PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 1 **Academic Year**: 2014

Date: 17 December 2014 **Time**: 13.30 - 16.30 (3 hours)

Subject Number: 242-530 **Room**: A205

Subject Title: Parallel and Distributed Computing

Exam Duration: **3 hours.**

This paper has 12 pages, 9 questions and 170 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	15	15		6	15	15	
2	10	10		7	25	25	
3	15	15		8	10	10	
4	30	30		9	30	30	
5	20	20	Raw marks (170)		100%	Collected (30%)	
Total	170	170					

Question 1 (15 marks; 15 minutes)

Answer the following questions about *Parallel Algorithm Design.*

a) According to Figure 1.1, explain what need to be done in the design methodology. (5 marks)

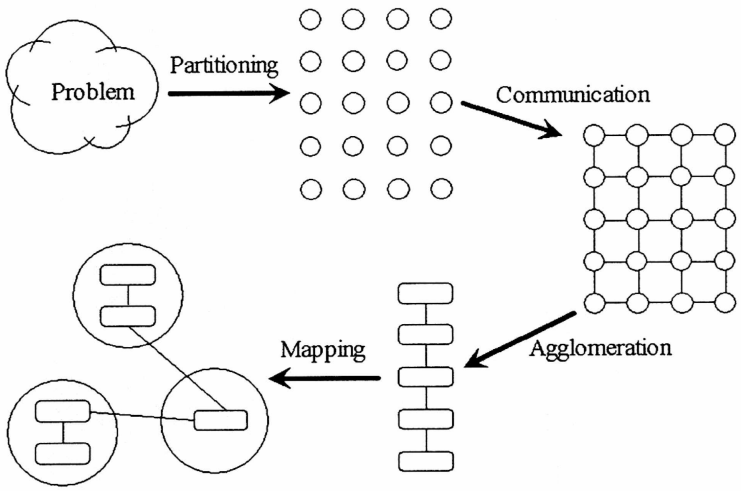

Figure 1.1 Foster's Methodology

b) What are the conflicting goals of mapping in Foster's methodology? (2 marks)

c) According to Figure 1.2, explain the tasks and their communication. (3 marks)

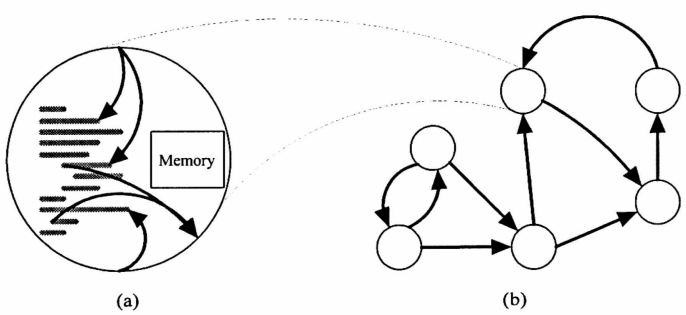

Figure 1.2 Task and Channel Model

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d) Explain the typical performance graph in Figure 1.3 (5 marks)

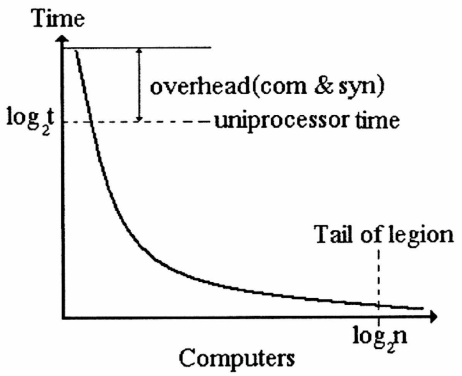

Figure 1.3 Typical Performance Graph

Question 2 (10 marks; 10 minutes)

Tell whether the following statements about *Parallel Algorithm Design* and *Foster's Methodology* are true (T) or false (F).

a) _____ In partitioning, we need to Minimize redundant computations and redundant data storage.

b) _____ Communication operations should be balanced among tasks.

c) _____ Each task should communicate with a large group of neighbors.

d) _____ Tasks can concurrently perform only communications or computations.

e) _____ Agglomerated tasks should have similar computational and communications costs.

f) _____ We need to consider tradeoff between agglomeration and code modifications costs.

g) _____ Replicated computations take more time than communications they replace.

h) _____ Data replication affects scalability.

i) _____ We need to consider tradeoff between agglomeration and code modifications costs.

j) _____ In mapping, if dynamic task allocation is chosen, a task allocator should not be a bottleneck to performance.

Question 3 (15 marks; 15 minutes)

Answer the following questions about *Performance Analysis*.

a) What are 4 *Performance Matrices*? Also explain their measurements. (4 marks)

b) Explain how to increase throughput in parallel computing. (2 marks)

c) What is a good factor for measuring the cost-effectiveness? (1 mark)

d) What are the importance parameters for *Memory Performance* and how to measure them? (3 marks)

e) What is Isoefficiency and how to apply it in system scalability? (5 marks)

Question 4 (30 marks; 30 minutes)

Answer the following questions about *Load Balancing*.

a) Compare the following basic techniques of Load Balancing. (16 marks)

Bin Packing	*Pressure Models*

Randomization	*Manager-Worker*

Name_____ ID_____

b) What are *Dynamic Load Balancing Factors?* Also explain them. (3 marks)

c) Give 5 examples of Processor Load Measurements. (5 marks)

d) Explain at least 6 *properties* of Load Balancing Systems. (6 marks)

Question 5 (20 marks; 20 minutes)

Tell whether the following statements about *Load Balancing* are true (T) or false (F).

a) _____ Distributed applications often face load imbalance in a heterogeneous environment and then require efficient resource allocation techniques.

b) _____ Load imbalance degrades the application performance and system utilization.

c) _____ System utilization can be increased if computers evenly share the workload.

d) _____ In static load balancing, the load is balanced at the end of the execution as the solution requires a complete knowledge of the behavior of the applications and the state of the system.

e) _____ Static load balancing concerns with finding an allocation of processes to processors, while minimizing the execution and communication cost.

f) _____ In dynamic load balancing, the load can be exchanged during runtime.

g) _____ Dynamic load balancing assumes very little knowledge about the system and applications.

h) _____ Dynamic load balancing is adaptive, and therefore is easy to implement.

i) _____ Migration of a blocked process is useful because it affects the local processor load.

j) _____ Migrating the currently scheduled process will incur extra overhead.

k) _____ Migrating the process with the highest remaining service time will benefit most in the long-term.

l) _____ Migrating processes which communicate frequently with the intended destination processor will reduce communication load.

m) _____ Migrating the most locally demanding process will be of great benefit to local load reduction.

n) _____ Tasks must not be moved around all the time.

o) _____ Increasing the pool of available processors should not affect the efficiency of the system.

Question 6 (15 marks; 15 minutes)

Draw graphs that illustrate the following items of Amdahl Laws. Give details of all axes and legends.

a) Plot and explain a graph showing the scalability of a parallel system (speedup changes as the problem size and the number of processors change). (5 marks)

b) Plot and explain a graph showing the efficiency change according to the number of processors when fixing the problem size. (5 marks)

c) Plot a graph showing the efficiency change according to the problem size when the number of processors is fixed. (5 marks)

Question 7 (25 marks; 25 minutes)

Manually sort the following array (from small to large) using the parallel quick sort algorithm. Suppose that the number of processors is 4. Also explain how to divide the items to processors and specify the pivot(s) for each round. Apply the following additional method. Demonstrate the details of each round. Hence: It takes 4 rounds.

41, 63, 18, 55, 33, 85, 67, 10, 72, 98, 75, 93, 15, 60, 19, 8, 89, 44, 13, 42

1) Always pick the first element to be a pivot on a pre-sorted array.

2) After each big round, place the pivot(s) in the middle of the array and do not mix it/them with the unsorted items.

3) If the whole unsorted sub-array is assigned to only 1 processor in that round and the number of quick sort divided items (by that round's pivot) is <= 4, then use another sorting algorithm.

Question 8 (10 marks; 10 minutes)

Answer the following questions about *Grid Technology*.

a) Explain the Grid Service Migration in Figure 8. (5 marks)

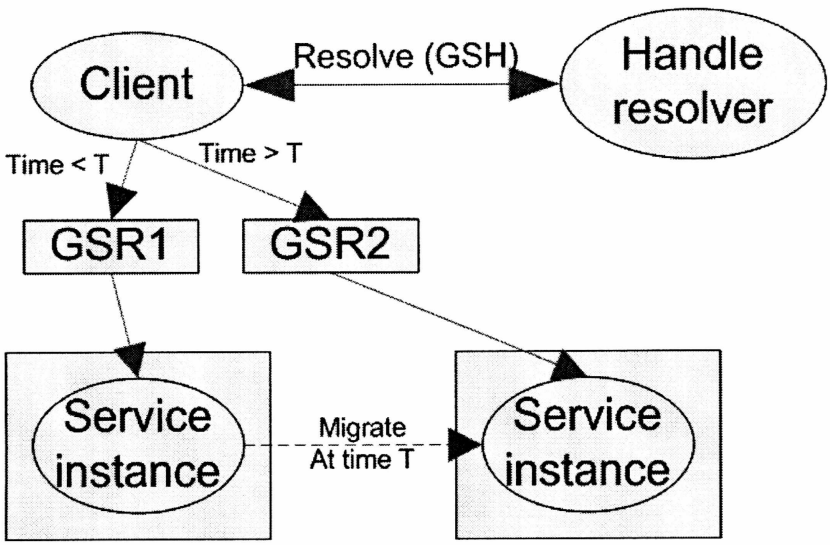

Figure 8 Grid Service Migration

b) Demonstrate how to bridge the gap of Service-Oriented Infrastructure with *Workflow Technology* in Grid Computing. Hint: multiple/complex composition of services and data flows (5 marks)

Question 9 (30 marks; 30 minutes)

Answer the following questions about *Cloud Computing.*

a) Demonstrate how the Pay-By-Use concept of Cloud Computing helps avoiding under-provisioning. (9 marks)

b) Explain the 3 cloud service models. Also give examples of applications applying the three models. (15 marks)

c) Explain the three Characteristics of Big Data (6 marks)

----End of Examination----

Pichaya Tandayya Lecturer

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