Spring 2023
Exam I
Thursday, March 9

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 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 (4 pts) Assume that Algorithm A runs in $\Theta(n^2)$ time, Algorithm B runs in $\Theta(n^3)$ time, and Algorithm C runs in $\Theta(n \log n)$ time. Order these algorithms from best to worst with respect to growth rate of n. Justify your answer.

Q2 (4 pts) Give the asymptotic number of multiplications performed in the following. Justify your answer.

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For i = 1 to n do
   For j = i to n do
      x = i * j
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Q3 (4 pts) Given n data stored in the global memory of an EREW PRAM, give an asymptotically cost-optimal algorithm of asymptotically optimal run time to compute the parallel prefix sum of n values. Justify your answer.

Q4 (4 pts) Given an integer value in the range [1, 2, …, 10] distributed one per processor on a mesh of size n, give an asymptotically optimal algorithm to sort the data. Justify your answer.

Q5 (4 pts) Give the a) Degree, b) Communication Diameter, and c) Bisection Width for the following architectures. Justify your answers.

1. Linear Array of size *n*
2. Mesh of size *n*
3. Tree with *n* leaves
4. Pyramid of base size *n*

Extra Sheet