Department of CSE, The University of Texas at Arlington

CSE5351/4351: Parallel Processing

Spring 2022

Homework Assignment 3

Q 1. (20 points) A sequential implementation of the Sieve of Earthosthenes marks about 2.2 million cells in order to compute all primes less than 1 million. Estimate (using the formula) the maximum speedup achievable by the control-parallel (shared memory) version of the Sieve of Erathosthenes as it finds all the primes less than 1 million.

Q 3. (20 points) Assuming a data-parallel approach on a distributed memory computer, calculate the speedup for n= 1,000,000 and $\lambda = 100X$. Repeat the same for $\lambda = 500X$ and $\lambda = X$. Calculate these speedups for 2, 3, 4, 5, ...16, 32 processors and show the numbers in a table. Also draw a figure showing the three curves of speedup (one for each λ to ratio X).

Q2. (**20 points**) Since 2 is the only even prime, one way to save memory and improve the speed of the sequential Sieve of Eratosthenes algorithm is to have the elements of the Boolean array represent only odd numbers. In this scheme, the first sieve step would mark multiples of the prime number 3. Then
(a) Estimate the reduction in execution time of the sequential algorithm resulting from this improvement for n = 1,000, and n = 1,000,000 (5 point).
(b) The improved sequential algorithm can be used as the basis for an improved data-parallel algorithm. Using the machine model of non-shared distributed memory, and assuming $\lambda = 100X$, estimate the execution time of the improved data-parallel algorithm for 1, 2,..., 16 processors (5 points).
(c) Compute the speedup of the improved data-parallel algorithm over the improved sequential algorithm. Compare this speedup with the speedup estimated for the original data-parallel algorithm (5 points).
(d) Why does the improved data-parallel algorithm achieve different speedup than the original data-parallel algorithm? (5points).

Q 4. (20 points) Consider the problem of adding n numbers. Assume that one person can add two numbers in time t_c. How long will a person take to add n numbers? (4 points)
Now assume that eight people are available for adding n numbers and that it is possible to divide the list into 8. The eight people have their own pencils and paper (on which to perform additions), are equally skilled, and can add two numbers in time t_c. Furthermore, a person can pass on the result of an addition (in the form of a single number) to the person sitting next to him or her in time t_w. How long will it take in the following scenarios?

(a) All eight people are sitting in a circle. (8 points)
(b) The eight people are sitting in al-to-all connected network. (8 points)

Q 5. (20 points) Describe major differences between the BSP model and the PRAM model

SUBMISSION: WHAT, WHEN & HOW

(1) This assignment is due on or before March 25
(2) Use MS Word to create your assignment and email it to the TA addison.clark@mavs.uta.edu