PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 1   **Academic Year**: 2009

Date: 28 July 2009   **Time**: 09.00-12.00 (3 hours)

Subject Number: 241-530   **Room**: R201

Subject Title: Parallel and Distributed Computing

Exam Duration: 3 hours

This paper has 13 pages, 6 questions and 120 marks (30%).

Authorised Materials:

● Writing instruments (e.g. pens, pencils).

● Handouts and normal or electronic dictionaries are permitted.

Instructions to Students:

   ● Scan all the questions before answering so that you can manage your time better.

   ● Answers **must** be written in **Thai**.

   ● Write your name and ID on every page.

   ● Any unreadable parts will be considered wrong.

When drawing diagrams or coding, use good layout, and short comments; marks will not be deducted for minor syntax errors.

Cheating in this examination

Lowest punishment: Failed in this subject and courses dropped for next semester.

Highest punishment: Expelled.

NO	Time (Min)	Marks	Collected	NO	Time (Min)	Marks	Collected
1	40	32		5	40	25	
2	20	18		6	40	25	
3	10	10					
4	10	10		Total	150	120	

Question 1   (32 marks; 40minutes)

a) What are the differences between *parallel computing* and *serial computing*.

(6 marks)

Parallel computing	Serial computing

b) What are the differences between *communication* and *synchronization*?

(4 marks)

Communication	Synchronization

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c) Explain how to do *automatic parallelization*, tell when to choose which method and inform the tradeoffs. (4 marks)

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d) What are the differences between *Uniform Memory Access (UMA)* and *Non-Uniform Memory Access (NUMA)*? (8 marks)

UMA	NUMA

e) Compare *Shared Memory* and *Distributed Memory* architecture?   (10 marks)

Shared Memory	Distributed Memory

e) Compare *Shared Memory* and *Distributed Memory* architecture?   (10 marks)

Question 2 (18 marks; 20 minutes)

Explain and **draw** the following Switched Network Topologies, and **tell** their tradeoffs.

a) 2D Mesh Network

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b) Crossbar Network

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c) Multistage Network

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d) Hypercube Network

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e) Tree Network

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f) Ring Network

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Question 3 (10 marks; 10 minutes)

Explain how and what are needed in implementing Cache Coherence in case of following situations in order to ensure different processors have same value for same address.

a) Local Shared Memory

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b) Distributed Shared Memory

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Question 4   (10 marks; 10 minutes)

Tell whether the following equations are parallelizable or non-parallelizable. Also show how to *decompose* the parts of the equations.

a) $F(i) = F(i - 1) * F(i - 2) * F(i - 3)$

b) $F(a) = A(a) + B(a) + C(a)$

c) $F(j+1) = 5.5 * F(j) + G(j) * H(j)$

d) $F(n+1) = F(n) * n-1$ if $n > 1$ and $= 1$ if $n = 1$

e) $F(x,y,z) = (\text{square root of } ((x+y)^{20} - (y-z)^{18})) / xyz$

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Question 5 (25 marks; 40 minutes)

From the following code fragments, 1) explain how the code will be processed, 2) check if there is something wrong with the code, and c) correct it or suggest a better code.

a)

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if (A > B)
    pthread_mutex_lock (&myLock);
    B = A;
    pthread_mutex_unlock (&myLock);
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b)

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#pragma omp parallel for
    for (i = 0; i < N; i++)
        a[i] = b[i] + c[i];
    for (i = 0; i < N; i++)
        a[i] = a[i]*2;
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c)

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#pragma omp parallel private(i,j)
for (i = 0; i < m; i++) {
  x = a[i];
  y = b[i];
  if (x == y) {
#pragma omp single
    printf ("Exiting (%d)\n", i);
    break;
  }
#pragma omp for
  for (j = x; j < y; j++)
    c[j] = (c[j] - a[i])/b[i];
}
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d)

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#pragma omp parallel for private(x)
for (i = 0; i < n; i++) {
    x = i*n;
#pragma omp critical
    y += x;
}
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e)

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#pragma omp parallel sections
    {
#pragma omp section
    v = F();
#pragma omp section
    w = G();
#pragma omp section
    y = H();
}
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Question 6   (25 marks; 40 minutes)

Find the best way to parallelize the following code fragment, explain how by using pictures or diagrams where it is possible.

For i = 1 to 10

    For j=1 to 1000

      For k=1 to 5

$$F(i, j, k) = (A(i)^k / B(j))$$

When A and B are 1D arrays and F is a 3D array.

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----End of Examination----

Pichaya Tandayya   Lecturer