UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2004/2005

October 2004

CCS524 – Parallel Computing Architectures, Algorithms & Compilers

Duration : 2 hours

INSTRUCTION TO CANDIDATES:

- Please ensure that this examination paper contains **FOUR** questions in **THREE** printed pages before you start the examination.
- Answer **ALL** questions.
- You can choose to answer either in Bahasa Malaysia or English.

ENGLISH VERSION OF THE QUESTION PAPER

1. (a) Discuss Amdhal's law with reference to Data parallel programs.

(6 marks)

(b) A pipeline computation has 3 processes. Process p1 takes 1 unit of time, Process p2 takes 2 units of time and process p3 also takes 2 units of time. Draw the timing diagram. Make it self explanatory by indicating all the parameters and details in the diagram. Using the diagram, find the speed up of the above computation.

(11 marks)

(c) An SIMD computer has a scalar execution rate of $R1$ = 10 MFLOPS and a vector execution rate of $R2$ = 50 MFLOPS. A program having a mix of scalar and vector computations was executed and found to have an average execution rate of 25 MFLOPS. Find out what percentage of its execution time was spent in scalar computation.

(8 marks)

2. (a) (i) What is a semaphore? What are the operations that can be performed on them? Explain them.

(ii) Explain how semaphores are used for process communication.

(13 marks)

(b) A simple solution for the producer consumer problem is given below:

```
Sem empty = 1, full = 0;
Process producer     Process consumer
While (true)         While (true)
Produce data;        P(full);
P(empty);            result = buf;
Buf = data;          V(empty)
V(full)              Consume data;
......               .....
```

(i) Discuss the drawback of the above solution.

(ii) Provide an improved solution and explain how this solution eliminates the drawback.

(12 marks)

3. (a) Describe the message passing operations *send* and *receive* and discuss their blocking properties.

(10 marks)

(b) Three processors in a distributed memory multiprocessor communicate by *send* and *receive* running the code sketched below, where upper case letters represent local activities.

Process P1	Process P2	Process P3
A	D	G
receive(p3)	send(p1)	receive(p2)
B	E	H
receive(p2)	send(p3)	send(p1)
C	F	I

If send is nonblocking and receive is blocking, draw a diagram of precedence relation on the local activities. Does a deadlock occur? State the basis of your answer.

(7 marks)

(c) Describe the send and receive routines and the parameters used in MPI programs.

(8 marks)

4. (a) What are GUARD commands? Explain them with simple examples. How are they used by the programming languages CSP and OCCAM? Explain with examples.

(10 marks)

(b) What are the conditions that should be satisfied if two statements in a program are to be executed in parallel?

(6 marks)

(c) Explain data flow concepts and the factors that distinguish a dataflow program from a program written in a procedural language.

(5 marks)

(d) Given a multicomputer with the hypercube architecture of dimension 'n'. 64 additional processors are required to make it a hypercube of dimension of n+1. What is the dimension of the given hypercube and what is the number of processors in it.

(4 marks)