Fall 2022
Midterm III
Thursday, November 17

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 (4 pts) Justify your answers to each of the following.

a) What is the bisection width of a hypercube of size n?
b) What is the communication diameter of a hypercube of size n?
c) How many unique paths are there between a pair of processors at maximal distance in a hypercube of size 16.

Q2 (4 pts) Given a hypercube of size 8, where every processor P_i, $0 \leq i \leq 7$, stores the value i. Use figures of a hypercube to show every step of an algorithm to compute the sum of these 8 values. At the conclusion of the algorithm, every processor should know this sum.

Q3 (6 pts) Draw a combinational circuit, using either of the types of diagrams that we drew in class, to perform each of the following.

a. Merge a bitonic sequence of size 2 into an ordered sequence of size 2.
b. Merge a bitonic sequence of size 4 into an ordered sequence of size 4.
c. Merge a bitonic sequence of size 8 into an ordered sequence of size 8.
d. Sort a sequence of 8 arbitrarily ordered items into a sorted sequence of size 8.

Q4 (3 pts) Given a set of n items, arbitrarily distributed one per processor on a mesh of size n, describe an asymptotically optimal algorithm to sort these items into row-major order. Justify your answer.

Q5 (3 pts) Given an algorithm to solve a problem on a CREW PRAM of size n that runs in $\Theta(M)$ time, give upper bounds to solve this problem on a *i*) Hypercube of size n, a *ii*) Mesh of size n, and a *iii*) RAM. Justify your answers.

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

1) Professor Miller has worked at which of the following institutions? Circle all that apply. (No partial credit – all or nothing.)
   a) SUNY-Buffalo
   b) SUNY-Stony Brook
   c) The Hauptman-Woodward Medical Research Institute
   d) San Diego Supercomputing Center

2) Prof Miller earned degrees at which institution? Circle all that apply. (No partial credit – all or nothing.)
   a) SUNY-Stony Brook
   b) SUNY-Binghamton
   c) University of California at San Diego
   d) Rensselaer Polytechnic Institute

3) Which of the following are true? Circle all that apply. (No partial credit – all or nothing.)
   a) Prof Miller is a Fellow of the Asia-Pacific Artificial Intelligence Association.
   b) Prof Miller is a Fellow of the Institute of Electrical and Electronics Engineers.
   c) Prof Miller is a member of the European Academy of Sciences.
   d) Prof Miller is a member of the Long Island Baseball Hall-of-Fame.

Extra Page that will be viewed.