ITCS 4145/5145 Parallel Programming
Test 1
11:00 am - 12:15 pm, Thursday February 21th, 2013

Name: .....

This test is closed book. Do not refer to any materials except those provided with the test. "Appendix A Basic MPI Routines" from the course text is provided, especially for Part II of the test.
Write your answers in the spaces provided.

Total /40
Part I /26
Part II /14

Part I

Qu. 1 Answer each of the following briefly:

(a) According to Amdahl's law, what is the maximum speed-up of a parallel computation given that 80% of the computation can be executed in parallel? Clearly explain. No points for simply putting down a numerical answer with an explanation. 2

(b) Assignment 1 asks you to issue the command mpdtrace. Why? 2

(c) The likely implementation of MPI_Bcast() uses $\log_2 P$ steps with P processes. How is that achieved? 2

(d) What does the MPI routine MPI_AlltoAll() do? 2

(e) If the outcome of MPI_Gather routine is the same as if individual MPI_send() and MPI_recv() routines were used including when processes return, when does the root process return in the MPI_Gather routine? 2

(f) What is the parallel time complexity of bucket sort using one process for each bucket? Explain clearly how you got your answer. 2

(g) In the instructions to generate graphical output for Assignment 2, it is suggested that you will need a sleep() statement in the code. Why? What does this statement do? 2

(h) If two threads execute the instruction x = x + 2; where x is a shared variable initialized to 0, what are the possible values that x could have after the execution of the threads? Clearly explain your answer? 2

(i) What is a Jacobi iteration? 2

(j) Why might statements not be executed in the order given in a program? 2

(k) What does the qualifier "synchronized" specify when attached to a Java method? 2

(l) Briefly describe the approximation that Barnes Hut algorithm uses to reduce the time complexity of the N-body problem from $O(N^2)$ to $O(N \log N)$ for one time period? 2

(m) What is a "detached thread"? 2

Part II

Qu. 2 Write an MPI program to add two N x N matrices where N is a defined constant (#define). Use **two** MPI processes only. The program must handle N being any value from 2 to 1000.

Matrix addition - Given the elements of **A** as $a_{i,j}$ and the elements of **B** as $b_{i,j}$, each element of C computed as:

$$c_{i,j} = a_{i.j} + b_{i,j}$$

$$(0 <= i < N, 0 <= j < N)$$

Make whatever reasonable assumptions that are necessary but state them. You can assume the appropriate include statements are declared.

Provide comments in your code to help the grader! If I do not understand the code, I will assume it is incorrect.

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