

SP 21  
CAMOOR

MAHINDRA UNIVERSITY, HYDERABAD  
École Centrale School of Engineering  
End-semester Regular Examination  
R21 Regulations

Program: B.Tech    Branch: AI/CSE/CM    Year: III    Semester: II  
High-Performance Computing (CS 3202)

Date: 28-05-2024

Start Time: 10:00AM

Duration: 3 Hours

Max. Marks: 100

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Instructions:

1. Open book examination. Students can attend the exam with the textbook "The Art of Multiprocessor Programming" by Maurice Herlihy, Nir Shavit, Victor Luchangco, and Michael Spear.
2. Answer any FIVE questions and each question carries 20 marks.

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1. Write an OpenMP program to multiply two matrices of order  $4096 \times 4096$  using block matrix multiplication. Assume that the size of the block is  $4 \times 4$ . Also, discuss a procedure to analyze your program?
  2. A scientist needs to carry out a simulation related to black holes. She has worked out that if she uses her 16-processor laptop, it will take 365 days to run it. How long would this simulation take for the PARAM supercomputer, using the 165,888 processors in its main module?. Assume that the Laptop and the PARAM are using the same type of processor.
  3. Suppose you are developing a concurrent treap by using a lock with name ABC. You claim that the lock satisfies mutual exclusion property and starvation-free property, and it works for any number of threads. Your faculty member wants to see the pseudocode of ABC lock. Please write the pseudocode.
  4. You are given a program that includes a method M that executes sequentially. Use Amdahl's Law to resolve the following questions:
    - (a) Suppose M accounts for 50% of the program's execution time. What is the limit for the overall speedup that can be achieved by running the program on an n-processor machine?
    - (b) Suppose M accounts for 50% of the program's execution time. You hire a programmer to replace M with  $M^1$ , which holds  $k$ -fold speedup over M. What value of  $k$  yields an overall speedup of 10 for the whole program?
  5. Write algorithms to perform *insert()*, *remove()* and *contains()* operations on a concurrent binary search tree using logical ordering. Provide the linearization points of your algorithms.
  6. Briefly discuss the following:
    - (a) Heterogeneous Computing
    - (b) perf tool
    - (c) Advantages of GPUs as compared with CPUs
    - (d) Flynn's Taxonomy