UNIVERSITI SAINS MALAYSIA

Supplementary Examination
Academic Session 2001/2002

April 2002

CPS304/CSA401 – Parallel Processing

Duration : 3 hours

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **FIVE** questions in **FOUR** printed pages before you start the examination.
- Answer **ALL** questions.
- If you choose to answer the questions in English, at least one question must be answered in Bahasa Malaysia.

ENGLISH VERSION OF THE QUESTION PAPER

1. (a) Explain the following terms:

(i) Parallelization

(ii) Speed-up

(iii) Shared memory

(6 marks)

(b) Describe Flynn's classification of computer systems. Discuss each classification with examples of different types computer systems.

(6 marks)

(c) In a pipeline program with p processes, a sequence of 'n' data values flows through the pipeline from beginning to end. Each process in the pipeline performs a transformation on each data value that requires T time units, and then sends it to the next process. The communication time between processes is C time units. The program ends when all the 'n' data values have passed all the way through the pipeline. Assume that there is no process creation overhead. Derive an expression for the program execution time and the speedup.

(8 marks)

2. (a) State and derive Amdhal's law.

(4 marks)

(b) In a parallel program,

10% of all instructions executed are scalar,
5% of all instructions can be executed vectorially only on 1,000PEs,
35% of all instructions can be executed vectorially only on 40,000PEs,
the rest can be executed vectorially on all PEs.

If this program takes 600 micro seconds in a SISD computer how much time will it take to execute on a SIMD computer with 50,000 PEs. Assume that all PEs are identical.

(8 marks)

(c) Carry out the following tasks for the program segment below:

(i) Determine all of the data dependencies.

(ii) Determine all of the dependencies that must be synchronized.

(iii) Parallelize the segment for an MIMD system. Attempt to achieve maximum parallelism.

```
A := B + C
FOR I = 2 TO N
      D(I) = A * E(I)
      S = E(I) * 10
      T = T + S
NEXT I
A = D(N) - 5
```

(8 marks)

3. (a) What are the important parameters that characterize multicomputer topology? How do these parameters influence the cost and the performance of the multicomputer?

(4 marks)

(b) Describe the crossbar switch network for connecting PEs and discuss the advantages and disadvantages.

(8 marks)

(c) Given a multicomputer with the hypercube architecture of dimension 'n'. How many processors does it contain? How many additional processors are needed to make it a hypercube of dimension 'n+2'?

(2 marks)

(d) Discuss the hypercube interconnection topology.

(6 marks)

4. (a) What is a semaphore? What are the operations that can be performed on them? What are the actions taken by the system when those operations are executed on the semaphores?

(8 marks)

(b) A database may be used either for reading or writing. Any number of users (not exceeding 100) may read from it simultaneously, but any user who is writing must have exclusive access to the database. Whenever, a writer is ready to use the database, he should be allowed to do so as soon as possible. Construct a solution to this problem using critical regions and semaphores.

Briefly describe your solution.

(12 marks)

5. (a) Explain, with simple examples, the constructs available in CSP language.

(4 marks)

(b) Write an alarm process in CSP language and explain as to how the user processes will use it.

(8 marks)

(c) Write a complete OCCAM program to double all the elements of a matrix. Assume that any number of transputers are available. Explain as to how the program will work?

(8 marks)

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