation

Asymptotic notation is a mathematical tool used to describe the performance (time or space complexity) of an algorithm as the input size (n) grows. It focuses on the trend of growth, not the exact timing, making it easier to compare algorithms in terms of scalability and efficiency.

There are three main types of asymptotic notation:

* Big O (O) – Worst-case scenario
* Big Omega (Ω) – Best-case scenario
* Big Theta (Θ) – Average or exact bound

Big O Notation (O)

Big O notation represents the upper bound on the time complexity. It tells us the maximum time an algorithm can take to execute as the input size grows.

| **Algorithm** | **Best Case** | **Average Case** | **Worst Case** | **Suitable For** |
| --- | --- | --- | --- | --- |
| Linear Search | O(1) | O(n) | O(n) | Unsorted/small data |
| Binary Search | O(1) | O(log n) | O(log n) | Sorted/large data |

* Linear Search might be used when filtering through a few user-selected products.
* Binary Search or Hash-based indexing is essential for scalable product searches on large catalogs.