EECS 739: Homework 1

Due: February 9, 2017 (at 11am)

Questions:

1. (20 points) Consider multiplying two $n \times n$ matrices, A and B, to generate a third matrix C as follows: $C = A * B$, where $*$ denotes standard matrix-matrix multiplication. Suppose that A and B can each be partitioned into blocks of size $m \times m$, where $n = cm$.

   Write down the mathematics for computing $C = A * B$ using a block-structured approach. (Note that C is also a block-structured matrix with blocks the size as those in A and B.)

   Now, let $A = \begin{pmatrix} 1 & 2 & -1 & 3 \\ 0 & 1 & 2 & 3 \\ 0 & 1 & 2 & -2 \\ 4 & 5 & -6 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & 1 & 0 & -1 \\ 2 & 3 & -1 & 1 \\ -5 & 6 & 2 & 0 \\ 7 & 3 & 1 & 2 \end{pmatrix}$.

   For $m = 2$, demonstrate how to compute $C = A * B$ using the mathematics prescribed above.

   Be sure to check your answer using Matlab or a similar software package to be sure it is correct before proceeding!

2. (20 points) Write pseudocode specifying a parallel formulation for computing $C = A * B$ using the block-structured approach given in (1). Assume the values of n and m are input parameters. **(Note: Your pseudocode does not need to include error handling.)**

3. (20 points) Draw a task-dependency diagram for computing $C = A * B$ using your parallel formulation in (2). Assume $n = cm$ and that the values of n and m are input parameters.

4. (20 points) Consider multiplying two $1,000,000 \times 1,000,000$ matrices, A and B, in parallel using your parallel formulation in (2). Consider two cases: $m = 100,000$ and $m = 1$. For which of these values of m would you expect to see better performance? Why? Use task-dependency diagrams to justify your answers. Consider their concurrency, length of the critical path, etcetera. Be sure to explain the factors that weighted into your decision.