COP4250 – Assignment 1 Explanation

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Simply, my approach for this assignment was to create 8 threads and run them concurrently in a function that obtained info on all prime numbers within the range $[1, 10^8]$. Note that since 1 is not prime, the actual range used throughout the program is $[2, 10^8]$.

To give each thread an equal amount of work, each one was mapped onto an integer representing its starting point, anywhere in the range $[2, 10]$. This was put to use in the run function, where it obtains the number mapped onto from the thread and increments it by 8 in each iteration of the while loop. This ensures that all numbers in the range $[2, 10^8]$ will be accounted for throughout the entire span of the program.

In terms of the prime function to determine if a number is prime, my approach runs in $O(\sqrt{n})$ time. Mathematically, a prime number cannot be divisible by any number that is not itself or 1, so if $n \,\%\, i = 0$, the number cannot be prime. The important part about my implementation that makes it efficient is that last possible iteration of the while loop is at $i = \sqrt{n}$. This is because if n is not divisible by any ≥ 2 number at this point, no number from $(\sqrt{n}, n)$ will be divisible. This works because considering all possible pair of factors, all numbers $> \sqrt{n}$ must be multiplied by a number $< \sqrt{n}$ to be equal to n. However, if at this point n is not divisible by any number from $[2, \sqrt{n})$, then it cannot be divisible by any number from $(\sqrt{n}, n)$. Thus, it is optimal to stop the loop at $i = \sqrt{n}$.

I ran my program under two versions, one with threads and one without. Without using threads and just directly iteration from $[2, 10^8]$, the time averaged around 68 seconds. Using my submitted approach with 8 threads, the time averaged was around 24 seconds, a deduction of around 3 times of the version with no threads. This shows that concurrency with multiple threads can be used to save a great amount of time in determining what numbers in a certain range are prime.