CSCI-UA.0480-051: Parallel Computing
Practice Exam (October 26th, 2023)
Total: 100 points

Important Notes- READ BEFORE SOLVING THE EXAM

• If you perceive any ambiguity in any of the questions, state your assumptions clearly and solve the problem based on your assumptions. We will grade both your solutions and your assumptions.

• This exam is take-home.

• You have up to 24 hours to complete this exam.

• Your answers must be very focused. You may be penalized for wrong answers and for putting irrelevant information in your answers.

• You must upload a pdf file.

• Your answer sheet must have a cover page (as indicated below) and one problem answer per page (e.g., problem 1 in a separate page, problem 2 in another separate page, etc.).

The very first page of your answer is the cover page and must contain:

-Your Last Name
-Your First Name
-Your NetID

Honor code (copy and paste to the first page of your exam)

"I understand the ground rules and agree to abide by them. I will not share answers or assist another student during this exam, nor will I seek assistance from another student or attempt to view their answers."

Section 1: Multiple Choice (20 points, 2 points each)

1. Which of the following is NOT a benefit of parallel computing?
a) Increased processing speed
b) Reduced memory usage
c) Enhanced fault tolerance
d) Simplified programming

Answer: _____

2. What is Amdahl's Law used to calculate?
a) The speedup achieved by adding more processors
b) The efficiency of a parallel algorithm
c) The communication overhead in a parallel system
d) The memory capacity of a parallel computer

Answer: _____

3. A race condition occurs when:
a) Two processes access the same memory location simultaneously
b) A process is waiting for an I/O operation to complete
c) A deadlock situation arises
d) A process is terminated unexpectedly

Answer: _____

4. Which type of parallel computer architecture involves a single, shared memory space?

a) Distributed memory

b) Shared memory

c) Hybrid memory

d) None of the above

Answer: _____

5. What is a significant challenge in designing parallel algorithms?

a) Load balancing

b) Data dependencies

c) Communication overhead

d) All of the above

Answer: _____

Section 2: Short Answer (30 points, 5 points each)

6. Explain the difference between strong scaling and weak scaling in parallel computing.

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7. Briefly describe the concept of a deadlock in a parallel system and provide a simple example.

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8. What is the role of a barrier synchronization in parallel programs?

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9. What are some common techniques for handling data dependencies in parallel algorithms?

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10. Explain the concept of cache coherence and why it is important in shared-memory parallel systems.

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Section 3: Problem Solving (50 points)

11. [25 points] Design a parallel algorithm to find the maximum element in an array of integers. Describe the algorithm, considering data partitioning and communication between processes. Analyze its time complexity.

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12. [25 points] You are given a parallel program that uses threads. Describe a scenario where a race condition could occur in your program and explain how you would fix it using appropriate synchronization mechanisms (e.g., mutexes, semaphores, etc.).

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