CSC 6220: Parallel Computing I: Programming
ECE 5610: Introduction to Parallel and Distributed Systems
Homework 5
Fall 2016

Assigned on: Monday October 17, 2016

Due on: Monday October 24, 2016, 5:00pm

Description:

Write an OpenMP program that computes the all sums of an array. The all sums for the following array of size 8: $[0|1|2|3|4|5|6|7]$ are:

$$[0|0+1|0+1+2|0+1+2+3|0+1+2+3+4|0+1+2+3+4+5|0+1+\ldots+5+6|0+1+\ldots+6+7]$$

That is, $[0|1|3|6|10|15|21|28]$.

The parallel algorithm should have a parallel running time of $O(\log n)$, where n is the size of the array. For the example above, the first phase of the algorithm should compute the sums between adjacent elements (at distance 1) resulting in the array:

$$[0|0+1|1+2|2+3|3+4|4+5|5+6|6+7]$$

In the next phase, the algorithm computes the sums of the elements of the array computed in phase 1 that are at distance 2 of each other. The result of this is:

$$[0|0+1|0+(1+2)|(0+1)+(2+3)|(1+2)+(3+4)|(2+3)+(4+5)|(3+4)+(5+6)|(4+5)+(6+7)]$$

In the third and last phase, the algorithm computes the sums of the elements of the array computed in phase 2 that are at distance 4 of each other. The result of this is:

$$[0|0+1|0+1+2|0+1+2+3|0+(1+2+(3+4)|(0+1)+(2+3+4+5)|(0+1+2)+(3+4+5+6)|$$
$$(0+1+2+3)+(4+5+6+7)]$$

This gives the all sums of the array.

Use the OMP_NUM_THREADS environment variable to control the number of threads. Your program should work with arrays having sizes equal to powers of 2. The array should be initialized as follows: $a[i] = i$, for $i = 0, \ldots, n$. The execution of your program should be timed using the function omp_get_wtime provided by OpenMP. You should determine the execution time of your program considering 1, 2, 4, and 8 threads on tomis.cs.wayne.edu machine and the following sizes for the array: 2^8, 2^{10}, 2^{12}, and 2^{14}.

You should plot the execution time vs. the number of threads and the speedup for each of the four sizes and provide a two page pdf document discussing the results. The plots should be generated using gnuplot and the document discussing the results should be typeset in Latex.

Submission: Use the Blackboard drop box. You should submit a zip file containing the source of the program, the output, a short readme file, and a file containing your plots and discussion.