

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 the 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 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)

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"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."

You may use the textbook, slides, and any notes you have. But you may not use the internet. You may NOT use communication tools to collaborate with other humans. This includes but is not limited to G-Chat, Messenger, E-mail, etc. Do not try to search for answers on the internet; it will show in your answer, and you will earn an immediate grade of 0. Anyone found sharing answers or communicating with another student during the exam period will earn an immediate grade of 0.

Problem 1

a. [5] Define Amdahl's Law. What are its limitations?

b. [5] Explain the difference between strong and weak scaling in parallel computing. Provide examples.

Problem 2

a. [10] Describe the concept of "race conditions" in parallel programming. How can they be avoided?

b. [10] What are critical sections? Explain how mutexes and semaphores are used to protect critical sections.

Problem 3

[15] A parallel program executes on 8 cores. The sequential portion of the program takes 20 seconds. The parallel portion takes 10 seconds on 8 cores. What is the speedup? What is the efficiency? Show your calculations.

Problem 4

[10] Explain the difference between OpenMP and MPI. When would you choose one over the other?

Problem 5

a. [5] What is a deadlock? Describe the four necessary conditions for deadlock to occur.

b. [5] Explain how to prevent deadlocks using the Banker's Algorithm.

Problem 6

[10] What are shared memory and distributed memory parallel architectures? Give examples of each.

Problem 7

[10] Explain the concept of load balancing in parallel computing. What are some techniques used to achieve good load balancing?

Problem 8

[10] Describe the difference between a thread and a process.

Problem 9

[10] Explain the concept of false sharing in cache coherence. How can it impact performance?

Problem 10

[10] What are the main challenges in debugging parallel programs? What tools or techniques can be used to assist in debugging?
