CSCI 654

Due at 9 am Monday September 28, 2020.

Project 1

Consider linear equations of the form,

$$
\begin{aligned}
&a_{11}\cdot x_1 + a_{12}\cdot x_2 + a_{13}\cdot x_3 + \ ...\ a_{1N}\cdot x_N = b_1 \\
&a_{21}\cdot x_1 + a_{22}\cdot x_2 + a_{23}\cdot x_3 + \ ...\ a_{2N}\cdot x_N = b_2 \\
&a_{31}\cdot x_1 + a_{32}\cdot x_2 + a_{33}\cdot x_3 + \ ...\ a_{3N}\cdot x_N = b_N \\
&. .. \\
&a_{N1}\cdot x_1 + a_{N2}\cdot x_2 + a_{N3}\cdot x_3 + \ ...\ a_{NN}\cdot x_N = b_N
\end{aligned}
$$

We can write the above equation as
Ax = b
where ***A*** is a $N \times N$ matrix and x is a vector of size *N and b* is the resulting vector of size *N.* This system of linear equations can be solved in 2 stages using the Gaussian Elimination (GE) algorithm as described in the class. The first stage involving reducing the matrix into an upper triangular matrix is the most compute intensive part of the algorithm. Also this is the part with maximum parallelism.
Implement the GE algorithm using PThreads in a shared memory system (Kraken). Please compare the results of your parallel program with that of a serial program and other parallel programs that are not as efficient as those of your code.

Your program should be tested with different sizes of of the problem: N = 64; N = 256; N = 1024; N = 4096; and N = 16384. A function for generating data will be available on MyCourses.

You will be required to submit the following:

1. A readme text describing how to execute your program and input/output data
2. A short report (less than a page)
3. Your design in the form of diagrams or pseudo code
4. Your code and sample data used
5. Results and plots; each point in your plot should be an average of at least 19 runs of the code for the same data.

Credit will be given for the efficiency of your parallel program.

Suggested programming language is C and POSIX (Pthreads). You are encouraged to use kraken. You can also use Parallel Java and Tardis . Indeed you can use any computer with 4 or more cores.