Fall 2022
Midterm I
Thursday, February 24

# 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.*

No exam questions on this page – Feel free to scribble/doodle on this page

Q1 (20 pts) Assume that Algorithm A runs in $\Theta(n)$ time. Assume that Algorithm B runs in $\Theta(\log n)$ time. For large $n$, which algorithm would you use? Justify your answer mathematically. (An answer of, or related to, "because it is faster" will earn you exactly 0 points.)

Q2 (20 pts) Given the pseudo-code below, what value is printed? In addition, what is the asymptotic running time of this code as a function of *n*? (You may assume that *n* is an even value.). Justify your answers.

```
x = 0
for i = 1 to n
        for j = i to n
                x = x + 1
print x
```

Q3 (30 pts) Given a list of size $n$ on a RAM, what is (*i*) the best-case running time of Quicksort, and (*ii*) the worst-case running time of Quicksort. You should assume that there is no pre-processing (*i.e.*, no initial check to see if the data is in order). For both (*i*) and (*ii*), give the running time as a recurrence equation and justify the running time via recursion trees. Efficiency counts!

Q4 (20 pts) Given an EREW PRAM with *n* processors, where every processor has a piece of data, give an efficient algorithm to determine the summation of these data values. When the algorithm terminates, all *n* processor should know this sum. Describe your algorithm and justify its running time. Efficiency counts!

Q5 (10 pts) Given a PRAM model of your choosing, define the model and give an efficient algorithm so that all *n* processors know the minimum of the initial set of *n* values distributed 1 per processor. Describe your algorithm and justify its running time. Efficiency counts!

**Extra Credit Questions (1 point each added to your final course grade):**

1) Prof Miller has done research in which of the following areas. Circle all that apply. (No partial credit – all or nothing.)
   a) Machine Learning
   b) Computational Geometry
   c) Parallel Algorithms
   d) Computational Crystallography

2) Prof Miller has spent time with which of the following. Circle all that apply. (No partial credit – all or nothing.)
   a) Hillary Clinton
   b) Michael Dell
   c) Chuck Schummer
   d) Mark Zuckerberg

Extra Page that will be viewed.

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