Fall 2023
Exam I
Thursday, October 5

DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO

Name:_____. Student ID No._____

1. **NO TALKING UNTIL YOU LEAVE THE EXAM ROOM, PERIOD. Not now. Not when you are done. Not when you are collecting your things. Not when you are getting ready for the exam. NO TALKING!** Doing so will earn you an F on the exam, at a minimum.
2. You May **NOT ASK ANY QUESTIONS DURING THE EXAM** due to Requirements of Social Distancing. Do your best and note any concerns on your page.
3. **Write the exam with a dark colored pen or pencil.** Light colored pens or pencils do not scan well.

- **Plagiarism** will earn you an F in the course and a recommendation of expulsion from the university.
  - **a.** You may not refer to any material outside of this exam.
  - **b.** That is, you may **not** refer to notes, books, papers, calculators, phones, classmates, classmates' exams, and so forth.
  - **c. Do not talk to fellow students at any time while in the exam room.**
- Answer all questions on these pages. No code or pseudo-code is necessary – just a precise and concise explanation and justification.
- *Unsupported work will receive no credit.*

Q1 (4 pts) Describe/define the following terms. Give an example of where each of these metrics might be useful.

a. **Degree** of a distributed-memory computer.
b. **Communication Diameter** of a distributed-memory computer.
c. **Bisection Width** of a distributed-memory computer.

Q2 (4 pts) Given n data items stored in the global memory of a CREW PRAM with n processors, give an algorithm with asymptotically optimal running time to determine the sum of all n values so that every processor knows the final result. Efficiency counts! Justify your answer.

Q3 (4 pts) Given a linear array with n data items evenly distributed amongst the processors, give an asymptotically cost-optimal algorithm to compute the sum of the n values. The algorithm should be the most efficient of the cost-optimal algorithms. Efficiency counts! Justify your answer.

Q4 (4 pts) Given a mesh of size n, with one piece of data per processor, give an asymptotically optimal algorithm to determine the parallel prefix of the data. Efficiency counts! Justify your answer.

Q5 (4 pts) Given a mesh with n pieces of data evenly distributed amongst the processors, give a cost-optimal algorithm of asymptotically minimal running time to compute the sum of the n values. The algorithm should be the most efficient of the cost-optimal algorithms. When the algorithm terminates, all processors should know the sum. Efficiency counts! Justify your answer.