MPI, Midterm **4/20/2020**

Pick one question from the following problem set. Complete the code and send me your answers with the code by 4/27/2020 10 a.m. Taiwan time.

1. Given a set of Nature numbers $S_n = \{x : x \in N, 1 \leq x \leq n\}$. From set S_n, we wish to draw k numbers and called it set $D_k = \{x_1, x_2 \ldots, x_k\}$ (without putting the drawed numbers back), then apply the function f to the drawed set D_k as $f(D_k) = \sum_{i=1}^{k} x_i$. Write a mpi code to exhaustively compute all possible cases when $(n, k) = (4000, 3), (4000, 4), (4000, 5)$ and compute the needed cpu time including evaluating the function f at all possible choices. Could you finish this job without using mpi ? If so, what is the speedup that you obtained.

2. Use "SparseMatVec" to implement Conjugate Gradient method for matrix A, where $A \in R^{1000\times1000}$ is tridiagonal matrix, and $A_{i,i} = 2$, $A_{i+1,i} = A_{i,i+1} = -1$. For a testing case, find $\mathbf{x} \in R^{1000\times1}$ such that $A\mathbf{x} = \mathbf{b}$, where $\mathbf{b} \in R^{1000\times1} = (1, 2, \cdots, 1000)^t$. Could you finish this job without using mpi ? If so, what is the speedup that you obtained.

3. Compare the write-out time for 4 levels of I/O on a 8192×8192 array. And explain your answers. And if the results match your expectation.

4. Write a mpi code to analyze the the four "levels" of access v.s. data length, i.e. we wish to understand the role of data length in strategic planning in implementing the four "levels" of access.

5. Please demonstrate the Central Limit Theory using MPI code. For each CPU to compute $\{\bar{x}_i\}_{i=1}^{50}$, where each $\bar{x}_i$ is the mean of 100 uniformly-generated numbers (between 0 and 1). Could you finish this job without using mpi ? If so, what is the speedup that you obtained.