

ITCS 4145/5145 Parallel Computing
Test 2
11:00 am - 12:15 pm, Tuesday April 2, 2013

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.*”

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

Total /40

Qu. 1 Answer each of the following briefly:

(a) What output does the following OpenMP create:

```
#pragma omp parallel
{
    printf("Hello World\n");
}
```

2

(b) Use Bernstein’s conditions to determine whether the two code sequences:

```
forall (i = 3; i > 0; i--)
    a[i] = a[i+2];

for (i = 3; i > 0; i--)
    a[i] = a[i+2];
```

always produce the same results. Clearly show how you got your answer. (No marks for just yes or no!)

4

(c) Explain the potential false sharing effect in the following code

```
main {
    int x,y;
    ...

    #pragma omp parallel (shared x,y)
    {
        tid = omp_get_thread_num();
        if (tid == 0) x++;
        if (tid == 1) y++;
    }
}
```

Suggest how could false sharing be prevented in this code.

2

(d) How many processors would be needed to perform matrix multiplication using block multiplication with $s \times s$ sub-matrices and $n \times n$ matrices, when each processor computes one sub-matrix result? Assume n is a multiple of s . Clearly explain your answer.

2

(e) Describe one parallel sorting algorithm that is cost-optimal.

2

(f) What characteristic of numbers is required for counting sort?

2

(g) In matrix multiplication, why is it not possible to parallelize the inner (3rd) for loop with a parallel for directive in OpenMP?

2

(h) Write the Jacobi iteration formula for the i th unknown for solving a system of linear equations with n unknowns.

2

(i) In Assignment 3, Part 2 on computing the heat distribution of a room, sequential code is given that includes:

```
...
for (i = 1; i < n; i++)
    for (j = 1; j < n; j++)
        h[i][j] = g[i][j];
...
```

What is the purpose of this code in the Heat distribution application?

2

How can the code be avoided in the sequential code but it is required in the parallel version?

2

(j) After the first step in odd-even merge algorithm, the first and last numbers are in their final positions. Clearly explain why?

2

(k) Demonstrate sorting the sequence:

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using bitonic mergesort. Explain each step. Clearly show the operation and result of each step and continue the steps until the end of the algorithm even though you may see the numbers sorted earlier.

4

(l) OpenMP is designed so that OpenMP programs can be compiled with a C compiler that does not recognize OpenMP directives. Clearly explain why and the effect of the parallel for directive?

2

Supplied: “*Summary of OpenMP 3.0 C/C++ Syntax.*”

Qu. 2 Write an OpenMP program that sorts N numbers using rank sort using available threads. Your code must handle duplicate numbers. 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.***

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