Fall 2022
Exam II
Thursday, October 27

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) Given a mesh of size n with one piece of data per processor, give an asymptotically optimal algorithm to determine the parallel prefix sum of the data. Justify your answer.

Q2 (4 pts) Given a tree with n leaf processors, where each leaf processor initially stores an integer value in the range [1,10], sort the data so that the i^{th} leaf processor contains the i^{th} sorted value. Efficiency counts. Justify your answer.

Q3 (4 pts) Given n pieces of data evenly distributed amongst the base processors of a Pyramid, give an asymptotically cost-optimal algorithm with asymptotically optimal run time to determine the sum of the n values. At the end of the algorithm, all base processors should store the result. Justify your answer.

Q4 (4 pts) Given a Mesh-of-Trees of base size n, where every base processor contains either a 1 or a 0, determine the row in the base mesh that contains the maximum number of 1's. All processors in the base mesh should know the result when the algorithm terminates. Efficiency counts. Justify your result.

Q5 (4 pts) Given an $n^{1/2} \times n^{1/2}$ array of data, evenly distributed amongst the processors of a mesh computer, where every piece of data is either a 1 or a 0, give an asymptotically cost-optimal algorithm with asymptotically optimal running time to determine the number of 1's in the array. Justify your answer.

Extra Credit Questions:

1) Circle each team that Prof Miller roots for. (No partial credit – all or nothing.)
   a) Giants
   b) Yankees
   c) Blue Jays
   d) Bills

2) Circle each area of computer science that Prof Miller has worked in. I.e., those areas where Prof Miller has published peer-reviewed research papers containing evolutionary or revolutionary results. (No partial credit – all or nothing.)
   a) Parallel algorithms
   b) Machine Learning
   c) Molecular Structure Determination
   d) Data Science

3) Prof Miller has worked with which high-end computing company? Circle one.
   a) nVidia
   b) IBM
   c) Cray
   d) Thinking Machines Corporation

4) Prof Miller has spent time discussing high-end computing research with which of the following. Circle all that apply. (No partial credit – all or nothing.)
   a) Michael Dell
   b) Bill Gates
   c) Hillary Clinton
   d) Steve Wozniak