

CSCI-UA.0480-051: Parallel Computing
Practice Exam (October 26th, 2023)
Total: 50 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 2 hours to complete this exam.
- You are allowed only one submission.
- 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 separate page, problem 2 in another separate page, etc).

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

Your Last Name

Your First Name

Your NetID

"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."

Problem 1 (50 points)

a. [15 points] Explain the difference between shared memory and distributed memory parallel programming models. Provide examples of programming paradigms or libraries commonly used with each model.

[illegible]

b. [15 points] Describe Amdahl's Law and its implications for parallel program performance. Provide a specific example demonstrating how the speedup of a parallel program is limited by the sequential portion of the code. Assume a program with 80% parallelizable code and 20% sequential code running on 4 cores. Calculate the speedup.

c. [20 points] You are tasked with designing a parallel algorithm to perform matrix multiplication of two $N \times N$ matrices. Describe a suitable parallel algorithm (e.g., using a divide-and-conquer approach or a data-parallel approach), outlining the steps involved. Discuss potential challenges and optimizations. Consider the impact of communication overhead.