

CSE 4351/5351  
Fall 2000  
Test 1

Name \_\_\_\_\_

Closed Book Questions - 5 Points Each

1. What are the two types of queues used in monitors?
2. How is an `MPI_Bcast` used during the row-oriented distributed Warshall's algorithm? Which processor will be the root of the `MPI_Bcast`?
3. What is the difference between signal-and-wait and signal-and-continue?
4. Explain how semaphores are used in the parallel run queue.
5. What is a communicator?
6. Give the table for the associative operator that describes how carry propagation of s, g, and p occurs.

Closed Book Questions - 10 Points Each

7. Give the steps in the parallel computation of a preorder traversal when the tree is represented as adjacency lists in a contiguous table.
8. Suppose that a theoretically-oriented classmate plans to do research on PRAM algorithms. This classmate claims that PRAM algorithms are of practical importance. Do you agree or disagree with your classmate? Why?

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Test 1

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Open Book Questions

1. Suppose that two pthreads have been created and there is a global integer table `A`. `A` has `n` positive integer elements. Give a function `allIdentical()` that, when ran concurrently by the two threads, will store in a global integer variable `identical` the value 1 if all values in `A` are identical and a 0 otherwise. Efficiency is important! 25 points
2. Suppose that table `A` with one million positive integers is partitioned (contiguously) over four MPI processes. Give a function `allIdentical()` that will determine if the same value is used for all entries in `A`. It is critical that all four processes receive the final conclusion. Efficiency is important! 25 points

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Test 2

Name \_\_\_\_\_

Closed Book Questions - 5 Points Each

1. What is the bisection width of a butterfly with  $2^k$  rows?
2. Draw the omega network with four rows.
3. How many vertex equivalence classes does a 4x4 mesh have?
4. How many rounds of communication are required to perform all-to-all broadcast on a 7-d hypercube when all bi-directional links are used simultaneously in each round?
5. Give the diameter, bisection width, and number of automorphisms for a 3-d hypercube.
6. What is a row multiplier? How is one computed and what is it used for?

Closed Book Questions - 10 Points Each

7. What is lock coupling?
8. Suppose that two ordered `N` element tables will be merged by `P` CREW PRAM processors using exactly `P` submerges. What is the minimum and maximum number of elements that may be written to the output table by a processor?

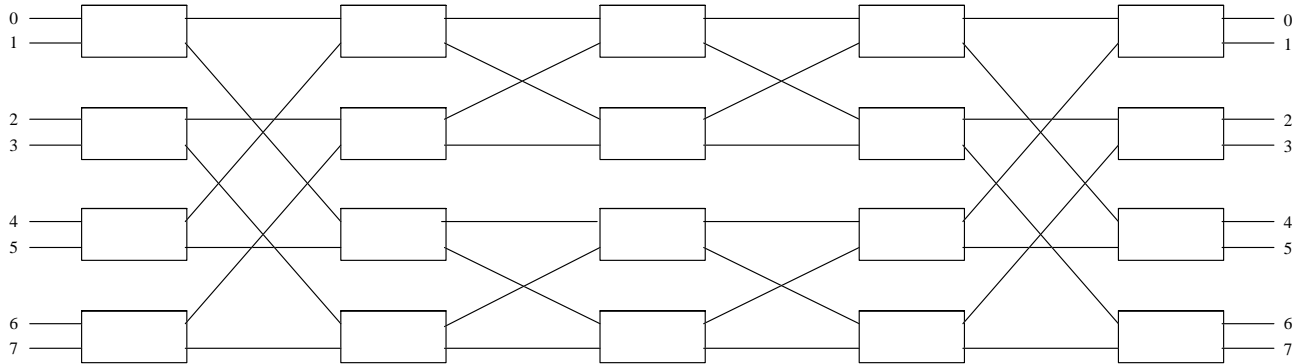
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Test 2

Name \_\_\_\_\_

Open Book Questions

1. Show how to route the following permutation on the Benes network. 10 points

$$\begin{pmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 3 & 1 & 6 & 7 & 0 & 4 & 2 & 5 \end{pmatrix}$$



2. Derive an all-to-all broadcast scheme for a 3-d hypercube similar to the one used for 6-d hypercubes. 20 points
3. Use Gray codes to show that a 4 x 8 torus is a subgraph of a 5-d hypercube. 20 points

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Test 3

Name \_\_\_\_\_

#### Closed Book Questions - 10 Points Each

1. What are `doall` and `forall` parallelism?
2. What is the GCD test? What is its application?
3. Give the algorithm for transposing a  $2^q \times 2^q$  matrix on a  $2^q$ -dimensional hypercube.
4. Draw the arrows for the comparisons for the bitonic mergesort on an 8-node hypercube.

0 \_\_\_\_\_  
1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_  
6 \_\_\_\_\_  
7 \_\_\_\_\_

5. Give an algorithm to broadcast a value from processor 0 in a  $k$ -dimensional hypercube to all other processors using no more than  $k$  rounds of messages. In a given round a processor may either send or receive data from one neighbor, but not both.

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Test 3

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#### Open Book Questions

1. Give a hypercube algorithm that implements the shuffle permutation (i.e. the original data for processor  $i$  will be moved to the processor whose address is the left rotation of  $i$ ) for a  $k$ -dimensional hypercube using no more than  $k$  rounds of messages. In a given round a processor may either send or receive data from one neighbor, but not both. Besides stating your algorithm, you must also demonstrate your algorithm for a 3-d hypercube. 25 points
2. Which permutation has rank 75 when there are  $n=6$  objects and each permutation has  $k=3$  objects. 10 points
3. Which combination has rank 15 when there are  $n=6$  objects and each combination has  $k=3$  objects. 10 points
4. What is an anti-dependence? 5 points