

# CMSC 351

## Introduction to Algorithms

Fall 2021

This class is being recorded

# Safety First

<https://umd.edu/4Maryland/health-plan>

- University policy is that face coverings over the nose and mouth are required while you are indoors at all times for all vaccinated and unvaccinated individuals. There is only one exception<sup>1</sup>.
- Students not wearing a mask will be given a warning and asked to wear one, or will be asked to leave the classroom immediately.
- Students who have additional issues with the mask expectation after a first warning will be referred to the Office of Student Conduct for failure to comply with a directive of University officials.

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<sup>1</sup>Instructors may remove masks during lecture while maintaining 6ft distance

# Administration

- Webpage

- ▶ Get homework assignments
- ▶ Syllabus
- ▶ Other documents

- Piazza

- ▶ Ask questions
  - ★ Do **not** post solutions.
  - ★ Do **not** ask if your answer or approach is correct.
- ▶ Discuss issues
- ▶ Public versus Private

- ELMS

- ▶ Get homework solutions
- ▶ See grades

- Gradescope

- ▶ Hand in homework
- ▶ See graded homeworks and exams

# Administration (continued)

- Textbook (bookstore/on reserve at McKeldin Library)
  - ▶ Cormen, Leiserson, Rivest, and Stein, *Introduction to Algorithms* (3rd ed., 2009). MIT Press. (Any edition is fine.)
- Homework
  - ▶ Regular homeworks: typically due each Friday.
  - ▶ Must be in PDF.
  - ▶ Must be easy to read (your responsibility).
  - ▶ Late date: 20% off your actual grade for 24 hours. (One get-out-of-jail-free card.)
  - ▶ Your neighbor should understand your answers.
  - ▶ Study groups. State who is in your study group at top of homework.
  - ▶ Must write up homework solutions yourself.
    - ★ State what outside resources you used to solve each problem.
  - ▶ Do problems from book (and other books).

# Administration (continued)

- Class attendance
  - ▶ You are responsible for what is said in class.
  - ▶ Lectures will be posted (mostly).
- Office hours
- Grading
- Exams
  - ▶ Two evening midterms: **6:00-8:00pm**.
    - ★ Tuesday, October 5th
    - ★ Thursday, November 11th
  - ▶ Final exam: **4:00-6:00pm**.
    - ★ Friday, December 17th
- Academic integrity.

# Topics (tentative)

- Introduction, Ch. 1,2
- Quadratic sorting algorithms
- Mergesort, Ch. 2
- Summations, Appendix A
- Recurrences, Ch. 4
- Heapsort, Ch. 6
- Quicksort, Ch. 7
- Sorting in Linear Time, Ch. 8
- Medians and Order Statistics, Ch. 9
- Graphs and Trees, Appendix B
- Minimum Spanning Trees, Ch. 23
- Shortest Paths: Dijkstra's algorithm, Ch. 24.3
- Introduction to NP-completeness, Ch. 34

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- from which the modern word algebra derives

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- Useful on the job.

# What is an algorithm?

## Definition

An *algorithm* is a finite list of step-by-step instructions for solving a problem.

## Efficiency

- Time
- Space

## Example

Tournament assignment. (Think about at home.)

# Runtimes are Critical

## Example

Two algorithms:

- Insertion sort:  $2n^2$
- Merge sort:  $50n \lg n$

Two computers:

- Computer A runs 10 Billion instructions / second
- Computer B runs 10 Million instructions / second

Compute the time to sort 10 Million numbers:

- Computer A uses Insertion Sort
- Computer B uses Merge Sort

# Calculate Time

## Example

Insertion Sort 10 Million numbers on Computer A:

# Calculate Time

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$$\frac{2 \cdot (10^7)^2 \text{ instructions}}{10^{10} \text{ instructions / second}} = 20000 \text{ seconds} \approx 5.5 \text{ hours}$$

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Merge Sort 10 Million numbers on Computer B:

$$\frac{50 \cdot 10^7 \lg(10^7) \text{ instructions}}{10^7 \text{ instructions / second}} = 1163 \text{ seconds} \approx 20 \text{ mins}$$