Problem 10 - Summation of Primes

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This document originally appeared as a blog post on my website. Find it at gautammanohar.com/euler/10.

1 Problem Statement

The sum of all primes below 10 is 2+3+5+7=17. Find the sum of all primes at most N.

2 My Algorithm

We use a Sieve of Eratosthenes to compute the primes up to the maximum possible value of N. We then construct a prefix sum array in $O(\frac{N}{\log N})$ time. Using a binary search, we find the index of largest prime less than N in $O(\log N - \log \log N)$ time. In O(1) time, we look up the corresponding partial sum of prime numbers. Our solution has time complexity $O(n \log \log n + \frac{n}{\log n} + T \log n)$, where T is the number of queries.