Homework 3 (due Oct 20, 2004)

(25 points each)
Based on exercises from Quinn’s Book

How to submit your homework
To qualify for the full credits
• Email your source codes to me at wchantam@cs.kent.edu by the due date. Please make the emails’ subject line as PDC_HW3_yourname--your email will be put in another folder automatically by my outlook program--and please submit your codes as the attachment files
• Submit the document for PCAM design methodology, benchmarks, and speedups in class by the due date

Exercise 4.9 (page 112)
The gap between consecutive prime numbers 2 and 3 is only 1, while the gap between consecutive primes 7 and 11 is 4.

Write a MPI program to determine, for all integers less than 1,000,000 (1 million), the largest gap between a pair of consecutive prime numbers. Your program should output the two consecutive primes \([prime X]\) and \([prime Y]\) with the largest gap \([Y-X]\).

Document your design methodology on each step of PCAM.

Benchmark your program on 1, 2, 3, and 4 nodes and compute the speedups when running with 2, 3, and 4 nodes.

Exercise 5.9 (page 135)
All the parallel developed in chapter 5 are the result of a domain decomposition of the original algorithm.

Write a MPI Sieve of Eratosthenes program based upon a functional decomposition of this algorithm.

Suppose there are \(p\) processes finding a prime up to \(n\). The program gets these parameters from the command line (the prompt).

In the first step each process independently identifies prime up to \(\sqrt{n}\).

In step two each process sieves the list of integer with 1/\(p^{th}\) of the primes between 2 and \(\sqrt{n}\).

During the third step the processes OR-reduce their arrays into a single array held by process 0.

In the last step process 0 counts the unmarked elements of the array and print the prime count.

For example, suppose three processes are cooperating to find primes up to 1000. Each process allocates an array of 999 elements, representing the integers 2 through 1000. Each process identifies the primes less than or equal to \(\sqrt{1000}\) : 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31. Process 0 sieves its array with primes 2, 7, 17, and 29; process 1 sieves its array with the primes 3, 11, 19, and 31; and process 2 sieves its array with the primes 5, 13, and 23.

Document your design methodology on each step of PCAM.

Benchmark your program on 1, 2, 3, and 4 nodes (for \(n = 50,000,000\)) and compute the speedups when running with 2, 3, and 4 nodes.