| **Sieve Type** | **Definition** | **Time Complexity** | **Space Complexity** | **Use Cases / When to Use** |
| --- | --- | --- | --- | --- |
| **Basic Sieve** | Marks multiples of each prime starting from 2 | O(n log log n) | O(n) | For finding all primes up to n where n is not very large |
| **Optimized Sieve** | Basic sieve + starts marking from i\*i + skips even numbers after 2 | O(n log log n) | O(n) | Slightly faster; when n is large but still fits in memory |
| **Segmented Sieve** | Sieve over a **range [L, R]** using base primes up to √R | O((R - L + 1) \* log log R) | O(√R + R−L+1) | When you need primes in a **large range**, e.g. [10^9, 10^9 + 10^6] |
| **Bitwise Sieve** | Compresses boolean array using **bits** (8x memory saving) | O(n log log n) | O(n / 8) | Memory-constrained environments like embedded systems or competitive programming |
| **Linear Sieve** | Marks each number using its **smallest prime factor only once** | O(n) | O(n) | When you need **efficient prime generation + factorization** in linear time |