Spring 2025
Exam I (scaled to 25 points)
Thursday, March 6

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.*

Q1 (8 pts) This question concerns QuickSort on a RAM (sequential computer). For this question, assume that the *n* input data are unique (*i.e.,* no duplicate data values) and that this data is given in a singly-linked list.

a. Give a brief, 3-step, high-level description of QuickSort.
b. Draw and label an execution tree that represents work performed for the best-case running time of QuickSort.
c. Give a recurrence relation/equation for the best-case running time of QuickSort.
d. What is the best-case running time of QuickSort?
e. What is the worst-case running time of QuickSort?

Q2 (6 pts) Given n pieces of data initially stored one per processor on a CREW PRAM, give an asymptotically optimal algorithm to compute the parallel prefix (sum). Justify your answer.

Q3 (6 pts) Given a linear array with n data evenly distributed amongst the processors, give an asymptotically cost-optimal algorithm of asymptotically minimal running time to determine the sum of the n values. At the end of the algorithm, all processors should know the final value. Justify your answer.

Q4 (5 pts) Justify your answers.

a. Show that $\log_2 n = O(n)$.
b. Show that $n = O(n^2)$.