EECS 739: Homework 2

Due: March 27, 2019 (at 3pm)

Questions:

1. (25 points) Implement the parallel cyclic reduction algorithm in MPI with C/C++ for use with tridiagonal linear systems with $n = 63$. For this MPI code only, you may hard code the value of $n = 63$. Assume that n processors are available.

   Consider which MPI commands will allow you to perform the communication most efficiently. In addition, you will want to pay attention to minimization of storage.

   Test your algorithm on the Slurm cluster with the following parameters: $A = diag(v) + diag(w, 1) + diag(w, -1)$, where $v = ones(63, 1)$ and $w = ones(62, 1)$, and $b = ones(63, 1)$. Note this tridiagonal linear system is specified using Matlab notation. Use 63 processors for your experiment. Report the wall clock time for this experiment; to do so, add the relevant timing instructions into your implementation.

   Turn-in: Your MPI and C/C++ code and output from the above experiment (with relevant variables printed out at each reduction/solve stage). These items should be printed out in hard copy. Also - e-mail your code and output to shontz@ku.edu. **Note: Both the hard copy and soft copy are required in order for this question to be graded.**

2. (20 points) Suppose that instead of solving a tridiagonal linear system, you are tasked with solving a pentadiagonal linear system for some value of n. (Note that pentadiagonal matrices have nonzeros on the main diagonal, the two diagonals above the main diagonal, and the two diagonals below the main diagonal. All of the other matrix entries are zero.) Summarize how the parallel cyclic reduction algorithm can be modified to solve pentadiagonal linear systems in the case when n processors are available. Your summary should be a paragraph or so. **Be sure to state your assumption as to the relationship between n and p.** Draw a task dependency diagram to go along with your summary.

3. (10 points) Do Problem 5.5 in Grama et al.

4. (15 points) Do Problem 5.10 in Grama et al.