

Fall 2021
Exam II
Thursday, November 18

**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.*

Q1 (8 pts) Give the asymptotically lower bound of the running time to sort n pieces of data distributed one per (base) processor for each of the following architectures. Justify your answer.

- a. Mesh of size n
- b. Tree with n leaves
- c. Pyramid of base size n
- d. Mesh-of-Trees of base size n

Q2 (6 pts) Given a linear array of size n with one piece of data per processor, compute the parallel prefix of the data. Efficiency counts. Justify your answer.

Q3 (6 pts) Given n pieces of data evenly distributed amongst the base processors of a Mesh-of-Trees, 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 processors should store the result. Justify your answer.

Q4 (5 pts) Given n pieces of data stored one per processor in the base of a pyramid computer of base size n , where the data are integer values in the range of $[1,10]$, sort the data. That is, at the end of the algorithm, the n input values should be distributed in a pre-defined order that you provide, one per base processor. Efficiency counts. Justify your result.

Q5 (5 pts) Given n pieces of data evenly distributed amongst the processors of a mesh computer, give an asymptotically cost-optimal algorithm with asymptotically optimal running time to determine the parallel prefix of the n pieces of data. Justify your answer.

Extra Credit Questions:

- 1) Circle each sport that Prof Miller has played. (No partial credit – all or nothing.)
 - a) Baseball
 - b) Basketball
 - c) Hockey
 - d) Golf

- 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) Cyberinfrastructure

- 3) Prof Miller was founding director of which supercomputing center? Circle one.
 - a) Center for Supercomputing Applications
 - b) National Energy Research Supercomputing Center
 - c) Lawrence Livermore National Laboratory
 - d) Center for Computational Research

- 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) Chuck Schummer
 - c) Hillary Clinton
 - d) Harry Hamlin

