Fall 2020
Exam II
Thursday, November 19

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 in the course, at a minimum.
2. Unlike the previous exam, **you may write on the front and back of these exam pages.**
3. 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.

- **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) Given an $n \times n$ array of values, distributed in a natural fashion on a mesh computer, give a cost-optimal algorithm to replace every value in position (i, j) with the average of values $(i, j+1)$, $(i, j-1)$, $(i+1, j)$, and $(i-1, j)$. You may assume that for values along the edge of the array, their exterior neighbors have a value of 0. Justify your answer.

Q2 (5 pts) Given an $n \times n$ array of values, distributed in a natural fashion on the mesh of a mesh-of-trees, give a cost-optimal algorithm that will replace the value of every entry (i, j) with the maximum of the average of the values in row i and the average of the values in column j. Justify your answer.

Q3 (6 pts) Give an asymptotically optimal algorithm to compute parallel prefix on a tree with n leaf processors. Assume that data starts and ends in the leaf processors. Justify your answer.

Q4 (6 pts) Draw a combinational circuit that represents a Bitonic Merge of 8 items. Show how the sequence $< 3, 5, 7, 8, 10, 6, 2, 1 >$ moves through your circuit.

Q5 (9 pts) Given n items that are either 1, 2, 3, or 4, give a description of an algorithm based on parallel prefix to sort these n items. That is, the input is a list of n items and the output is a list of n items where each of these items is either a 1, 2, 3, or 4.

a. Describe your algorithm.

b. What is the running time of your algorithm on a mesh of size n?

c. What is the running time of your algorithm on a hypercube of size n?

d. What is the running time of your algorithm on a CREW PRAM with n processors?

Extra Credit (1 pt each). Circle the correct answer.

1. Dr. Miller earned his Ph.D. from which institution?
    a. SUNY-Stony Brook
    b. SUNY-Albany
    c. SUNY-Buffalo
    d. SUNY-Binghamton
2. Dr. Miller has spent time with which one of the following?
    a. Jimmy Smits
    b. Susan Dey
    c. Jill Eikenberry
    d. Harry Hamlin
3. Where did Dr. Miller grow up?
    a. Rhode Island
    b. Long Island
    c. The Galapagos Islands
    d. Grand Island