Introduction to Computing Using Matlab

CS 1112

(CS1142)

Dr. K.-Y. Daisy Fan

http://www.cs.cornell.edu/courses/cs1112/

Today's lecture

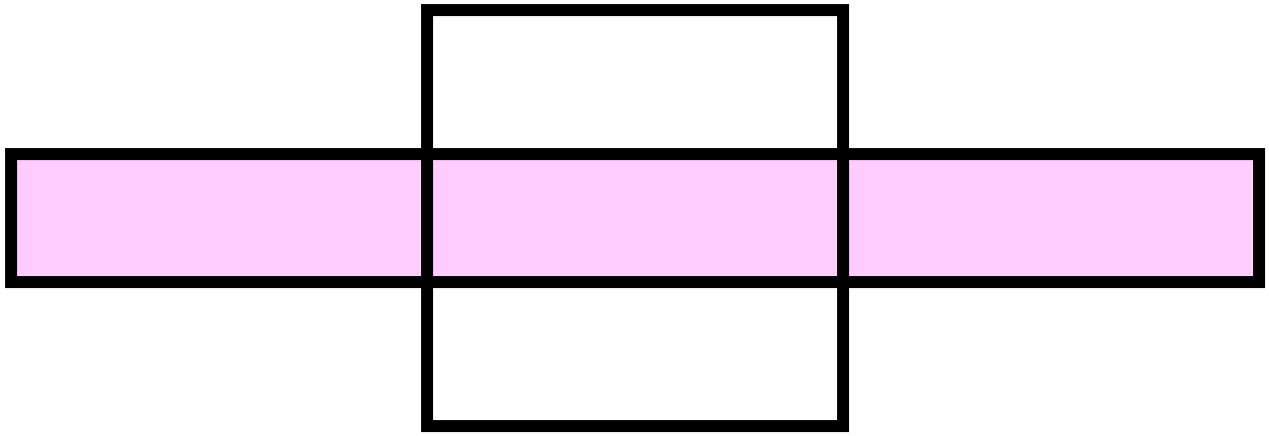
- An illuminating problem
- CS1112 philosophies & syllabus
- What is computer programming?
- Choosing between CS1112 & CS1110
- Course logistics/policies (highlights)

An illuminating problem: computing square roots

- Suppose A > 0
- Observation: If A is the area of a square, then I can just measure the side length—that is $\sqrt{A}$
- Idea: Make a square with area A
- Real task: Make a sequence of increasingly square rectangles, each with area A

How to make a rectangle "more square"?

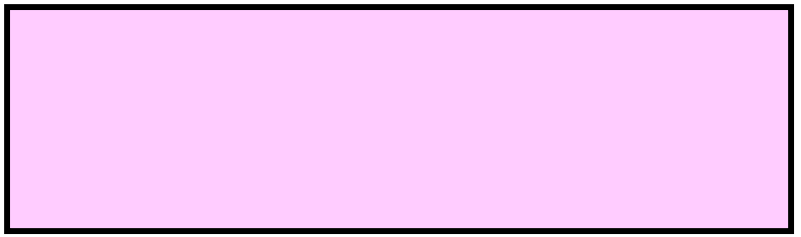
- If a square and a rectangle both have area A …



- then $\sqrt{A}$ is between the length and width of the rectangle

An improvement strategy

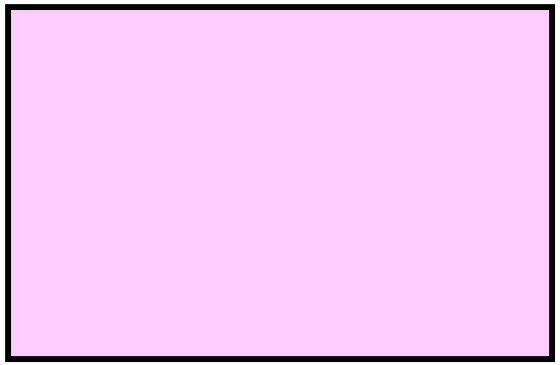
Current:



Recipe: $L_{new} = (L + A/L) / 2$

The average of the length and width.

Next:



A Matlab program to make “increasingly square” rectangles

```
% The first rectangle...
L1 = A;
W1 = 1;
% The second rectangle...
L2 = (L1+W1)/2;
W2 = A/L2;
% The third rectangle...
L3 = (L2+W2)/2;
W3 = A/L3;
% and so on...
```

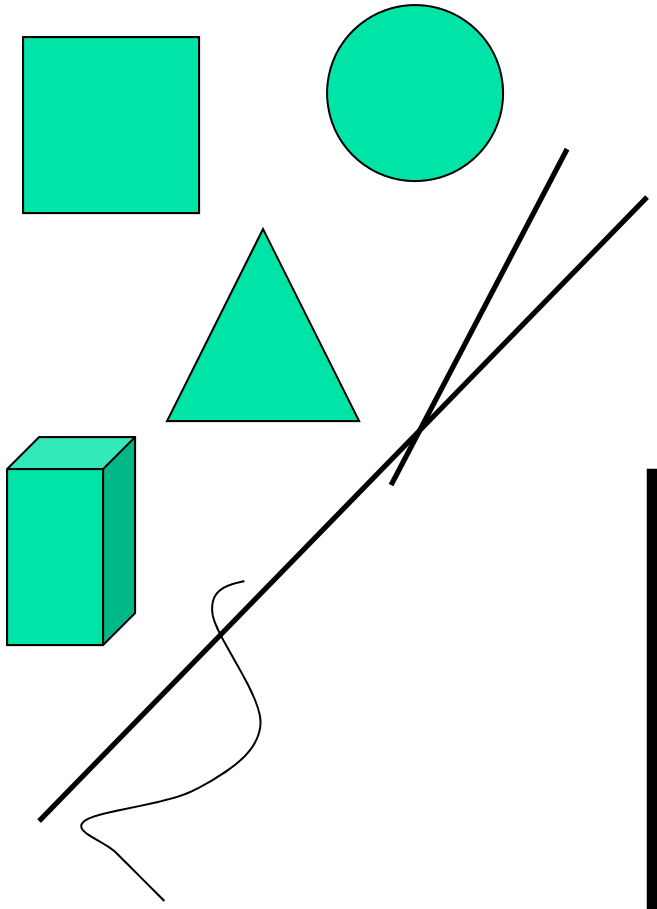
Some conclusions from square root finding problem

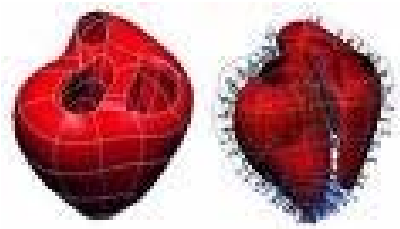
- It paid to have a geometric sense
- A complicated computation was reduced to a sequence of elementary calculations
- A program is like a formula (or sequence of formulas)

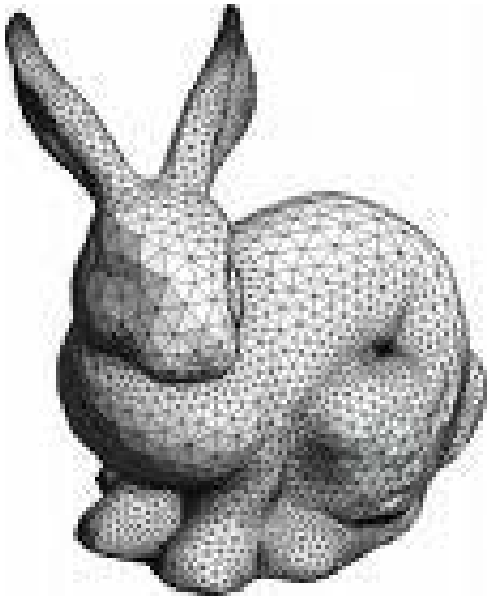
Course Goals

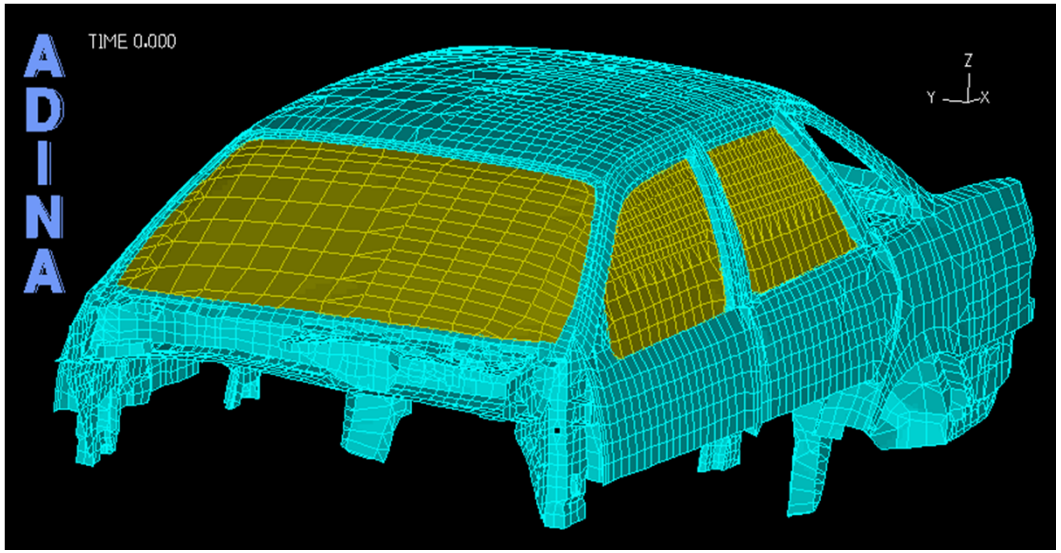
- Develop your "computational senses," senses that you need in computer problem-solving
- Develop a facility with the Matlab programming environment

A sense of geometry









A sense of complexity

What is the best itinerary to visit Boston, Miami, LA, Dallas?

3! = 6 possibilities

Add Seattle, NYC Austin, Denver

7! = 5040

If a computer can process 1 billion itineraries a second, how long does it take to solve a 100-city problem?

A sense of complexity

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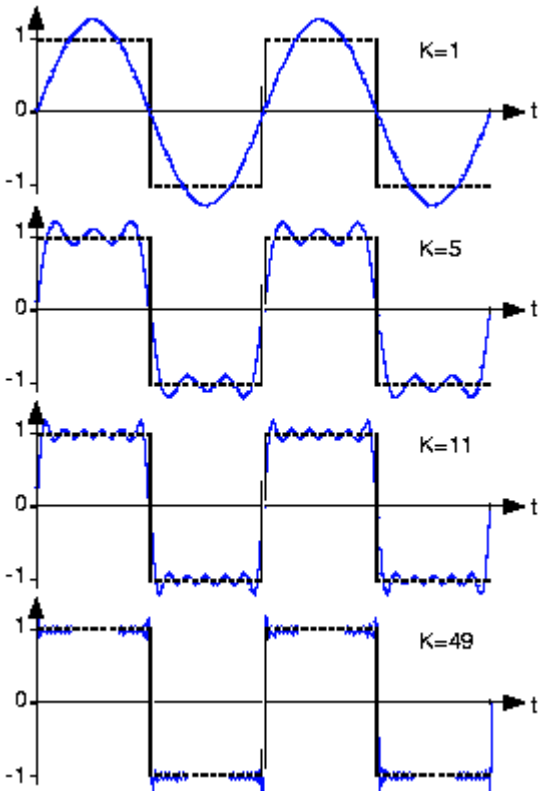
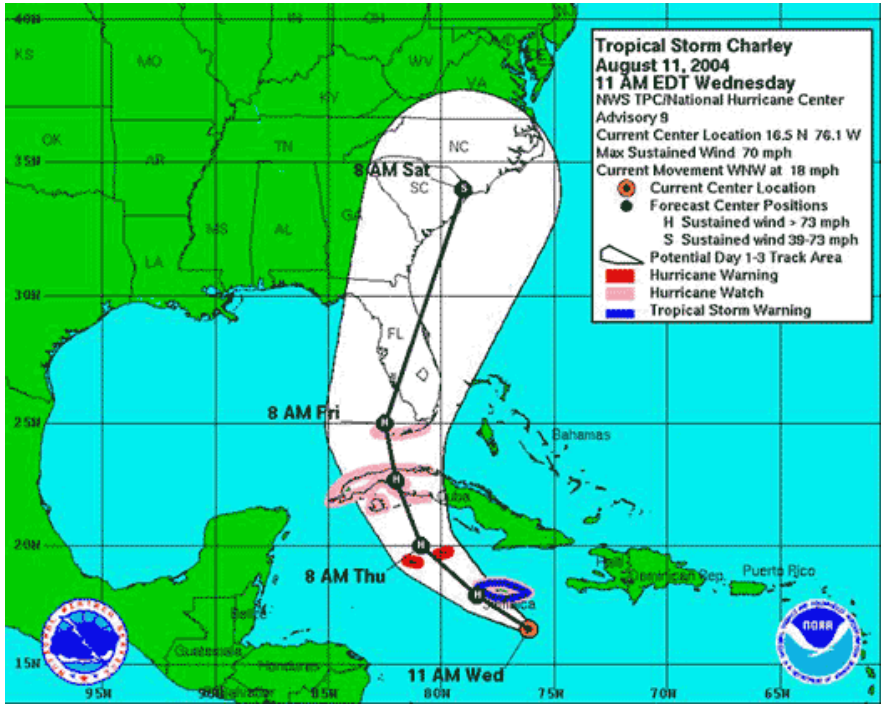
About a century…

A sense of approximation & error

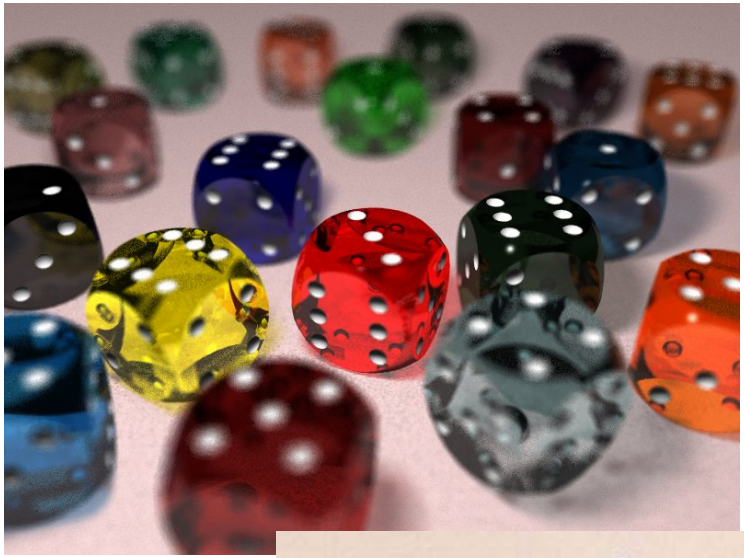


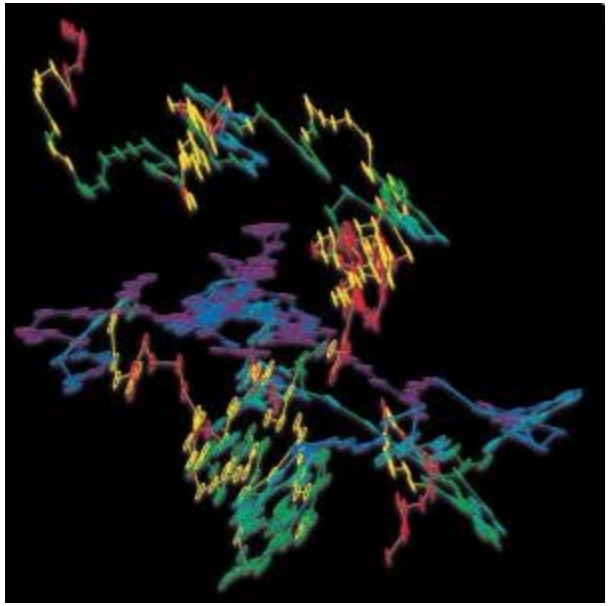
π

1/3 = .33333...



A sense of randomness and probability





Random walk
Brownian motion in water

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- Develop a facility with the Matlab programming environment

Computer problem-solving

Key: Algorithmic thinking

Algorithm:

A step-by-step procedure that takes you from a prescribed set of inputs to a prescribed set of outputs

Program:

The algorithm expressed in a specific language, e.g., Matlab

Computer problem-solving — Programming

- Developing instructions for the computer to execute (in order to solve some problem)
- The steps must be logical
- Use a particular language *and follow the rules of the language* (grammar/syntax)

Example: *Adding songs from the internet to your music library*

- Find a website with MP3 or other audio files
- Register with the music site, if required for music downloading. (Don't steal music.)
- Click on the music file to download it onto your computer
- Drag the file to your library

Reference: iTunes

Example: *Adding songs from the internet to your music library*

- Drag the file to your library
- Click on a music file to download it onto your computer
- Find a website with MP3 or other audio files
- Register with the music site, if required for music downloading. (Don't steal music.)

These steps are out of order! Illogical!

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- Click [redacted] to dowNload [redacted]
- file Drag your librAry to

Bad grammar (syntax)!

Computer programming is …

- a tool used by computer scientists, engineers, and other professionals
- not all of computer science

- Think about astronomy: Telescope is a tool used by astronomers; astronomy is not about telescopes…

Matlab is the vehicle we use

With the Matlab environment, you can easily

- Develop programs
- Display results & ideas graphically
- Interact with large data sets (process text, image, and other files)

Matlab has extensive libraries of mathematical, statistical, simulation, and other tools. It is heavily used in engineering & sciences, both in industry and academia.

Engineering students take one of these courses:

- CS1112 – this course, Matlab
- CS1110 – Python

Each course satisfies the Engineering Computing Requirement. In 1112 you will learn procedural programming in depth and be introduced to object-oriented programming.

Each course can serve as the prerequisite for CS/ENGRD 2110 Object-Oriented Programming & Data Structure

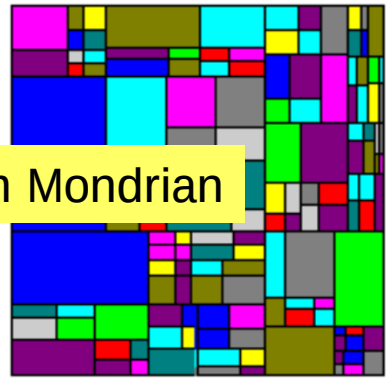
CS1112 has a focus on *computational science & engineering*

Approximation, randomness,
model building, sensitivity of models

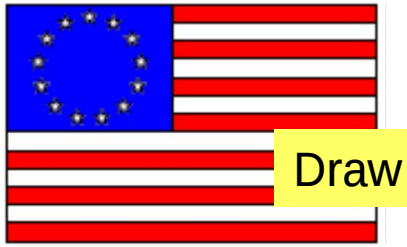
- Lecture examples and homework illustrate above themes
  - Edge detection
  - Ranking web pages
  - Congressional apportionment

Some past programming assignments

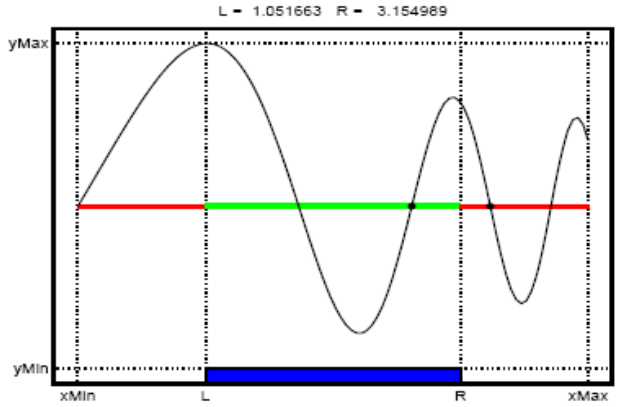
- Find the US population center from census data
- Organize protein data using structure arrays
- Mozart's musical dice game



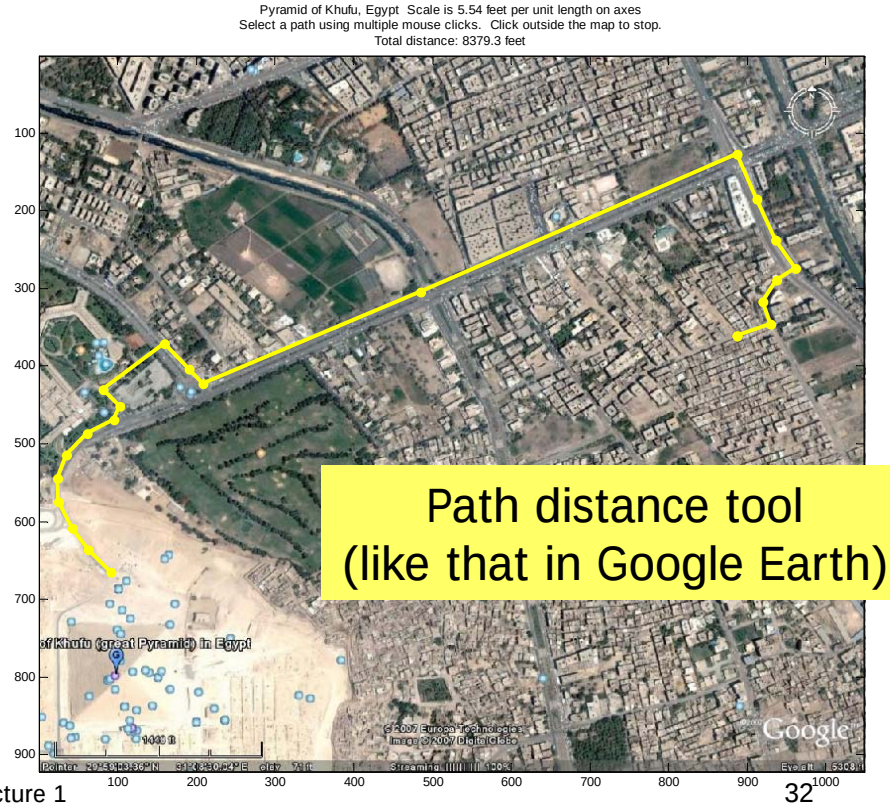
Draw the random Mondrian



Draw the "Betsy Ross Flag"



Root finding tool



Path distance tool
(like that in Google Earth)

CS1110 – Now in Python

- Switched from Java to Python because Python is a friendlier and more modern object-oriented language.
- Python is more relevant to non-computer scientists than Java—numerical libraries are available

Matlab and Python are just different vehicles we use to travel the "computational landscape."
→Different scenery along the way
→Both vehicles can get you there

CS1112

- No prior programming experience
- One semester of Calculus
- Focus on computational science & engineering
- Matlab

CS1110

- No prior programming experience
- No Calculus
- Focus on software development
- Python

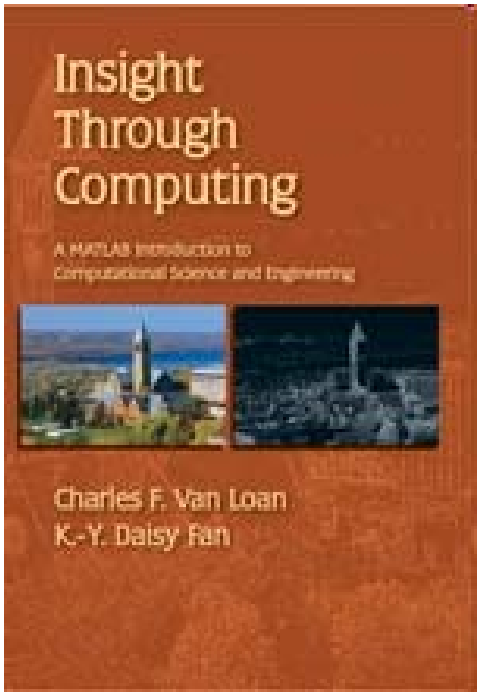
CS1112 requirements

- Attend lecture
- Attend discussion—get individual attention/help on weekly exercises!
- Monitor course announcements on website
- Do homework: best 5 of 6 programming projects
- Take 2 prelims and a final exam at their scheduled times
- Answer in-class quizzes (use your clicker)
- Adhere to the Code of Academic Integrity

Grading

- Best five of six projects (25%)
- Discussion exercises (4%)
- In-class quizzes (1%)
- Prelim 1 (20%)
- Prelim 2 (20%)
- Final exam (30%)

Course Materials



- *Insight Through Computing*

  A Matlab introduction to Computational Science and Engineering

- An iClicker clicker

- MATLAB Student Version (2008 or later) optional because you can use it in the public labs

Consulting & Computing

- Consulting in ACCEL Green Room (Engineering Library, Carpenter Hall). Check course website for hours.

- Some public labs that have Matlab:
  - Upson B-7
  - ACCEL
    - (Carpenter Hall, former Engrg Lib)
  - North campus: RPCC

What to do now?

- Pick a course

  Take CS1112 or CS1110

  (add/drop: lecture and discussion and optional AEW)
- Check course website
- Start reading (see listing on course website)
- Attend discussion in the lab (Upson B7) on Tues/Wed
- You must attend the discussion in which you are enrolled!

CS1112 Discussion Sections

Sec #	Time	Room
201	T 12:20-1:10p	UPS B7 Right & HLS 314
202	T 1:25-2:15p	UPS B7 Right & HLS 401
203	T 2:30-3:20p	UPS B7 Right & HLS 401
204	T 3:35-4:25p	UPS B7 Right & HLS 401
205	W 10:10-11:00a	UPS B7 Right & HLS 401
206	W 11:15a-12:05p	UPS B7 Right & HLS 401
207	W 12:20-1:10p	UPS B7 Right & HLS 401
208	W 1:25:2:15p	UPS B7 Right & HLS 401
209	W 2:30-3:20p	UPS B7 Right & HLS 401
210	W 3:35-4:25p	UPS B7 Right & HLS 401

Discussions are held in UPS B7 the first two weeks