HW #4 - due 11/13/2009

Consider the following problem: Given two matrices **A** and **B** each of size $n \times n$ evaluate

1. $\|\mathbf{AB}\|_F$
2. $\mathbf{C} = \mathbf{AB}$

where $\| \cdot \|_F$ denotes the Frobenius matrix norm

$$\|A\|_F = \sqrt{\sum_{i,j=1}^{n} a_{ij}^2}$$

Consider the following parallel implementation framework given p processes:

- Assume that $p = q^2$ and $loc\_n = n/q$ is an integer.
- Process 0 generates the matrices **A** and **B** using a random number generator then broadcasts them to all other processes.
- Each process performs computations (evaluates) for a submatrix of the product **AB** of size $loc\_n \times loc\_n$
- Process 0 gathers the result.
- Process 0 "checks" the correctness of the parallel implementation by verifying the result against the serial computation.

Provide:

1. (**20p**) A parallel code that evaluates $\|\mathbf{AB}\|_F$.
2. (**5p***) A parallel code that evaluates $\mathbf{C} = \mathbf{AB}$.
3. (**5p**) An analysis of how the problem scales with n and p. Provide timings for a sequence of runs:
$$n_i = 100 * i, p_i = i^2, \ \ i = 1, 2, \ldots 10$$

Time first only the computational part of the code (exclude broadcast operations) then both computational and broadcast. Comment on the results.

Using a Cartesian structure (topology) may help at part 2 of the assignment.