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. Submit before 5 PM on October 27th, 2023.

• You are allowed only one submission.

• Your answers must be concise and focused. You may be penalized for irrelevant information.

• You must upload a PDF file.

• Each problem should be answered on a separate page.

• The very first page of your answer must be a cover page containing:

- Your Last Name
- Your First Name
- Your NetID

Problem 1: Amdahl's Law and Speedup (50 points)

a. [20 points] A program has a sequential portion that takes 20% of the execution time. The remaining 80% is parallelizable. Using Amdahl's Law, calculate the speedup achievable with 4 processors. Show your work. Round your answer to one decimal place.

b. [15 points] Explain, in your own words, the limitations of Amdahl's Law and discuss any factors that could lead to a speedup less than predicted by the formula.

c. [15 points] Assume you have a parallel algorithm with a computation time of T_c = 100 milliseconds and a communication time of T_comm = 20 milliseconds. Using this algorithm, what is the speedup on 8 processors? Assume that the communication time is constant regardless of the number of processors. Show all your work. Round your answer to one decimal place.

Problem 2: Task Scheduling and Parallel Performance (50 points)

Consider a parallel program with five tasks (A, B, C, D, E) and the following dependencies:

A -> B, A -> C, B -> D, C -> D, D -> E

The execution time (in milliseconds) for each task is as follows:

Task	Execution Time (ms)
A	10
B	5
C	15
D	20
E	10

a. [20 points] Assume you have two processors available. Create a schedule that minimizes the overall execution time. Show the schedule and calculate the total execution time. Explain your reasoning.

b. [15 points] Now assume you have four processors. Create a schedule that minimizes the overall execution time. Show the schedule and calculate the total execution time. Explain your reasoning. How does the speedup compare to the case with two processors?

c. [15 points] What are the critical path and its length for this task dependency graph? How does the critical path affect the performance of the parallel program?