Spring 2026
Exam I (scaled to 30 points)
Thursday, February 26

DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO

Name:_____. Student ID No._____

1. **NO TALKING FROM WHEN YOU ENTER THE EXAM ROOM UNTIL YOU HAVE EXITED THE EXAM ROOM!** Any violation will earn you an F on the exam, at a minimum.
2. If you have a question, come to the front of the room and whisper very quietly to the professor.
3. Please note any concerns of interpretation of a question on your exam.
4. **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, watches, other electronic devices, 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 (6 pts) Given the summation

$$\log_2 n + \log_2 \frac{n}{2} + \log_2 \frac{n}{4} + \cdots + 3 + 2 + 1$$

(a) (3 pts) Give a closed form solution to the summation, *e.g.*, $18n + 13$.
(b) (3 pts) Give the best asymptotic representation of the summation.

Justify your answers.

Q2 (8 pts) Given a CREW PRAM with one piece of data distributed per each of the n processors, give an asymptotically time-optimal algorithm to compute the parallel prefix sum of the data. Justify your answer.

Q3 (8 pts) Given a CREW PRAM with n pieces of data evenly distributed amongst the processors, give an asymptotically cost-optimal solution with asymptotically optimal running time to compute the sum of the data. At the end of the algorithm, all processors should know the result. Justify your answer.

Q4 (8 pts) Given a linear array of size n with one piece of data per processor, give an asymptotically time-optimal algorithm to sum the data. At the end of the algorithm, all processors should know the result. Justify your answer.

Bonus Question (2 pts): What is the number? _____