Parallel Computing

Practice Exam

Difficulty: medium

Parallel Computing Practice Exam

****Instructions:** Answer all questions to the best of your ability. Show your work where applicable.**

****Section 1: Multiple Choice (1 point each)****

****Question 1:** Which of the following is NOT a common challenge in parallel computing?**

a) Data dependencies
b) Load balancing
c) Increased code simplicity
d) Communication overhead

****Answer:**** _____

****Section 2: Short Answer (5 points each)****

****Question 2:** Describe the difference between shared-memory and distributed-memory parallel architectures. Include at least one advantage and one disadvantage of each. Your answer should clearly explain how processes access data in each architecture.**

****Answer:****

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****Section 3: Problem Solving (10 points)****

Question 3: Consider a program that calculates the sum of a large array of numbers. Assume the array has 1,000,000 elements. We want to parallelize this task using 4 processors.**

a) Describe a simple parallel algorithm to accomplish this task. Be specific about how the array is divided among the processors and how the partial sums are combined.

b) If each processor takes approximately 1 second to process its portion of the array, and the communication overhead for combining the partial sums is 0.1 seconds, what is the total execution time of the parallel program? Show your calculations.

c) What is the speedup achieved by using 4 processors compared to a sequential implementation that takes 100 seconds to complete? Show your calculations and explain the concept of speedup.

Answer:

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Answer Key (For Instructor Use Only):

Section 1:

1. c) Increased code simplicity

Section 3:

3. a) Divide the array into four equal parts (250,000 elements each). Assign each part to one of the four processors. Each processor calculates the sum of its assigned portion. Then, a designated processor (or a separate process) collects and sums up the four partial sums to obtain the final result.

b) Processor computation time: 1 second per processor. Total computation time = 1 second.

Communication overhead: 0.1 seconds.

Total execution time = 1 second + 0.1 seconds = 1.1 seconds

c) Sequential execution time: 100 seconds.

Speedup = Sequential execution time / Parallel execution time = 100 seconds / 1.1 seconds "H 90.9
Speedup represents the factor by which the parallel program is faster than the sequential program. In this case, it's approximately 90.9 times faster. Note that perfect speedup (factor of 4) is rarely achieved due to overhead.
