

Introduction to Computing Using Matlab

CS1112 Spring 2011
(CIS1121)

Dr. K.-Y. Daisy Fan

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

Today's lecture

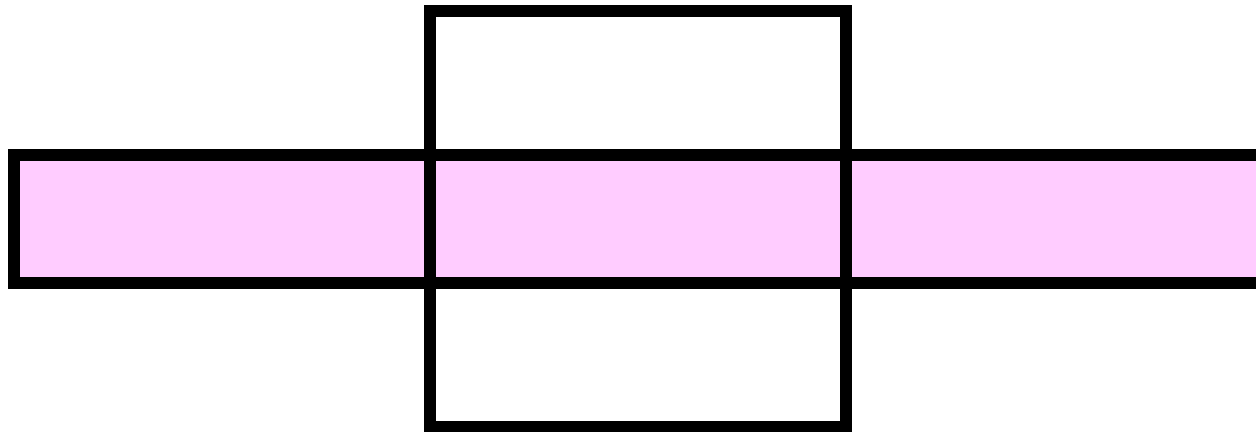
- An illuminating problem
 - CS1112 philosophies & syllabus
 - What is computer programming?
 - Choosing between CS1112 & CS1110
 - Course logistics/policies (highlights)
-
- How about CS1114? Introduction to Computing using Matlab & Robotics

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”?

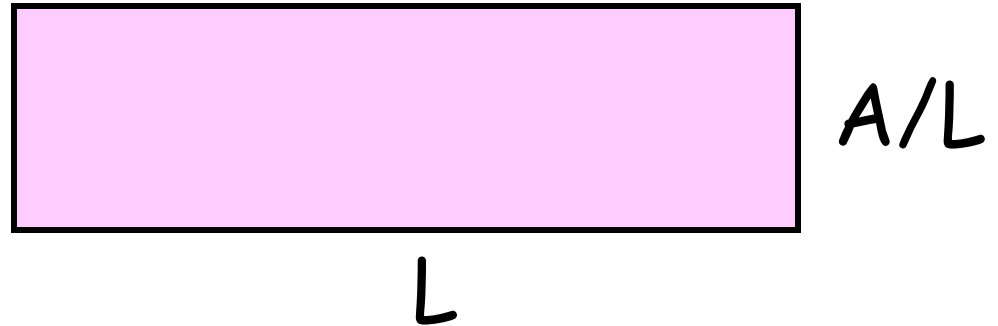
- If a square and a rectangle both have area A ...



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

An improvement strategy

Current:

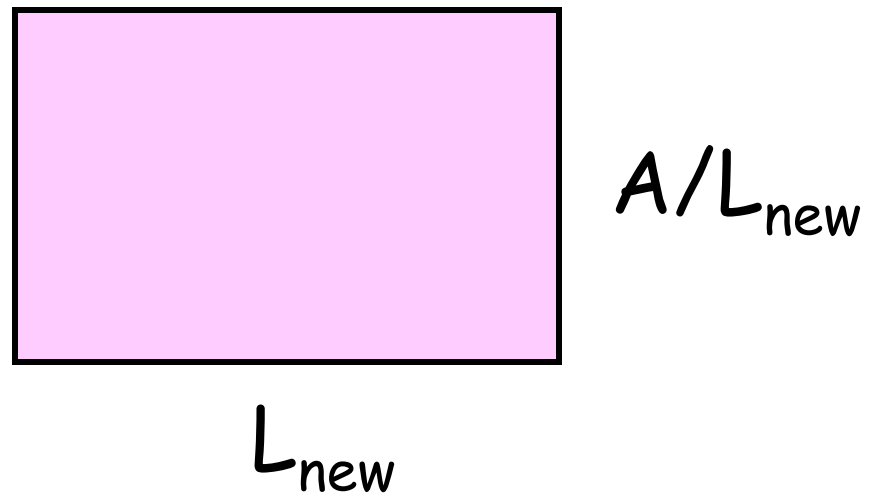


Recipe:

$$L_{\text{new}} = (L + A/L) / 2$$

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...
```

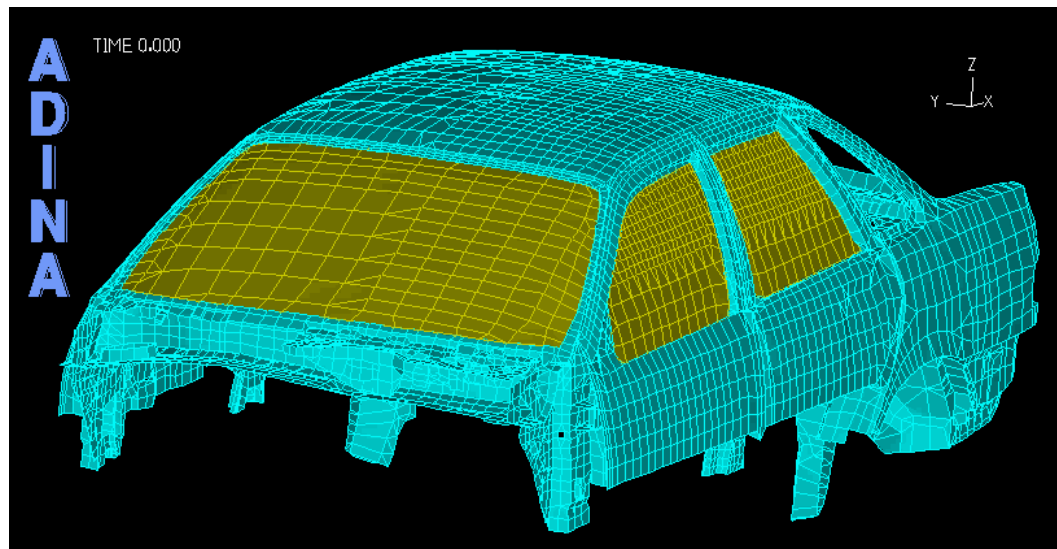
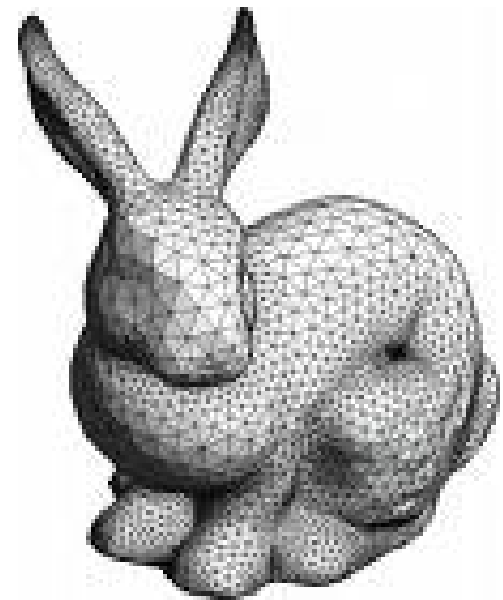
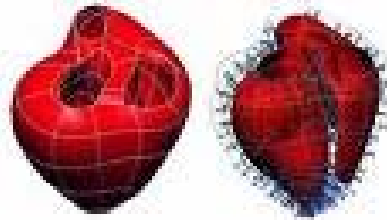
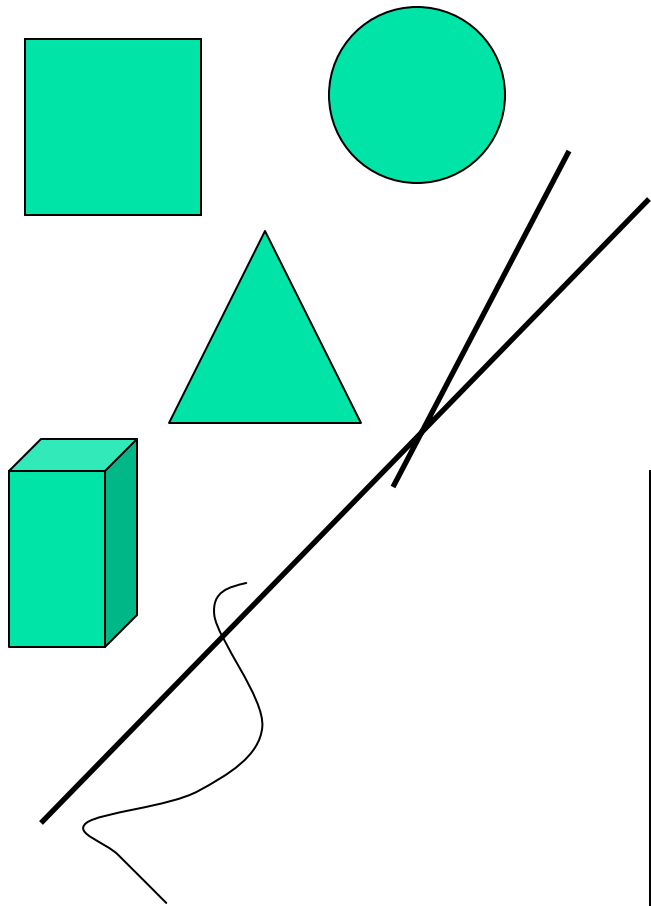
Some conclusions from square root finding problem

- 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



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

$3! = 6$ possibilities

Add Seattle, NYC
Austin, Denver

$7! = 5040$

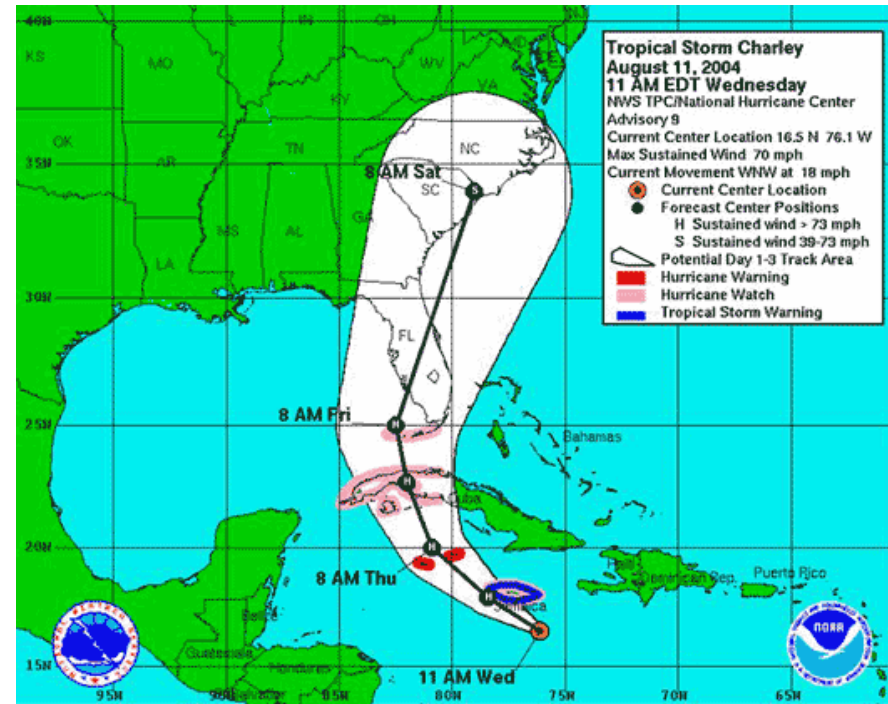
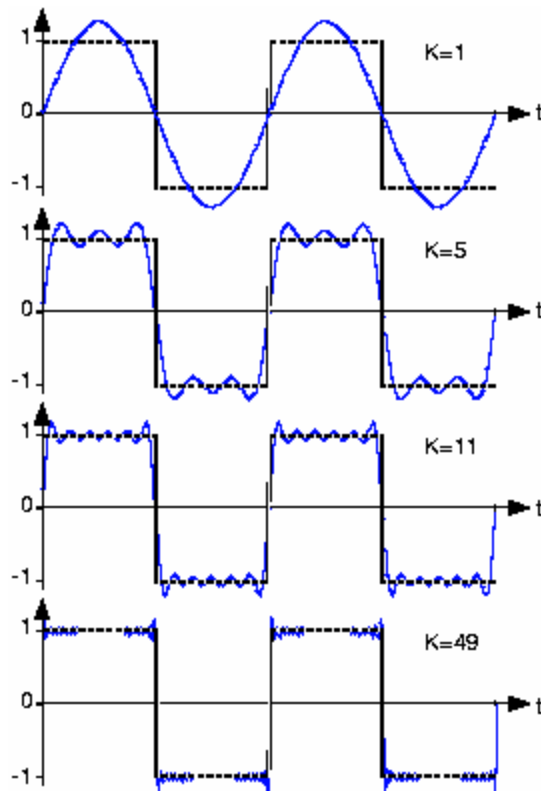
If a computer can process 1 billion itineraries a second, how long does it take to solve a 100-city problem?

About a century...

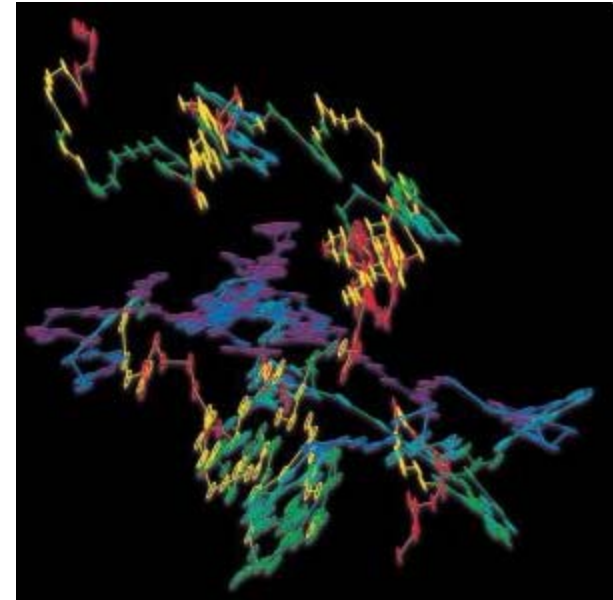
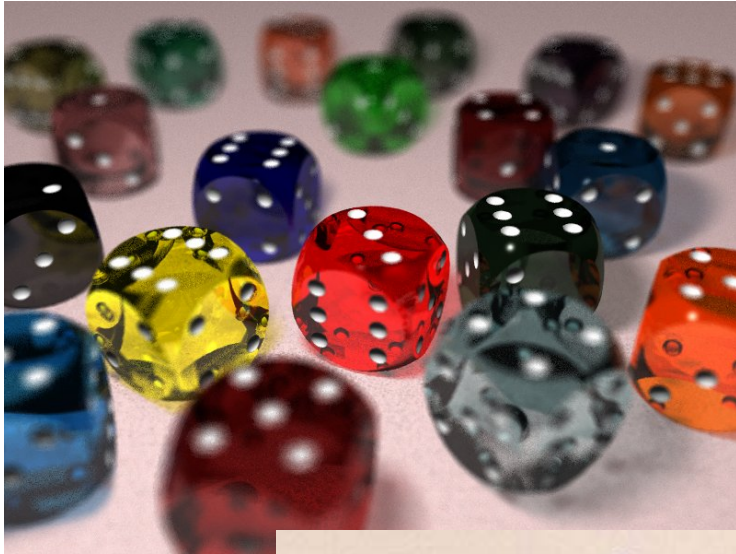
A sense of approximation & error

π

$1/3 = .33333...$



A sense of randomness and probability



Random walk
Brownian motion in water

Course Goals

- Develop your “**computational senses,**” senses that you need in **computer problem-solving**
- 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!

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*

- Find a website with MP3 or other audio files
- Register with the music site, if required for music downloading. (Don't steal music.)
- Click [REDACTED] to download [REDACTED]
[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 images and sound

Engineering students take either CS1112 or CS1110

- Matlab and Java are just different vehicles we use to travel the “computational landscape”
- Different scenery along the way
- Both vehicles get you there

- Take 4 credits in one language (e.g., Matlab, 1112)
- Followed by 1 credit in the other (e.g., Java, 1130)

CS1112 has a focus on *computational science & engineering*

Approximation, randomness,
model building, sensitivity of models

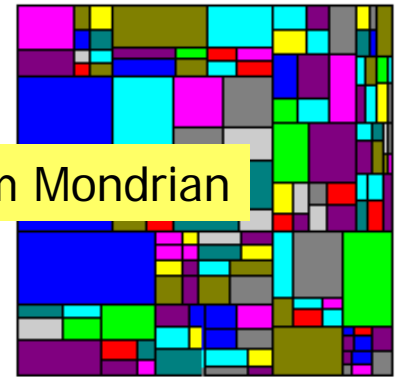
■ Lecture examples and homework illustrate above themes

- Edge detection
- Ranking web pages
- Congressional apportionment

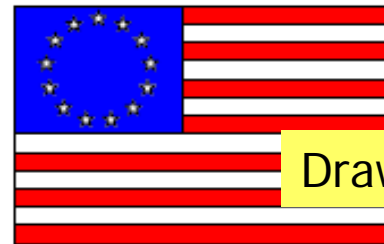


Some past programming assignments

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



Draw the random Mondrian

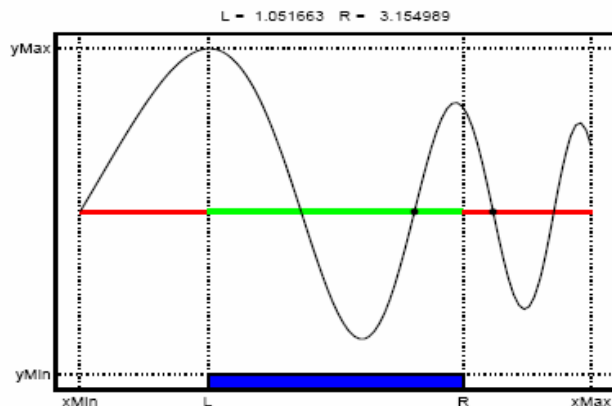


Draw the "Betsy Ross Flag"

Pyramid of Khufu, Egypt Scale is 5.54 feet per unit length on axes
Select a path using multiple mouse clicks. Click outside the map to stop.
Total distance: 8379.3 feet



Path distance tool
(like that in Google Earth)



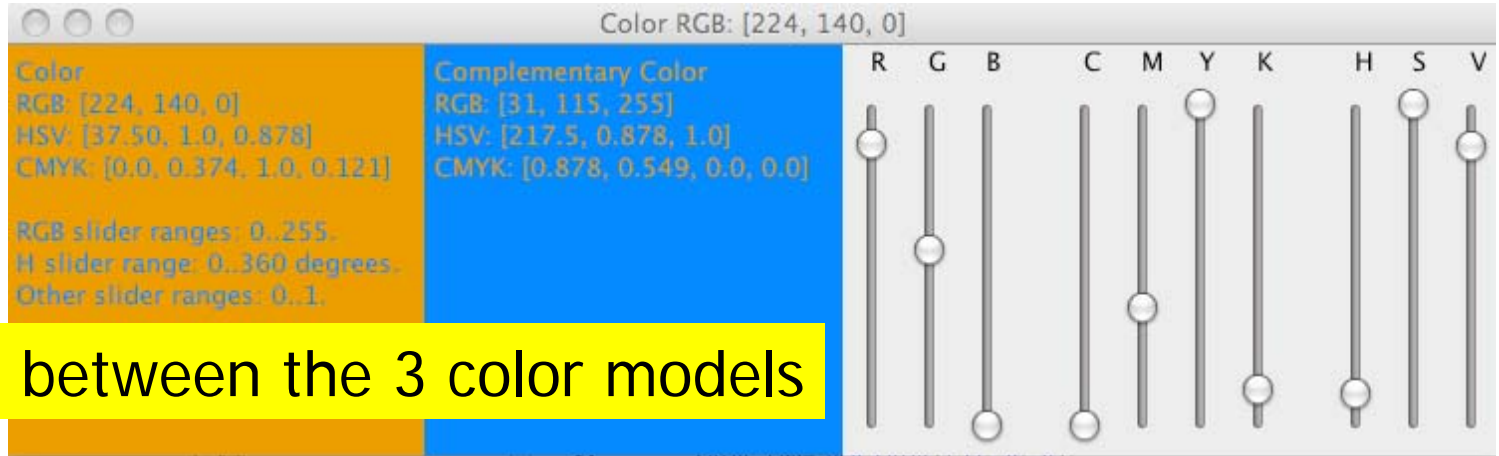
Root finding tool

Java, another vehicle ...

- An “object-oriented” language. A different way to *structure* a program compared to Matlab
- Conducive to discussion of design

Matlab and Java each has its place where it shines.
Both are good vehicles for beginning our travel
over the computational landscape.

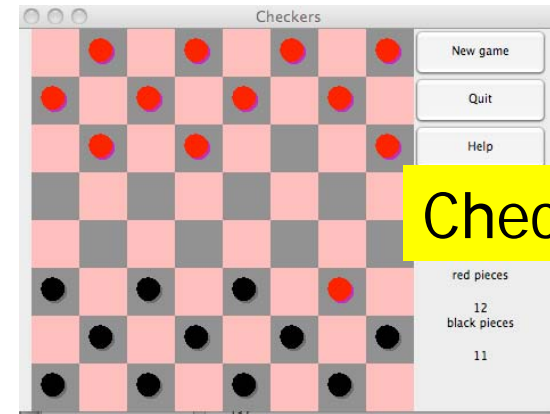
Some assignments in CS1110



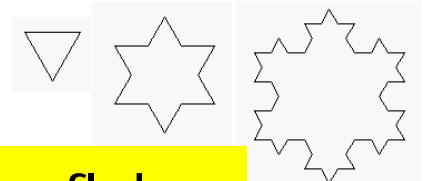
Translate between the 3 color models



Process images



Checkers



Koch snowflakes

CS1112

- No prior programming experience
- One semester of Calculus
- Computational science and engineering
- Matlab

CS1110

- No prior programming experience
- No Calculus
- Focus on object-oriented programming
- Java

CS112 requirements

- Attend lecture
- Attend section—get individual attention/help on weekly exercises!
- Monitor course announcements on website
- Do homework: best 5 of 6 programming projects
- Take 3 prelims and a final exam
- Answer in-class quizzes (use your clicker)
- Adhere to the Code of Academic Integrity

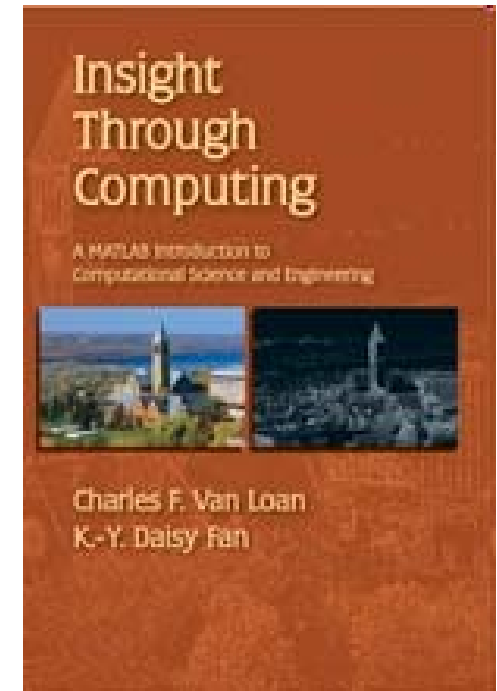
Grading

- Best five of six projects (25%)
- Discussion exercises (4%)
- In-class quizzes (1%)
- Prelim 1 (10%)
- Prelim 2 (15%)
- Prelim 3 (15%)
- 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
(Engineering Library, Carpenter Hall)
 - North campus: RPCC



What to do now?

- Pick a course

Take **either** CS1112 **or** CS1110, not both.

(add/drop: lecture **and** section **and** AEW)

- Check course website
- Start reading (see listing on course website)
- Attend section in the **lab** (Upson B7) on Tues/Wed

Need to enroll in a discussion section?

- All the discussion sections are full
- Newly added section: **Wednesdays 7:30-8:20p**
- Enroll in the newly added section later today

CS1112 Discussion Sections

Sec #	Time	Room
201	T 12:20-1:10p	UPS B7 Right & HLS 306
202	T 1:25-2:15p	UPS B7 Right & BRD 140
203	T 2:30-3:20p	UPS B7 Right & UPS 215
204	T 3:35-4:25p	UPS B7 Right & BRD 140
205	W 10:10-11:00a	UPS B7 Right & THR 203
206	W 11:15a-12:05p	UPS B7 Right & THR 205
207	W 12:20-1:10p	UPS B7 Right & HLS 306
208	W 1:25-2:15p	UPS B7 Right & OLH 245
209	W 2:30-3:20p	UPS B7 Right & THR 203
210	W 3:35-4:25p	UPS B7 Right & THR 203
211	W 7:30-8:20p	UPS B7 Right & ???

NEW!

Sections are held in UP B7 the first two weeks