

ITCS 4145/5145 Parallel Computing
Test 2
2:00 pm - 3:15 pm, Thursday April 16, 2009

Name:

This is a closed book test. Do not refer to any materials except those supplied for the test.

Supplied: “*Summary of OpenMP 3.0 C/C++ Syntax.*” Do not write anything on this summary. Return with test.

Answer questions in space provided below questions. Use additional paper if necessary but make sure your name is on every sheet.

Total /50

Qu. 1 Answer each of the following briefly:

(a) What is meant by a thread-safe routine?

2

(b) In the following code:

```
a = b + 5;  
x = x * 4;  
p = x + 9;
```

Why might a compiler or a processor re-order instructions so that they are not in program order when executed?

2

(c) Both locks and semaphores can be used to control access to critical sections. What additional feature is provided with semaphores? (More than one acceptable answer.)

2

(d) In the following shared memory code where x is available to both processes:

Process 1	Process 2
flag = TRUE;	.
x = z;	.
.	.
.	while (flag != TRUE) { };
.	y = x;

under what circumstances would y not equal z after both sequences are executed?

2

(e) Use Bernstein's conditions to determine whether the two code sequences:

```
forall (i = 0, j = 4; i < 4; i++, j--)  
    a[i] = a[j+3];  
  
for ((i = 0, j = 4; i < 4; i++, j--)  
    a[i] = a[j+3];
```

always produce the same results.

4

(f) What is meant by the term “false sharing” in a cache? 2

(g) Explain one way that the number of threads in an OpenMP program can be established? 2

(h) What does the following OpenMP code do?

```
sum = 0;
#pragma omp parallel for reduction(+:sum)
    for (k = 0; k < 100; k++) {
        sum = sum + funct(k);
    }
```

2

(i) Explain the following Java code:

```
public class HelloThread extends Thread {
    public void run() {
        System.out.println("Hello from a thread!");
    }
    public static void main(String args[ ]) {
        (new HelloThread()).start();
    }
}
```

2

(j) Given one reason why one might create threads in Java by implementing the interface Runnable rather than extending the class Thread.

2

(k) Explain how to multiply two 200 x 200 matrices using 8 processors.

2

(l) What is a Jacobi iteration (that is, its basic characteristic compared to other types of iterations)?

2

(m) Suppose two sequence of numbers are known to be bitonic sequences. Describe the way to merge these sequences into one sorted list using Bitonic merging algorithm. Illustrate your answer starting with two bitonic sequences each having 4 numbers.

4

Qu. 3 Write OpenMP code that **uses red-black ordering** to solve Laplace's equation numerically by iteration. Note: each solution point is computed as the average of the four neighboring points i.e.

$$h_{i,j} = \frac{h_{i-1,j} + h_{i+1,j} + h_{i,j-1} + h_{i,j+1}}{4}$$

($0 < i < n$, $0 < j < n$) iteratively to converge on the solution. Use a fixed number of iterations. Assume a square boundary and an $n \times n$ array of points, and one thread for each point.

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