

UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama  
Sidang Akademik 1995/96

Oktober/November 1995

**CSA401 - Pemprosesan Selari**

Masa: [3 jam]

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**ARAHAN KEPADA CALON:**

- Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMA** soalan di dalam **EMPAT** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.
  - Jawab **SEMUA** soalan. Anda boleh memilih untuk menjawab **SEBAHAGIAN** daripada soalan di dalam Bahasa Inggeris atau menjawab keseluruhan soalan di dalam Bahasa Malaysia.
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ENGLISH VERSION OF THE QUESTION PAPER

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1. (a) Describe Flynn's classification of computer systems. Discuss as to how various types of parallel computer systems fit into the classification. (8 marks)
  - (b) Consider a general form of pipeline program, in which a long sequence of data values continues to flow through the pipeline from beginning to end. In this general pipeline, different types of operations may be performed by different processes. Assume that the specific operation performed by each process  $i$  requires  $T_i$  time units. Let process  $k$  be the one with the largest such time. Explain, with suitable timing sketches why the time  $T_k$  limits the performance of the pipeline, even if all the other  $T_i$  are much less than  $T_k$ . (4 marks)
  - (c) State and explain Amdahl's law. (4 marks)
  - (d) A parallel program is to be executed on a MIMD computer with 100 processors. However, 3% of all instructions during program execution must be carried out sequentially, but the rest can be executed in all processors in parallel. What is the speedup of this program on this computer? (4 marks)
2. (a) Explain, with the help of simple sketches, the control driven, data driven and demand driven parallel computation model. (6 marks)
  - (b) Derive the speed up for the pipelined execution of a vector processor for processing a vector of length 'n'. The number of sub operations on each vector element is 's' and 'i' is the time(in number of units of cycle time) taken to set up a loop. (8 marks)
  - (c) What are virtual processors? Explain, with a simple example, the mapping of virtual processors onto the physical processors in an SIMD system. (6 marks)

3. (a) What is meant by data dependency in programs? What are the types of data dependency? State them in a formal form. (8 marks)

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

- (i) Determine all of the data dependencies with directions.  
 (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
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(8 marks)

- (c) Explain, with examples, the use of 'FORK' and 'JOIN' in parallel programming.

(4 marks)

4. (a) Multiple processes wish to access a shared memory area, some just reading and others writing. While a number of processes can read from a shared memory block simultaneously, only one process at a time may be allowed write access. During the write-access no other process can be allowed to read from the memory area. Present a solution which allows maximum possible parallelism. Take care to avoid 'starvation' of the write process.

(8 marks)

- (b) Explain, with simple examples, the constructs available in CSP language.

(4 marks)

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

(8 marks)

5. (a) Discuss the hypercube interconnection topology. (6 marks)
- (b) Show that mesh topology can be embedded in hypercube topology. (6 marks)
- (c) Develop a two-way merge sort algorithm for a mesh connected computer. Illustrate the execution of the algorithm by means of an example drawing the mesh rows and columns. (8 marks)

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