Spring 2023
Exam II
Thursday, April 13

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 on the exam, at a minimum.
2. 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.
3. **Write the exam with a dark colored pen or pencil.** Light colored pens or pencils do not scan well.

- **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.*

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Q1 (4 pts) Given a hypercube of size n, with one piece of data per processor, give an asymptotically optimal algorithm to determine the sum of all values. At the end of your algorithm, all processors should know this sum. Justify your answer.

Q2 (4 pts) What is the running time of Bitonic Sort on a RAM? Justify your answer.

Q3 (4 pts) Given a mesh of size 16, clearly show the comparisons between processors and steps required for Bitonic Sort to merge ordered 1×2 regions into ordered 2×2 regions, assuming that shuffled row-major indexing is used. You do not need to show whether items are sorted into increasing or decreasing order. Justify your answer.

Q4 (4 pts) Given a set of n overlapping line segments, initially distributed in the first n positions of global memory on a CREW PRAM, give a cost-optimal algorithm of minimal running time to determine a point of maximum overlap. Efficiency counts! Justify your answer.

Q5 (4 pts) Given n records distributed on a hypercube, give a cost-efficient and time-efficient algorithm to solve the array packing problem. Efficiency counts! Justify your answer.

Extra Sheet