CMSC 351
Introduction to Algorithms

Spring 2019

Administration

- General Administration:
  Jamie Matthews <jamiem@cs.umd.edu>

- Exam Scheduling:
  Andrew Witten <awitten1@terpmail.umd.edu>

Administration (continued)

- 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.
  - NP-completeness homeworks: typically due every other Wednesday.
  - Progamming project.
  - Must be in PDF.
  - Must be easy to read (your responsibility).
  - Late date: 25% off your actual grade. (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.
  - Laptops and other devices: Do not share during class.
  - Lectures will be posted (mostly).
- Office hours
- Grading
- Exams
  - Two evening midterms: **6:00-8:00pm**.
    - ★ Tuesday, March 12th
    - ★ Tuesday, April 16th
  - Final exam: **4:00-6:00pm**.
    - ★ Saturday, May 18th
- 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

Why learn this material?

Why learn this material?

- Algorithms are everywhere in Computer Science (and elsewhere).

Why learn this material?

- Algorithms are everywhere in Computer Science (and elsewhere).
- Useful for later courses.

Why learn this material?

- Algorithms are everywhere in Computer Science (and elsewhere).
- Useful for later courses.
- Useful for computer programming.

  "Micro-algorithms"

Why learn this material?

- Algorithms are everywhere in Computer Science (and elsewhere).
- Useful for later courses.
- Useful for computer programming.

  "Micro-algorithms"
- Useful to get a job.

Why learn this material?

- Algorithms are everywhere in Computer Science (and elsewhere).
- Useful for later courses.
- Useful for computer programming.

  "Micro-algorithms"
- Useful to get a job.
- 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

Example

Insertion Sort 10 Million numbers on Computer A:

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

Calculate Time

Example

Insertion Sort 10 Million numbers on Computer A:

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

Merge Sort 10 Million numbers on Computer B:

Calculate Time

Example

Insertion Sort 10 Million numbers on Computer A:

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

Merge Sort 10 Million numbers on Computer B:

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