UNIVERSITI SAINS MALAYSIA

Supplementary Examination
Academic Session 1996/97

May 1997

CSA401 - Parallel Processing

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

• Please ensure that this examination paper contains **FIVE** questions in **THREE** 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 Bahasia Malaysia.

ENGLISH VERSION OF THE QUESTION PAPER

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) State and explain Amdahl's law.

(4 marks)

(c) In the light of Amdhal's law. explain why it is important for multiprocessor systems to have specially designed high-bandwidth disk I/O systems.

(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) What are the important parameters that characterise the multicomputer topology? How do these parameters influence the cost and the performance of the multicomputer?

(4 marks)

(b) Discuss the hypercube interconnection topology.

(6 marks)

(c) Just as a 2-D mesh can be enhanced to a Torus topology, 3-D mesh can also be enhanced. What is the connectivity and diameter of such an enhanced 3-D Mesh with n processors? Explain your answer.

(6 marks)

(d) Show that mesh topology can be embedded in hypercube topology.

(4 marks)

3. (a) Explain, with the help of sketches, data driven and demand driven parallel computation model.

(4 marks)

(b) State the rigorous and simplified forms of data dependency rule for anti dependency. Explain with an example as to how the simplified form will affect the parallelisation.

(6 marks)

(c) 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 synchronised.

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

(6 marks)

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

(4 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) 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)

(c) Explain, with an example, the use of Monitor construct in process communcation.

(4 marks)

5. (a) Write a complete OCCAM program to sum all the elements of a matrix. Assume that any number of transputers are available.

(6 marks)

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

(4 marks)

(c) Write an MIMD procedure to find the root of a nonlinear equation. Explain the algorithm used.

(10 marks)

- oooOooo -