PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester 1 **Academic Year**: 2010

Date: 3 August 2010 **Time**: 09.00-12.00 (3 hours)

Subject Number: 241-530 **Room**: S817

Subject Title: Parallel and Distributed Computing

Exam Duration: 3 hours

This paper has 13 pages, 7 questions and 150 marks (30%).

Authorised Materials:

- Writing instruments (e.g. pens, pencils).
- Textbooks, a notebook, handouts, and 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	60	56		5	20	15	
2	20	16		6	20	16	
3	10	10		7	40	25	
4	15	12		Total		Collected	

Question 1 (56 marks; 60minutes)

a) Compare Serial and Parallel Programming (4 marks)

Serial Programming	Parallel Programming

b) Compare *communication* and *synchronization*. (2 marks)

Communication	Synchronization

c) Give examples of compute resources for parallel computing. (3 marks)

d) Give 5 reasons for using parallel computing. (5 marks)

e) Explain 3 significant limits in building faster serial computers. (6 marks)

f) Compare the following interconnection media types (6 marks)

Shared medium	Switched medium

g) Compare *Uniform Memory Access (UMA)* and *Non-Uniform Memory Access (NUMA)*. (8 marks)

UMA	NUMA

h) Explain the following problems associated with shared data. (6 marks)

Cache coherence	Synchronization

i) Compare Parallel Vector Processor (PVP) and Symmetric Multiprocessors (SMP). (8 marks)

Parallel Vector Processor	Symmetric Multiprocessors

j) Compare OpenMP and MPI. (8 marks)

OpenMP	MPI

Question 2 (16 marks; 20 minutes)

Give the advantages and disadvantages of the following ways to program parallel computers:

a) Extend compilers

b) Extend languages

c) Add parallel language layer on top of sequential language

d) Define totally new parallel language and compiler system

Question 3 (10 marks; 10 minutes)

Explain how to implement Cache Coherence in case of Distributed Shared Memory.

Question 4 (12 marks; 15 minutes)

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

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

b) $F(a) = P(a) - Q(a) - R(a)$

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

d) $F(m,n) = m! * n!$

e) $F(x,y,z) =$ square root of $((x+y)^{32} - (y+z)^{48})$

f) For i = 1 to 10

For j=1 to 10000

For k=1 to 10

$F(i, j, k) = (A(i)^{k} * B(j))$

When A and B are functions that produce a 1D array and F is a function that produces a 3D array.

Question 5 (15 marks; 30 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 better code fragment.

a)

```
if (x < min)
#pragma omp critical
  min = x;
```

b)

```
#pragma omp parallel private(i,j)
for (i = 0; i < NUMBER; i++) {
  a *= F(i);
  b *= G(i);
  if (a == b) {
#pragma omp single
    printf ("Exiting (%d)\n", i);
    break;
  }
}
```

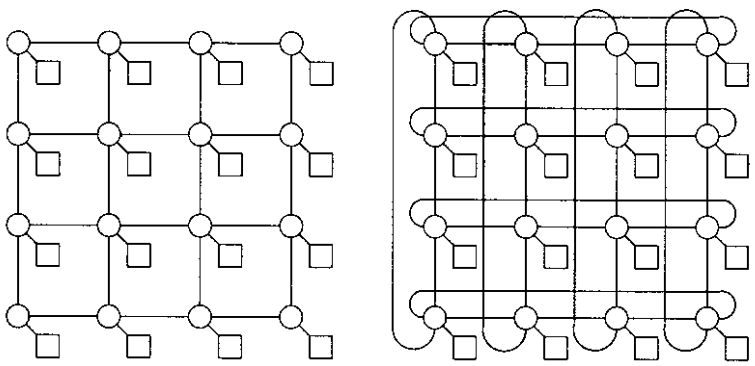
c)

```
#pragma omp parallel sections
 {
   F();
   G();
   H();
 }
```

Question 6 (16 marks; 20 minutes)

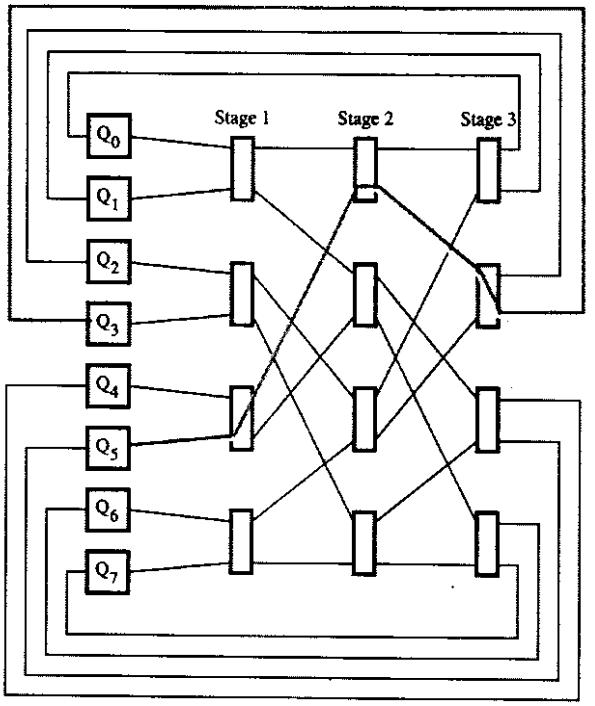
Explain **how** the following Switched Network Topologies **work**.

a) 2D Mesh Network

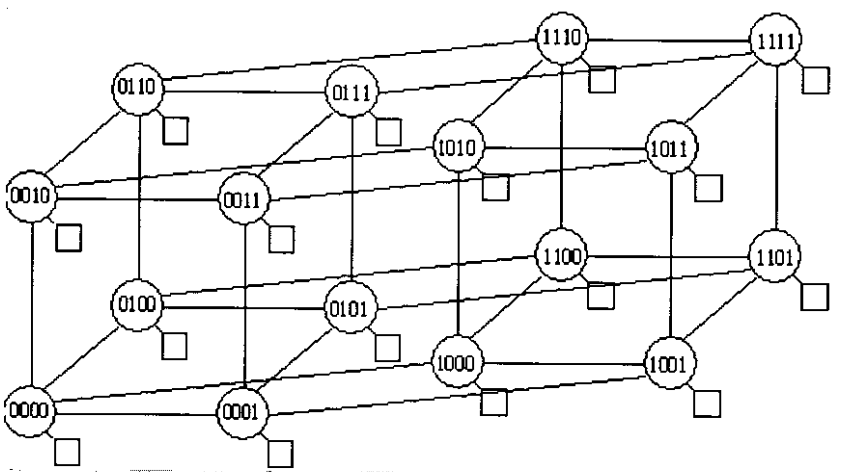


(a) (b)

b) Multistage Network



c) Hypercube Network



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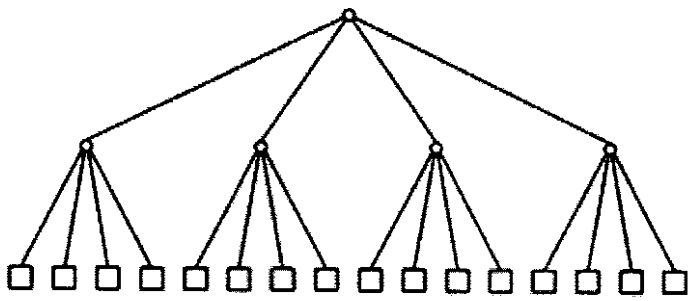
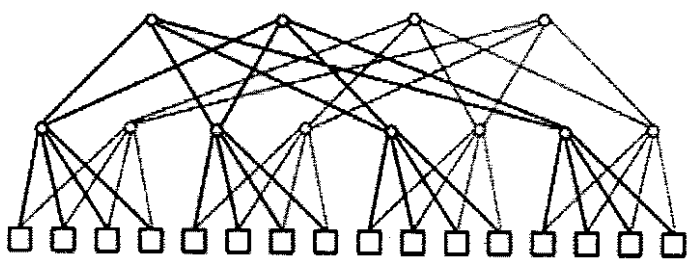
d) Tree Network





Question 7 (25 marks; 40 minutes)

Write a C program using either OpenMP or MPI to parallelize the following **factorial** function. Also explain how your code works by using pictures or diagrams where it is possible.

$F(n) = \Sigma\, i^2$ when $i = 1$ to n

----End of Examination----

Pichaya Tandayya Lecturer

Name_____ID_____