Parallel Computing

Practice Exam

Difficulty: medium

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 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 separate page, problem 2 in another separate page, etc).

Problem 1: Amdahl's Law and Speedup (25 points)

a. [10 points] A program has a parallelizable portion that constitutes 90% of its execution time. If we have 4 cores available, what is the theoretical speedup according to Amdahl's Law? Show your calculations. Round your answer to one decimal place.

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b. [15 points] Explain two real-world scenarios where Amdahl's Law might underestimate the actual speedup achieved. In each scenario, describe the conditions that lead to this discrepancy, and suggest a reason why Amdahl’s Law falls short in these cases.

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Problem 2: Scheduling and Parallelism (25 points)

Consider the following task graph, where each node represents a task and the directed edges represent dependencies. The execution time of each task is given in cycles:

Task | Execution Time (cycles)

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A | 10

B | 5

C | 15

D | 10

E | 5

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

a. [10 points] Determine the critical path of this task graph. What is the total execution time along this critical path? Show your work.

b. [15 points] Assuming you have two processors available, devise an optimal scheduling strategy to minimize the overall execution time. Illustrate your scheduling scheme with a Gantt chart or a similar representation. What is the total execution time with this scheduling strategy?