MA/CSSE 473
Day 01

Course Intro
Algorithms Intro

Pick up a handout from the back table

MA/CSSE 473 Day 01

- In-class Quizzes (NOT)
- Roll Call/Instructor quick intro
- Questions about the Syllabus?
- The importance of Data Structures
- The importance of Algorithms
- Begin Algorithm Overview/Review
  - Which will last a few days

No in-class quizzes in 473

- By now, you know whether they help you.
- Many days, a "handout with fill-ins" instead.

- You will not usually need to have your computer in class.
- But if you want to follow along with the slides…
- Be careful about distractions!

Attendance sheet

- Please write the name you want me and other students to call you

A Few Claude Facts

- Degrees: Caltech, Illinois, Indiana (MA, MA, CS)
- This is my 29th year at Rose
- Have taught about 22 different courses; favorites are …
- I have 9 children, ages 14-35) 9 grandchildren.
- I live **very** close to campus
- In 2010 I was diagnosed with a very rare connective tissue disease, scleromyxedema. 2-day infusions.
- Despite ugly prognosis, I still know that God's in control.
- I *really* like it when you put 473 as part of the subject line in your email to me.

Contact Info

- Claude Anderson, F-210, x8331
- anderson@rose-hulman.edu
- http://exchange.rose-hulman.edu/owa/calendar/anderson@rose-hulman.edu/Calendar/calendar.html . "View by week" is probably best
- If you email me, please include 473 somewhere

		From		Subject
	✉	Anderson, Cl…		230: Does it really start Thursday?
	✉	Anderson, Claud…		Show 473 in subject
	✉	Ande…		FW: todo
	✉	Apple		Welcome to your new iPad.
	✉	Laxer, Cary		Reminder of tonight's ice cream social

Where to find course materials

- Moodle: drop boxes, solutions, etc.
- Piazza: Announcements and discussions.
- Schedule page and things linked from it
- Notice the **Hints to Exercises** section that begins on p 497 of the textbook
  - First try to do each problem without using the hint.
  - But if you get stuck, by all means look at the hint.
- Sometimes I will post my PowerPoint slides *after* lectures, because they may contain spoilers. When I do post them before, I may repost a different version after.
- Sometimes my slides contain more than we actually get to in class. When that happens, I will usually move that material to the following day's class.

Questions about the Syllabus?

- … or the schedule page?
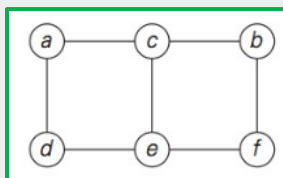- … or other course details?
- You can ask now, or ask tomorrow

One detail before the course intro

- CSSE 230 previously discussed graph implementations
- So HW1 has a problem to "review" this.
- For some of you, it won't be review
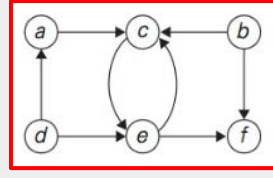- So we take 5 minutes to show two representations now.

Graph representations

$V = \{a, b, c, d, e, f\}, E = \{(a, c), (b, c), (b, f), (c, e), (d, a), (d, e), (e, c), (e, f)\}.$

Graph	**Digraph**	
Vertex	**Head, Tail**	
Edge	**Cycle, Loop**	
Endpoints	**Complete**	
Adjacent	**Connected**	

$V = \{a, b, c, d, e, f\}, E = \{(a, c), (a, d), (b, c), (b, f), (c, e), (d, e), (e, f)\}.$

	a	b	c	d	e	f
a	0	0	1	1	0	0
b	0	0	1	0	0	1
c	1	1	0	0	1	0
d	1	0	0	0	1	0
e	0	0	1	1	0	1
f	0	1	0	0	1	0

a	→ c → d
b	→ c → f
c	→ a → b → e
d	→ a → e
e	→ c → d → f
f	→ b → e

(a)   (b)

FIGURE 1.7 (a) Adjacency matrix and (b) adjacency lists of the graph in Figure 1.6a.

The Ideal and the Real

- Ideal
  - Everyone comes to this course with the material from CSSE 230 and MA 375 fresh in their minds
- Real
  - Only about 50% of you took 230 within the last year.
- We'll do quite a bit of review/reinforcement in this course
  - In many cases, you'll understand things much better the second time you see them.
- Several of the early reading assignments discuss things you have probably seen before
  - Sometimes treated at a higher level than what you saw before.

The Ideal and the Real, part 2

- Ideal
  - Everyone comes to this course with the same background
- Real
  - You have taken a variety of courses that introduce common algorithms
  - Not all versions of CSSE 230 and the Disco courses are the same
  - And some people have taken Graph Theory, crypto, …
- Result
  - For every algorithm we discuss, chances are good that someone in the class will have already seen it
- What to do about it?
  - Live with it, or only discuss obscure algorithms? I choose the former

This is a very mathematical class

- **More about ideas than implementations**
- But there will be some implementation projects
- An occasional "regular" homework problem will require a small implementation (usually 50 lines of code or fewer)

An approach to this course

- Examine and/or analyze lots of algorithms.
- Look for similar approaches.
- Develop a toolbox.
  - Some might call it a "bag of tricks"
- Internalize the common terminology and ways of talking about algorithms.

Ways of organizing algorithms

- By area of application (230 approach), e.g.
  - Sorting algorithms
  - Search algorithms
  - Algorithms based on what data structure is used
    - Tree algorithms
    - Graph algorithms
    - Heap algorithms
- By techniques used (473 approach), e.g.
  - Brute Force
  - Greedy
  - Decrease and Conquer
  - Divide and Conquer
  - Dynamic Programming

Structuring Data Can Help a Lot

- If you have seen this problem before, please don't speak up (so other students get a chance to think about it).

- Example is here.
  (Note: I am not putting the example on-line)

Algorithms are Important

- The next few slides are based on Chapter 0 of *Algorithms* by Dasgupta, Papadimitriou, and Vazirani (McGraw-Hill, 2008)
- Two enterprises have fueled the computer revolution:
  - Rapidly-increasing hardware speeds
  - Efficient Algorithms

A Big Idea That Changed the World

- Moveable type
  - Gutenberg, 1448 (I saw a Gutenberg Bible in summer 2008 at the Library of Congress)
  - According to Dasgupta, et. al
    - Literacy spread
    - The Dark Ages ended
    - The human intellect was liberated
    - Science and technology triumphed
    - The Industrial Revolution happened
    - Many historians say we owe all of this to typography
  - For a great discussion of algorithms and typography
    - See the interview with Donald Knuth in July-August CACM
    - It's assigned reading for this course. See Day 11 in schedule.

The Other Earth-Shaking Big Idea

- **Algorithms**
- First step: Replacing Roman Numerals by decimals (India, 7th century AD)
  - Could now do arithmetic efficiently
  - Codified by Al Khwarizimi (Baghdad, 9th cent.)
    - Add, subtract, multiply, divide, square roots, digits of π.
    - Precise, unambiguous, mechanical instructoins
    - The word **algorithm** is derived from his name.
- The champion of algorithms in the West
  - Leonardo of Pisa (a.k.a. Fibonacci) (early 13th century)

Do you agree with Dasgupta?

- Are moveable type and algorithms the biggest change motivators since the Dark Ages?
- What else would you include in the list?

Brainstorm

- What is an algorithm?
- In groups of three, try to come up with a good definition.
- Goal: Short but complete
- Two minutes

Write an algorithm …

- … based on the schedule page for this course
- Input: A session number (1 .. 40)
- Output: A number representing the day of the week.   0 represents **M**, 1 **T,** 2 **R**, 3 **F**.
- Write the algorithm (a function, actually) with your group.