CSE 569M
Parallel Architectures and Algorithms
Assignment #4

Due: April 9, 2009.

In this assignment, we are interested in investigating the performance of the coordination operations used to implement parallel codes, both in a shared memory and message passing environment. For each of the operations below, develop a test code that repeatedly invokes the operation and provides timing results (e.g., min, average, max). You may use the built-in barrier operators to provide an artificial barrier synchronization between timing runs if you find it beneficial to do so.

1. We are first interested in the performance of the send() and rcve() primitives in the message passing environment. Characterize the time to send a message as a function of the length of message for message sizes up to about 10 Kbytes. This can most effectively be carried out by actually sending a message in a round trip (A to B to A) and timing the operation on A.

   How well does your data fit the standard model of communication cost

   $$T = s/BW + o$$

   where s is the message size, BW is the effective bandwidth, and o is the startup overhead?

2. Implement the logical equivalent of the MPI_All_Reduce() using the common send() and rcve() calls. You may assume that the reduction is an ADD operation. Quantitatively compare the performance of your implementation to the built-in function as the number of processors varies from 2 to 8.

3. Implement a barrier synchronization operation in a shared memory environment using mutex locks to guard the necessary critical sections. Develop versions that use both the standard lock() call and the trylock() call. Compare the performance of each version on 2 to 4 processors.

4. Using any one of your previous implementations of the Monte Carlo calculations of π, measure the time required to compute a single dart throw (i.e., draw two random variables and determine whether the point is within the circle). Compare the compute cost of a dart throw to the cost of each of the above operations (single message delivery, global reduction, and barrier).