Fall 2022
Midterm III
Thursday, April 21

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

Name:_____. Student ID No._____

Student UB E-Mail Address_____

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**. Do your best and note any concerns on your page.
3. **Write only on the front of each page**. Anything written on the back of a page will not be graded.

- **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.*

No exam questions on this page – Feel free to scribble/doodle on this page

Q1 (20 pts) Draw and label a hypercube of size 16. Draw multiple distinct paths between a pair of processors at maximal distance from each other.

Q2 (20 pts) Given a hypercube of size 8, where every processor $P_i$, $0 \leq i \leq 7$, stores the value $i$. Show every step of the algorithm to compute the parallel prefix sum of these 8 values. That is, at the conclusion of the algorithm, processor $P_i$ stores the $i^{th}$ prefix value.

Q3 (20 pts) Draw a combinational circuit to determine the minimum value of 8 input items. You may only use comparison elements. You must use the minimal number of comparison elements possible to solve the problem. Draw the combinational circuit using either model that we used in class. Justify your answer.

a. Clearly mark the 8 input items ($a_1$,…,$a_8$) on the left side of the circuit.
b. Clearly mark the output item, call it M, on the right side of the circuit.

Q4 (20 pts)

1. Describe a Cluster.

2. Describe a Grid.

3. Define Amdahl's Law.

4. What is the main conclusion drawn from Amdahl's Law?

5. What is the fallacy in terms of the general conclusion drawn from Amdahl's Law?

Q5 (20 pts) Justify all of your answers.

1. How many comparison operations are performed with Bitonic Sort? Justify your answer by stating the number of levels of comparitors and the number of comparitors used per level.
2. What is the running time of Bitonic Sort on an EREW PRAM? Give a brief explanation of how the algorithm is implemented on the EREW PRAM model.
3. What is the running time of Bitonic Sort on a Hypercube? Give a brief explanation of how the algorithm is implemented on the Hypercube.

**Extra Credit Questions (1 point each added to your final course grade):**

1) Prof Miller has run seminars on which topics? Circle all that apply. (No partial credit – all or nothing.)
   a) High-Performance Computing
   b) World Wide Web
   c) Natural Language Processing
   d) Grid Computing

2) Prof Miller earned his Ph.D. at which institution?
   a) Stanford
   b) SUNY-Binghamton
   c) Rochester Institute of Technology
   d) The Ohio State University

Extra Page that will be viewed.

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