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Total No. of Questions : 08] [Total No. of Pages : 03

M.Tech.

PARALLEL COMPUTING

SUBJECT CODE :CS - 517 (Elective - III)

Paper ID : [E0697]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours Maximum Marks : 100

Instruction to Candidates:

1) Attempt any **Five** questions.
2) **All** questions carry equal marks.

Q1) (a) Prove that a k-stage linear pipeline can be at most k times faster than that of a non-pipelined serial processor.

(b) Summarize all forms of parallelism that can be exploited at different processing levels of a computer system, including both multiprocessor and unprocessed approaches. Indicate example computers that have achieved various forms of parallelism.

Q2) (a) A program has only two modes of operation; purely sequential mode for 40% of the program and fully parallel for the remaining program. The program is run on a multiprocessor system in which the total number of processors n is much greater than the maximum degree of parallelism of the program m (n >>m). Calculate the percentage increase in speed up performance of the multiprocessor system when the number of processors is increased from 4 to 10 for the following models, ignoring all system overheads.

(i) Fixed workload model.
(ii) Fixed execution time model.
(iii) Memory bound model.

Assume that the workload is increased by 25% more than the maximum available parallelism, when memory size is increased. Thus the workload is increased 5 times when the maximum number of processors is 4 and increased 12.5 times when the number of processors is 10.

(b) Elaborate Handler's classification of parallel computers.

Q3) (a) State and explain Amdahl's law for measuring speed up performance of parallel systems. Also, list the outcomes of analysis of the Amdahl's law.

(b) Write a parallel pseudocode for performing an even-odd transportation sort on a linear array of n processors. Show the computation time and the communication time at each step. What is the overall time complexity? Illustrate the sorting process for a sequence of 8 numbers :

3, 1, 9, 7, 5, 2, 0, 6.

Q4) (a) Explain in brief the various topologies of a multiprocessor system. Also find the number of processors for which the hypercube topology has a lower total bandwidth than the completely connected topology.

(b) What is the diameter of a 16-space hypercube?

Q5) (a) Compare and contrast the shared memory and distributed memory programming approaches.

(b) Consider two different implementations, P1 and P2, of the same instruction set. There are five classes of instructions (A,B,C,D and E) in the instruction set. P1 has a clock rate of 4GHz and P2 has a clock rate of 6GHz. The average number of cycles for each instruction for P1 and P2 are as follows :

Class	*CPI on P1*	*CPI on P2*
A	1	2
B	2	2
C	3	2
D	4	4
E	5	4

Assume that the peak performance is defined as the fastest rate that a computer can execute any instruction sequence. What are the peak performances of P1 and P2 expressed in instructions per second?

Q6) (a) Explain in detail the scheduling and parallelization techniques for parallel programs.

(b) Suppose the links are 1 byte wide and operating at 300 MHz in a network where the average routing distance between nodes in log4 P for P nodes. Compare the unloaded latency for 80-byte packets under store-and-forward and cut-through routing, assuming 4 cycles of delay per hop to make the routing decision and P ranging from 16 to 1,024 nodes. Perform the comparison for 32-KB transfer fragmented in 1-KB packets.

Q7) (a) What is the PRAM model? Which PRAM model can be used to execute any other PRAM algorithm and how?

(b) Compare the distributed memory model for parallel programming in terms of various parameters.

Q8) Write short note on any two of the following :

(a) Parallelism versus Pipelining.

(b) Processor organizations.

(c) Control versus Data Parallelism.