PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

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

Date: 4 October 2010 **Time**: 09.00-12.00 (3 hours)

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

Subject Title: Parallel and Distributed Computing

Exam Duration: 3 hours

This paper has 13 pages, 9 questions and 178 marks (30%).

Authorised Materials:

- Writing instruments (e.g. pens, pencils).
- Textbooks, a notebook, a calculator, 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	40	40		6	30	30	
2	20	19		7	10	12	
3	10	7		8	20	20	
4	20	20		9	20	20	
5	10	10		Total	180	178	

Question 1 (40 marks; 45 minutes)

1) Compare the following two *static* load balancing methods? (6 marks)

Graph Theoretic Approach	*Heuristic Approach*

2) What are the following Dynamic Load Balancing factors? (3 marks)

Factors	Description
System load	
Network traffic conditions	
Characteristics of tasks	

3) Compare the following approaches of System Information exchange policy.

(10 marks)

Approach	Policy
limited approach	
paring approach	

Approach	Policy
load vector approach	
broadcast approach	
global system load approach	

4) What are the migration rules for Dynamic Load Balancing? (6 marks)

5) Explain the following Dynamic Load Balancing phases (5 marks)

Phase	What to be done
Load evaluation	
Profitability determination	
Work transfer vector calculation	
Task selection	
Tasks migration	

Name_____ ID_____

6) Explain what to be aware of the following Load Balancing System properties.

(7 marks)

Property	What should be aware of
Efficiency	
Stability	
Scalability	
Configurability	
Generality	
Heterogeneity	
Transparent	

7) When do we consider to initiate Load balancing? (3 marks)

Question 2 (19 marks; 25 minutes)

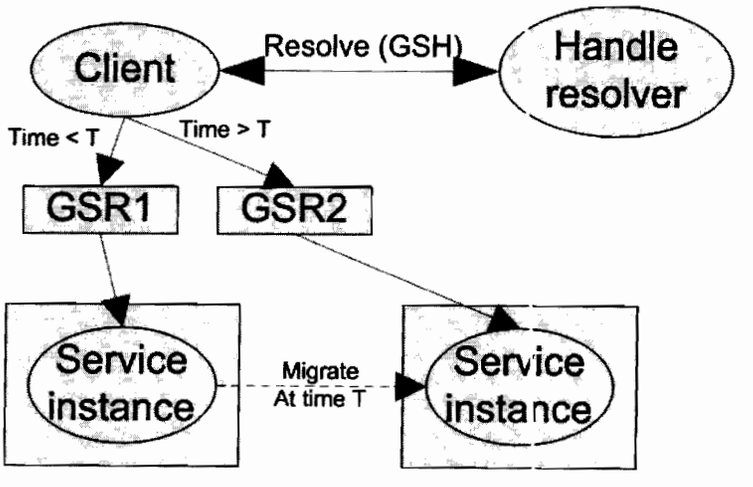
1) What do we need Grid Computing for? (5 marks)

2) What does Grid Middleware do? (4 marks)

3) Inform 3 ways to develop grid applications. (3 marks)

4) What are added to normal web services in order to make grid services. Give at least 5 examples of the new services. (5 marks)

5) From the following diagram, explain the service migration concept and the naming scheme of Open Grid Service Infrastructure (OGSI) concept. (5 marks)



Name_____ ID_____

Question 3 (7 marks; 10 minutes)

Answer the following questions about Load Balancing.

1) Which load balancing technique would be suitable when the size of data structure cannot be pre-determined?

2) Which load balancing transfer policy does perform best under heavy loading conditions?

3) Which work transfer vector calculation algorithm does not work well on a heterogeneous system?

4) Which work transfer vector calculation algorithm is not suitable for a high computation system? And Why?

5) Which work transfer vector calculation algorithm is suitable for a hyper-cube network of computers?

6) Which work transfer vector calculation algorithm is not proper for a highly connected network of computers?

7) What is more important between reducing the size of the task transfer and reducing the number of tasks transferred?

Question 4 (20 marks; 20 minutes)

1) Explain the following performance matrices? (4 marks)

Performance matrix	Description
Execution time	
Processing speed	
System throughput	
Utilization	

2) Explain how to measure the following Memory Performance parameters? (3 marks)

Parameters	Measurement
Capacity	
Latency	
Bandwidth	

3) What should be concern of when using Amdahl Law to predict speedup? (2 marks)

4) Fix the number of processors, plot an efficiency graph that shows the effect of the problem size. (3 marks)

5) Fix the problem size, plot an efficiency graph that shows the effect of the number of processors. (3 marks)

6) Plot and explain a graph of a scalable system that the speedup and efficiency are fixed by increasing both the size of problem and number of processor. (5 marks)

Question 5 (10 marks; 10 minutes)

1) What is granularity? (2 marks)

2) Compare fine grain and coarse grain parallelism. (8 marks)

Fine grain	Coarse grain

Question 6 (30 marks; 30 minutes)

Propose ***a parallel*** algorithm for generating prime numbers up to **n**. It works by first generating the primes up to sqrt(n) and then using those to sieve the values up to n. **Explain and demonstrate** how to partition data with your proposed algorithm by giving an example of a data set. Also **define a policy** to select the number of processes.

The sequential algorithm for finding prime numbers is as follows.

1. Create an array of booleans and set them all to true at first. (true = prime)

2. Set array element 1 to false. Now 2 is prime.

3. Set the values whose index in the array is a multiple of the last prime found to false.

4. The next index where the array holds the value true is the next prime.

5. Repeat steps 3 and 4 until the last prime found is greater than the square root of the largest number in the array.

Name_____ ID_____

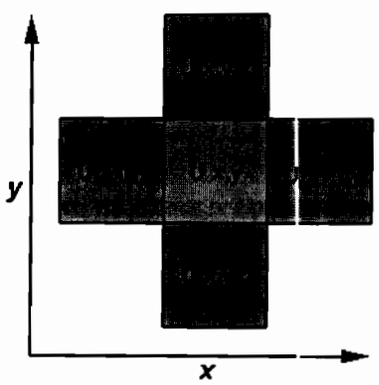
Question 7 (12 marks; 10 minutes)

From Amdahl's Law, find out the speedups if the scenarios are as follows.

Number of processors	Percentage of parallelizable code	Speedup
8	25	
8	80	
16	25	
16	80	
64	60	
64	90	

Question 8 (20 marks; 20 minutes)

In order to calculate **heat transfer**, the elements of a 2-dimensional array represent the temperature at points on the square as seen below.



The calculation of an element is dependent upon neighbor element values time using stepping algorithm below.

$$U_{x,y} = U_{x,y} + C_x * (U_{x+1,y} + U_{x-1,y} - 2 * U_{xy}) + C_y * (U_{x,y+1} + U_{x,y-1} - 2 * U_{x,y})$$

Derive and demonstrate how to find the **speedup** and **efficiency** of the parallel Heat Equation.

Name_____ ID_____

Name_____ ID_____

Question 9 (20 marks; 20 minutes)

Sort the following array using **4** processors applying the **parallel quick sort**:

45, 32, 12, 23, 56, 74, 17, 83, 96, 28, 35, 78, 65, 43, 21, 79, 31, 92, 11, 53

Inform the pivots in each step and how to find it.

----End of Examination----

Pichaya Tandayya Lecturer

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