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 and submit 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 a 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
Copy and paste the honor code shown in the rectangle at the bottom of this page.

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."

You may use the textbook, slides, and any notes you have. But you may NOT use the internet or any communication tools to collaborate with other humans.

Problem 1

a. [10] Briefly explain five common sources of overhead in parallel programming.

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b. [10] Describe the difference between data parallelism and task parallelism, providing a concrete example of each.

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Problem 2

[15] You are given a task graph with the following dependencies: A -> B, A -> C, B -> D, C -> D, D -> E. Each task has the following execution times: A=5, B=3, C=4, D=6, E=2 (all times in milliseconds). What is the critical path length, and what is the minimum execution time for this task graph on an

unbounded number of processors? Show your work.

Problem 3

[15] Explain the concept of Amdahl's Law and its implications for parallel program performance. Give a specific example illustrating how Amdahl's Law limits the potential speedup achievable through parallelization.

Problem 4

a. [10] What are race conditions in parallel programming? Describe a scenario where a race condition could occur.

b. [10] Explain how mutex locks can prevent race conditions. What are some potential drawbacks of using mutex locks?

Problem 5

[15] Compare and contrast OpenMP and MPI. Discuss their strengths and weaknesses, and when you might choose one over the other.