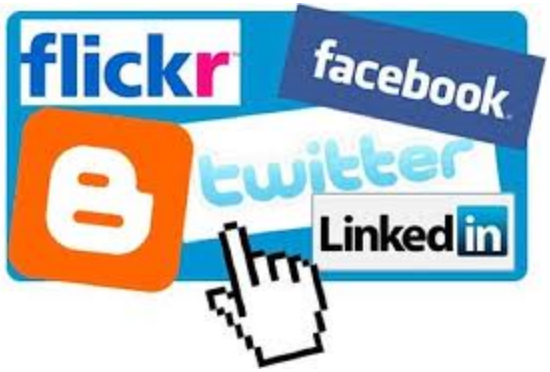
CMSC 110
Introduction to Computing

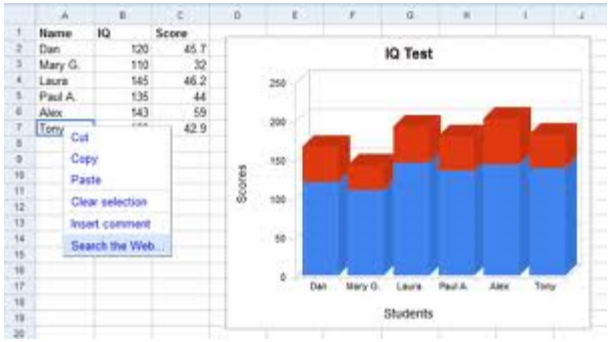
Eric Eaton Paul Ruvolo

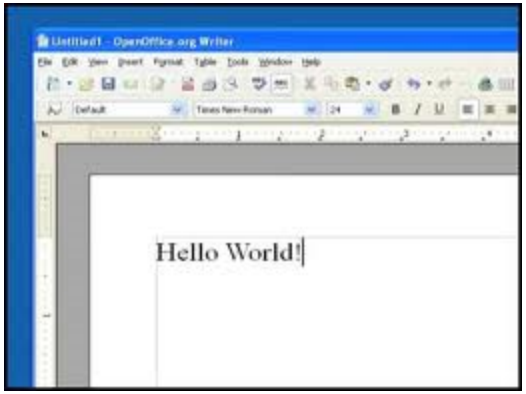
What is Computing?

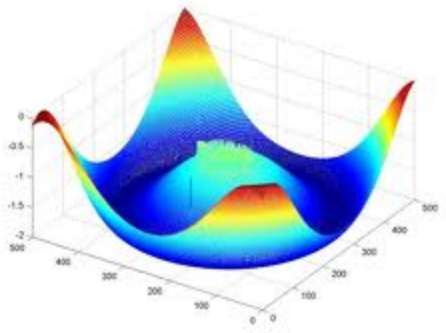
Computing: internet, e-mail, network…

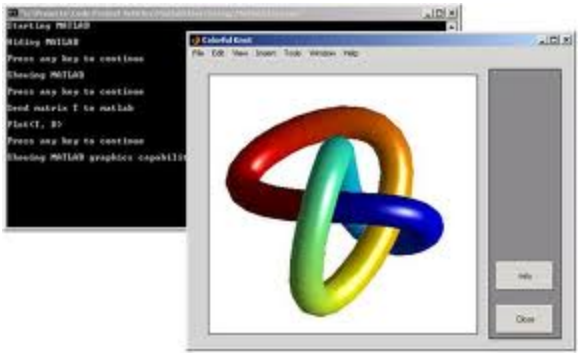


Computing: Productivity…







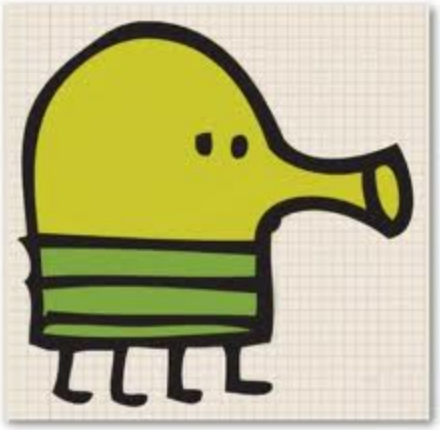


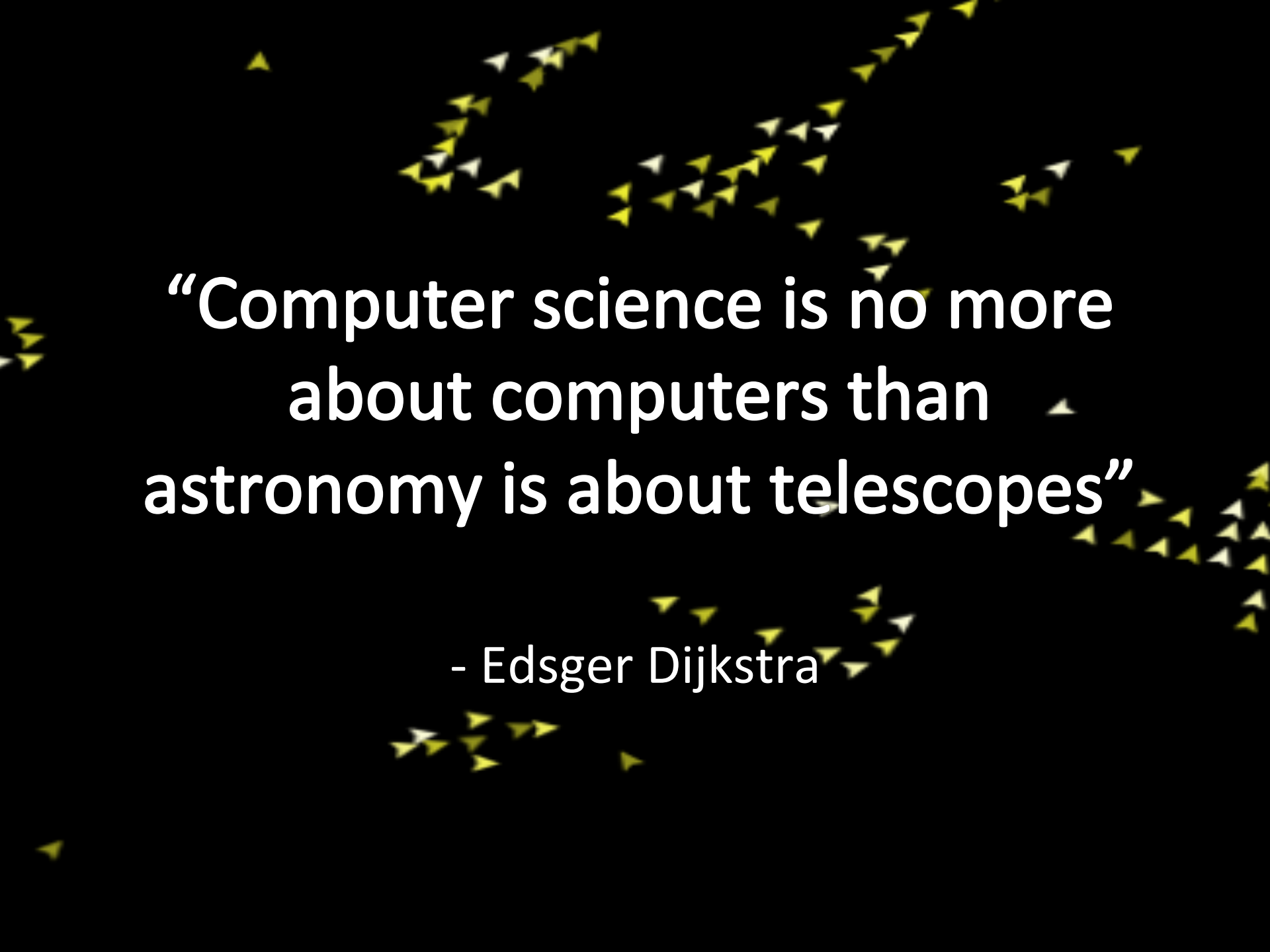
Computing: Digital Photography

http://www.alanzeyes.com/2009/02/hdr-photography.html

Computing: Entertainment…

Computing: Entertainment…

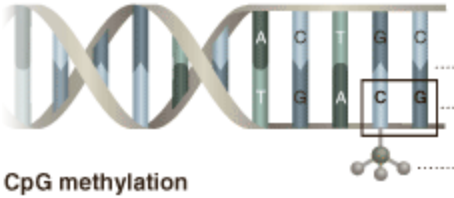



“Computer science is no more about computers than astronomy is about telescopes”
- Edsger Dijkstra

Cutting Edge Computer Science

Mapping the Epigenome

DNA contains the genetic blueprint for all human cells, but the reading and execution of the blueprint inside each cell is controlled in part by chemical markers attached to the DNA. Scientists have begun to map some of these epigenetic markers, including CpG methylation.



CpG methylation

DNA is a code written with four letters: **A**, **T**, **C** and **G**, each standing for one nucleotide.

In CpG methylation, a small marker called a methyl group attaches to the DNA at a CpG site, where a **C** and a **G** nucelotide sit next to each other.

Reading the ch

The outer ring r
Orange marks l
CpG methylatio

1 million base pairs

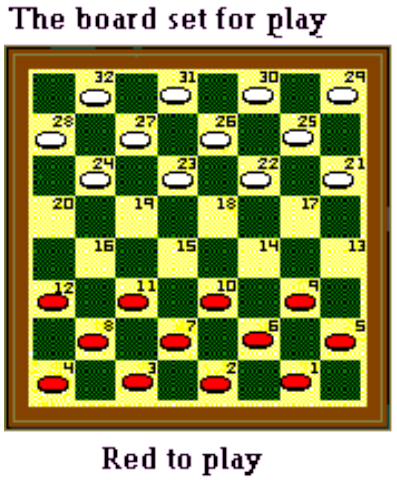
MUSCLE
LIVER
HEART
WHITE BLOOD CELL
SKIN
PLACENTA
SPERM

Chromosome 22

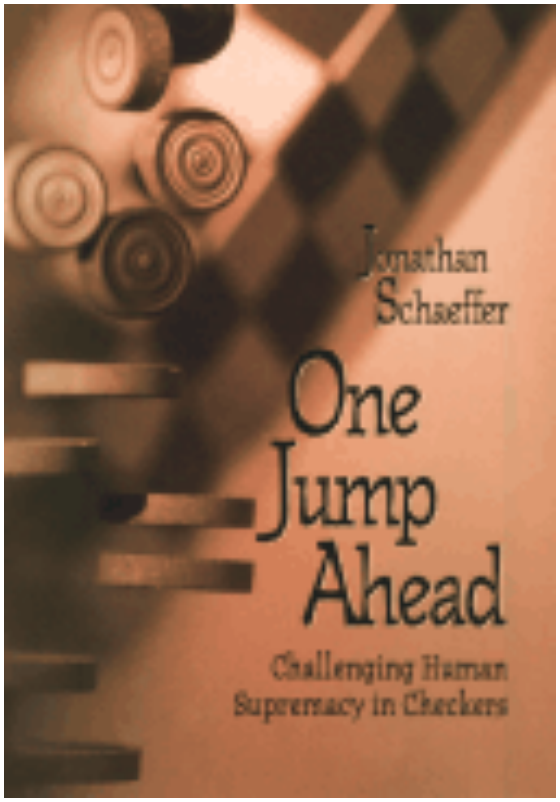
Of the 23 pairs of chromosomes in the human genome, 22 is the second smallest, containing only about 2

Gray and white bands on the circular chart correspond to

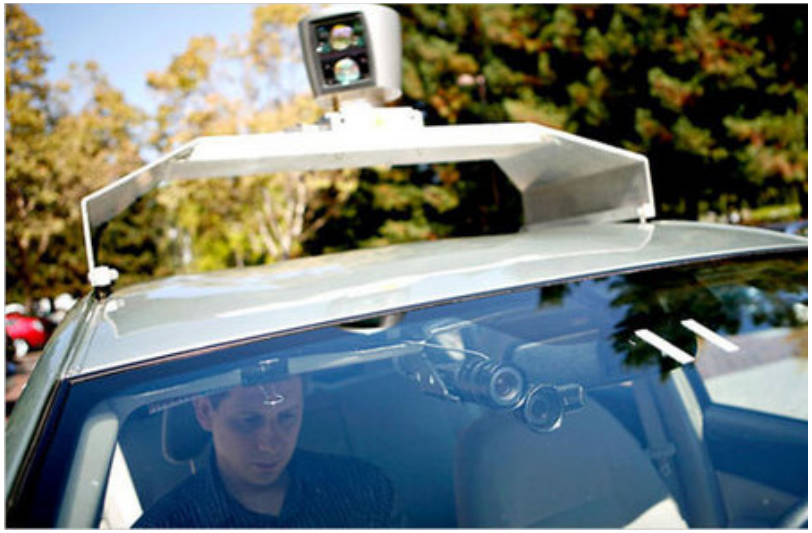
Chinook

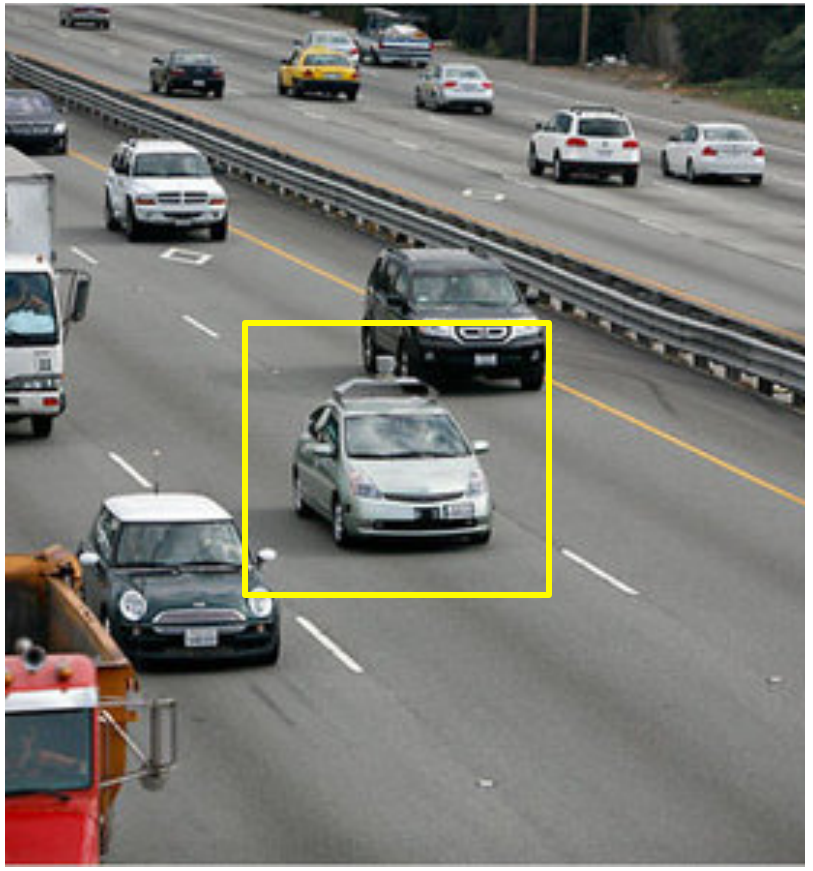


- Chinook is the World Man-Machine Checkers Champion, developed by researchers at the University of Alberta.
- It earned this title by competing in human tournaments, winning the right to play for the (human) world championship, and eventually defeating the best players in the world.
- Visit http://www.cs.ualberta.ca/~chinook/ to play a version of Chinook over the Internet.
- The developers have fully analyzed the game of checkers and have the complete game tree for it.
  - Perfect play on both sides results in a tie.
- "One Jump Ahead: Challenging Human Supremacy in Checkers" Jonathan Schaeffer, University of Alberta (496 pages, Springer. $34.95, 1998).



Google's Autonomous Car





- Nevada made it legal for autonomous cars to drive on roads in June 2011
- California introduced a similar bill in Aug 2012

2011 Jeopardy!

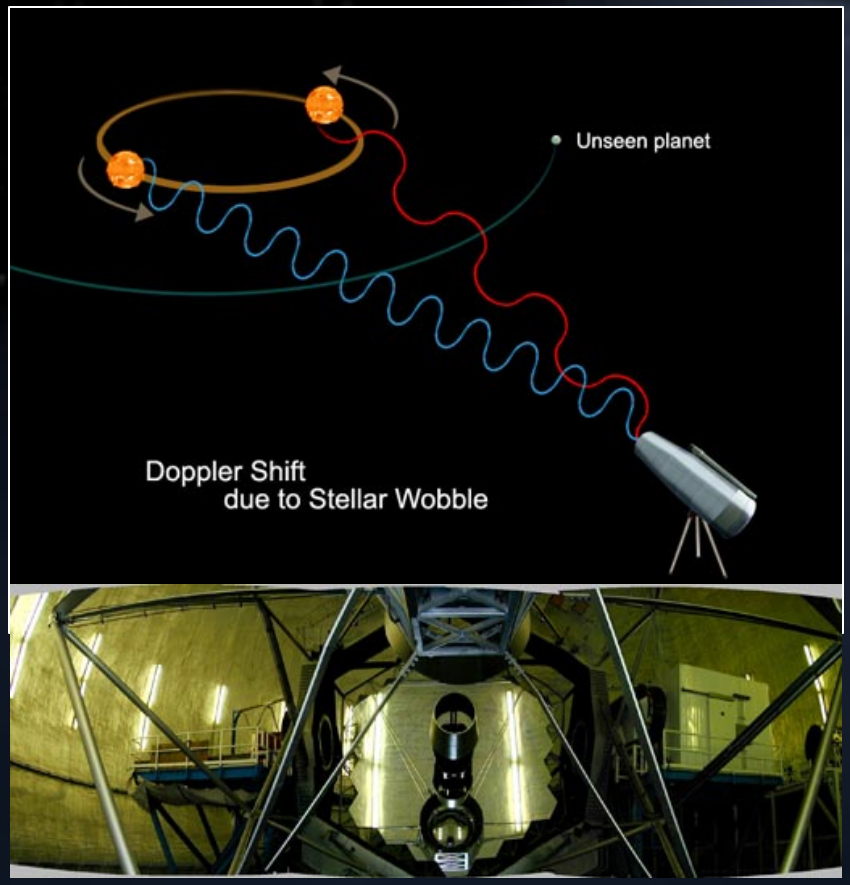
- In February 2011, IBM Watson bested Brad Rutter (biggest all-time money winner) and Ken Jennings (longest winning streak)
- IBM is currently applying Watson's technology to medical diagnosis and legal research

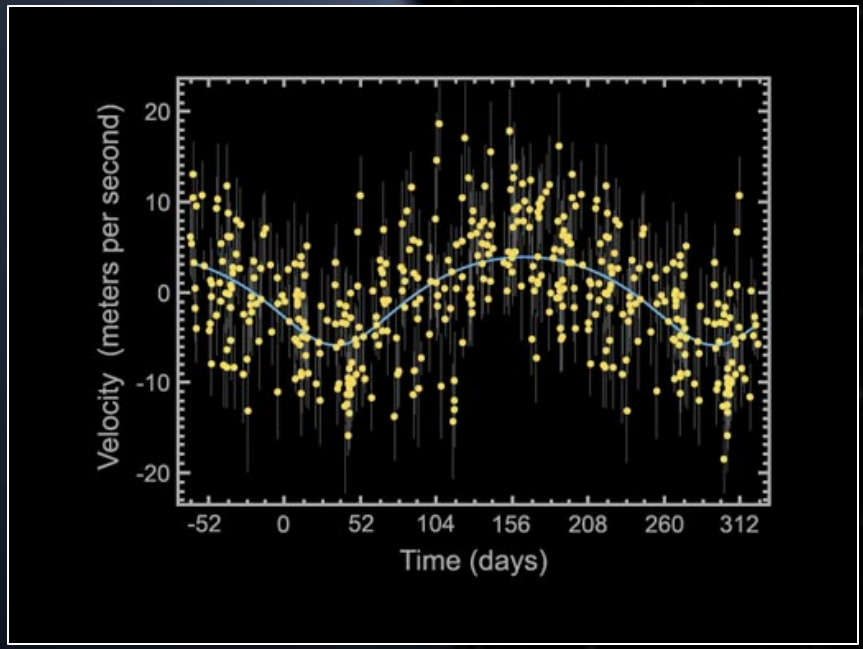
Robot Soccer

Bryn Mawr Robot Soccer Team
(Mexico 2012)

RoboCup International Robotics Competition
http://www.robocup.org/

Finding Life-Supporting Planets





ART

Protobytes
By Ira Greenberg

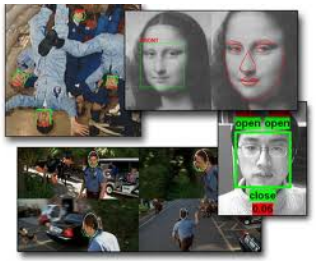
Areas in Computer Science

Artificial Intelligence

Robotics

Human-Computer Interaction

Computer Graphics



Computer Vision

Operating Systems

Computer Networking

Databases

Computer Security

Ubiquitous Computing

What is Computer Science?

Computer science is the study of solving problems using computation

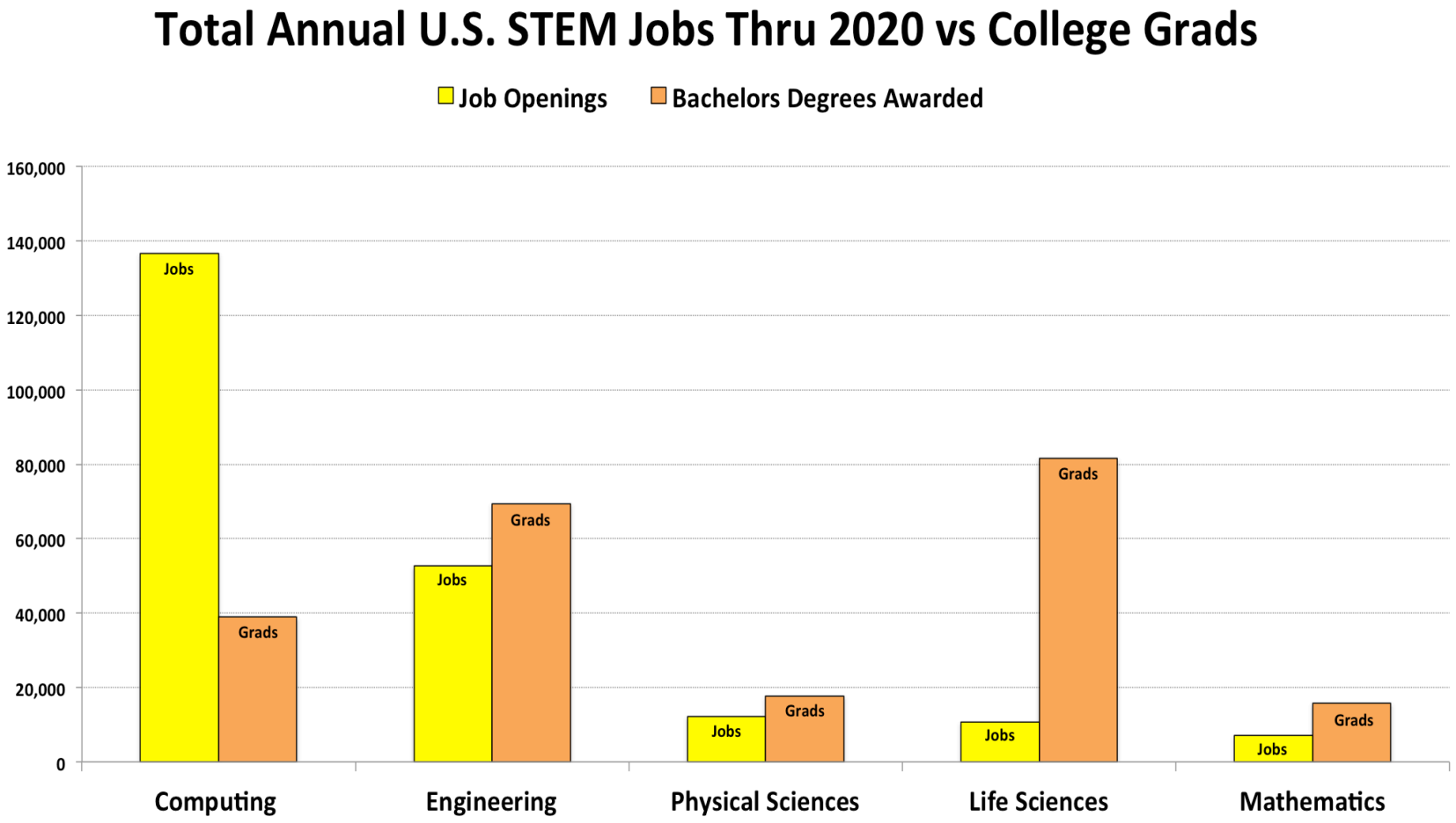
- Computers are part of it, but the emphasis is on the problem solving aspect

Computer scientists work across disciplines:

Mathematics	Geoscience	Medicine/Surgery
Biology (bioinformatics)	Archeology	Engineering
Chemistry	Psychology	Linguistics
Physics	Sociology	Art
Geology	Cognitive Science	…

Computing is important

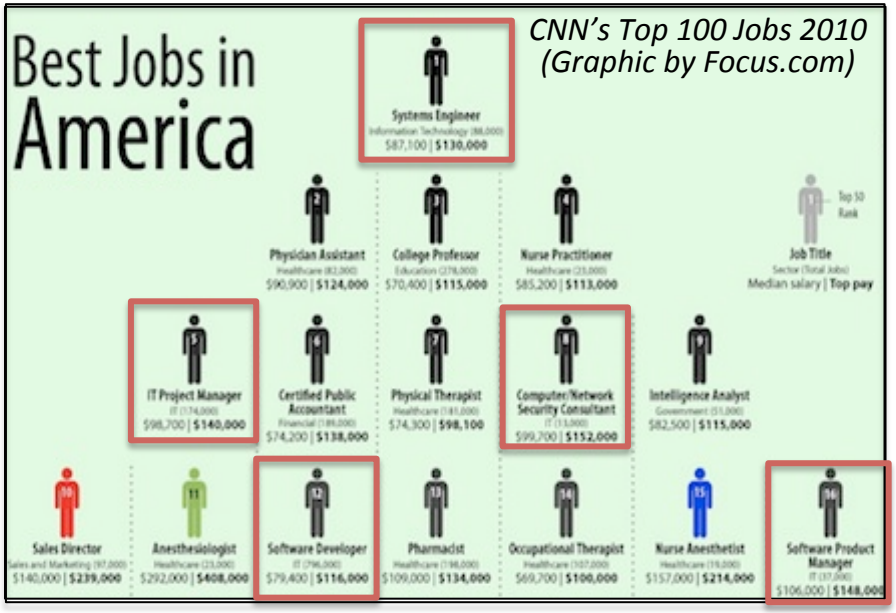
Huge Growth in Computing-Related Jobs



Data Sources: *US-BLS Employment Projections, 2010-2020* (http://www.bls.gov/emp/ep_table_102.htm),
National Science Foundation Division of Science Resource Statistics (http://www.nsf.gov/statistitcs/nsf11316/pdf/tab28.pdf, tab33,pdf, tab34.pdf, tab35.pdf, tab46.pdf)

Computing is Consistently Ranked Among the Best Occupations

CS-Related Jobs Highlighted in Red



BEST JOBS U.S.News 2012

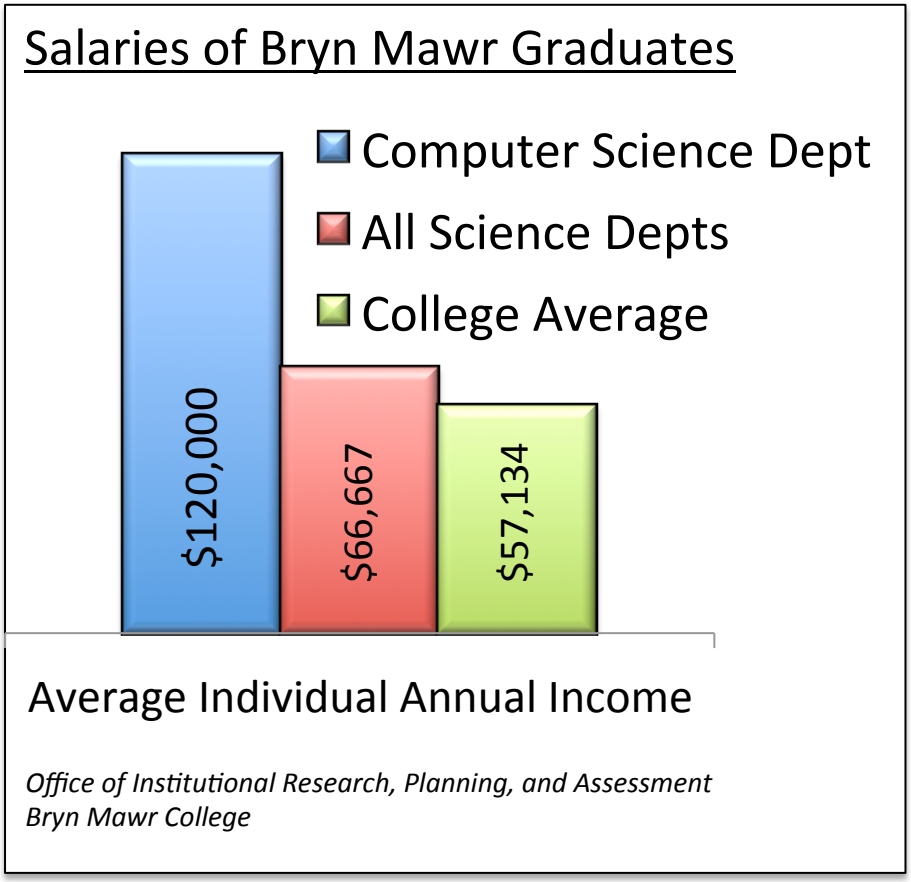
The 25 Best Jobs of 2012

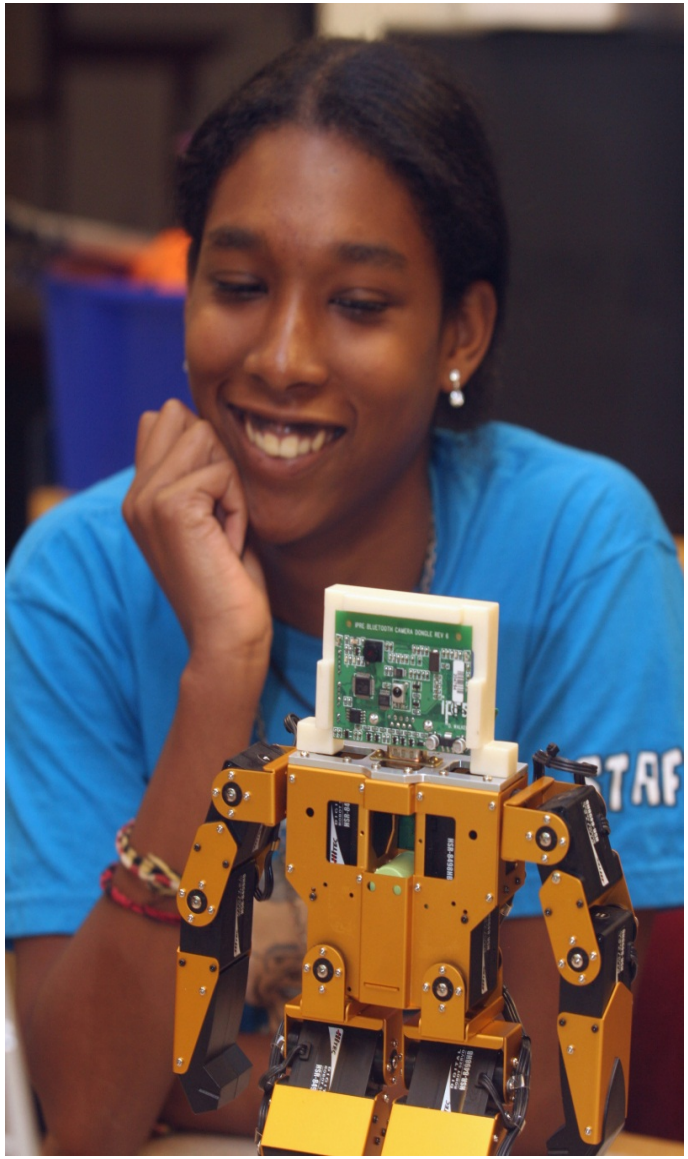
#1	Registered Nurse	#6	Web Developer
#2	Software Developer	#7	Computer Systems Analyst
#3	Pharmacist	#8	Physical Therapist
#4	Medical Assistant	#9	Computer Programmer
#5	Database Administrator	#10	Occupational Therapist

CS Careers Rank Highly In:

- Job satisfaction
- Salary
- Work/life balance
- Growth potential
- Employment rate
- Work environment

Strong Earnings Potential





Computer science tops list of best major for jobs

BY RACHEL GOTTFRIED

Computer science graduates now get more offers of employment than any other major. This is the first time since 2008 that computer science has topped the list: previously, accounting majors had the highest offer rate.

In 2011, 56.2% of computer science majors received job offers, compared to only 53.8% of accounting majors. The offer rate for computer science majors increased 13.8% this year from the previous year.

Computer science and accounting majors are in high demand because both are needed in a wide range of industries.

"There are many different companies that need to hire computer scientists," said Mimi Collins, director of communications at the National Association of Colleges and Employers.

"They aren't tied to one particular industry—majors like nursing do not enjoy that benefit."

Although this is good news for computer science grads, it might not be for the computer industry. According to Collins, "One computer science graduate may have 10 offers as opposed to one accounting graduate that's getting five offers." So, computer science majors may be getting more offers, but this is only because there is a shortage of people who graduate with such a degree.

According to Collins, companies like to hire recent graduates because they have the latest skills.

"Things change very quickly, especially in computer science," said Collins. "Many organizations have a formal track where they want to bring in new college graduates and train them the way they want them to be trained."

Annabelle Evans graduated as a computer science major from the University of Southern California in 2008. "When I picked my major, I knew there wouldn't be a lack of jobs as a computer scientist, and that was part of the appeal," she said. Evans now works at Google.

…many different companies … need to hire computer scientists. They aren't tied to one particular industry.

Administrivia
CMSC 110: Introduction to Computing
Fall 2012 – Section 001

Co-Instructors:

Eric Eaton, Ph.D. (eeaton@cs.brynmawr.edu)
Paul Ruvolo, Ph.D. (pruvolo@cs.brynmawr.edu)
(Questions/issues should be e-mailed to both instructors via cs110-01@cs.brynmawr.edu)

Lectures

MWF 10-11 am in Park 349

Hands-On Sessions

Meet in computer labs (Park 231 and 232)

Open Labs (Optional)

Mon/Tues/Friday 11am-12:30 pm in Park 231

Grading

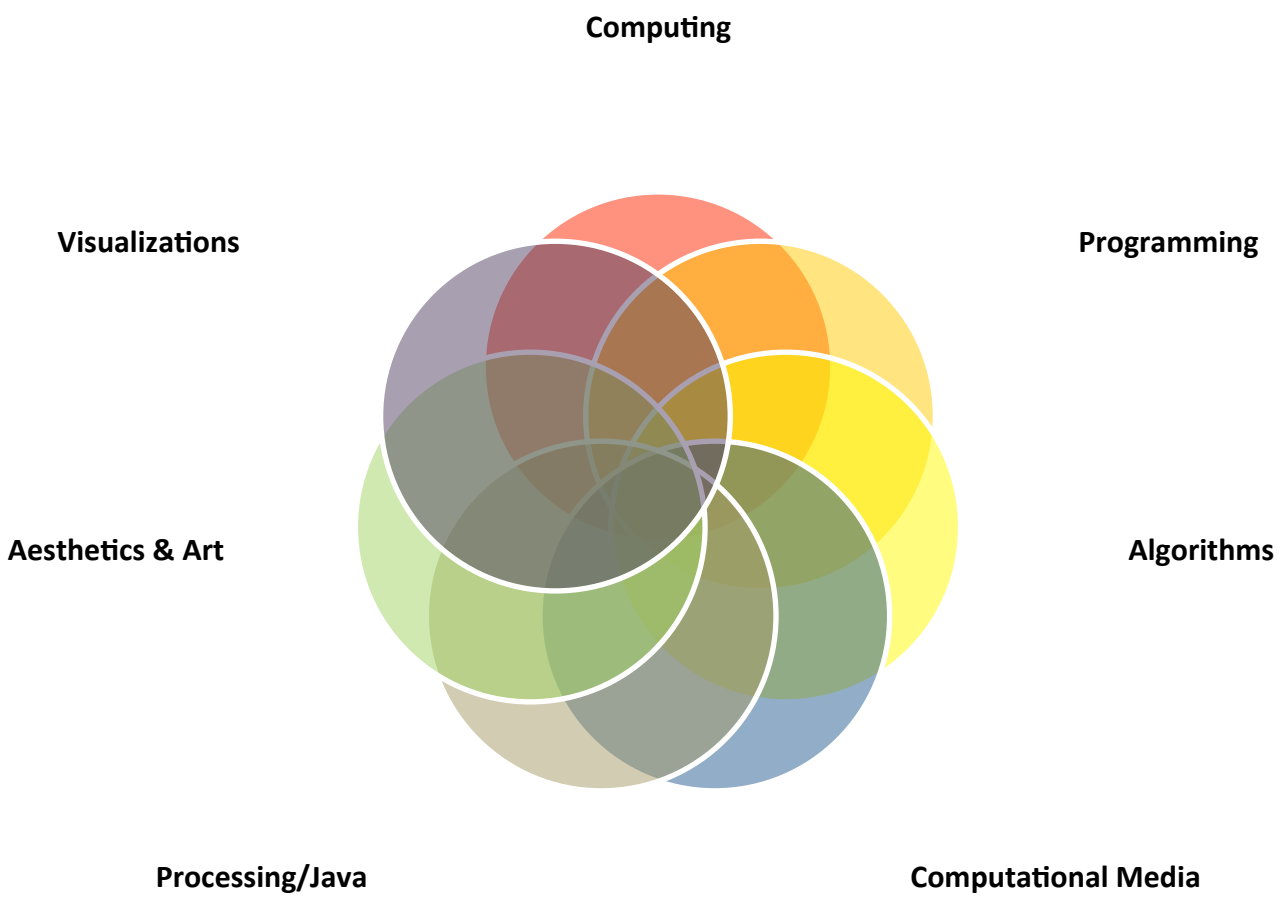
• 7 Assignments	56%
• In-class Quizzes	4%
• Exam 1	18%
• Exam 2	22%
Total	100%

Office Hours

Eric Eaton: Tues/Wed 1:30-2:30 pm and by appointment in Park 249
Paul Ruvolo: Monday 3-4pm and by appointment in Park 246-D

Introduction to ^ Computing

Creative



Algorithms

An **algorithm** is an effective method for solving a problem expressed as a finite sequence of instructions. For example,

Put on shoes

left sock
right sock
left shoe
right shoe

Programming = Writing Apps

Programming is the process of designing, writing, testing, debugging / troubleshooting, and maintaining the source code of computer programs. This source code is written in a programming language.

A program

```
int areaOfCircle(int radius){
   return PI*radius*radius;
}

r = 10;
area = areaOfCircle(r);
```

Programming Languages

Processing	Python	Lisp

`int areaOfCircle(int radius){`
`  return PI*radius*radius;`
`}`
 	
`r = 10;`
`area = areaOfCircle(r);`
	`def areaOfCircle(radius):`
	`  return PI*radius*radius;`
	
	`r = 10`
	`area = areaOfCircle(r)`
		`(defun areaOfCircle (radius)`
		`  (return (* PI radius radius)))`
		
		`(setq r 10)`
		`(setq area (areaOfCircle r))`

A more interesting program...

```
Eye e1, e2, e3, e4, e5;

void setup()
{
  size(200, 200);
  smooth();
  noStroke();
  e1 = new Eye( 50,  16,  80);
  e2 = new Eye( 64,  85,  40);
  e3 = new Eye( 90, 200, 120);
  e4 = new Eye(150,  44,  40);
  e5 = new Eye(175, 120,  80);
}

void draw()
{
  background(102);

  e1.update(mouseX, mouseY);
  e2.update(mouseX, mouseY);
  e3.update(mouseX, mouseY);
  e4.update(mouseX, mouseY);
  e5.update(mouseX, mouseY);

  e1.display();
  e2.display();
  e3.display();
  e4.display();
  e5.display();
}
```

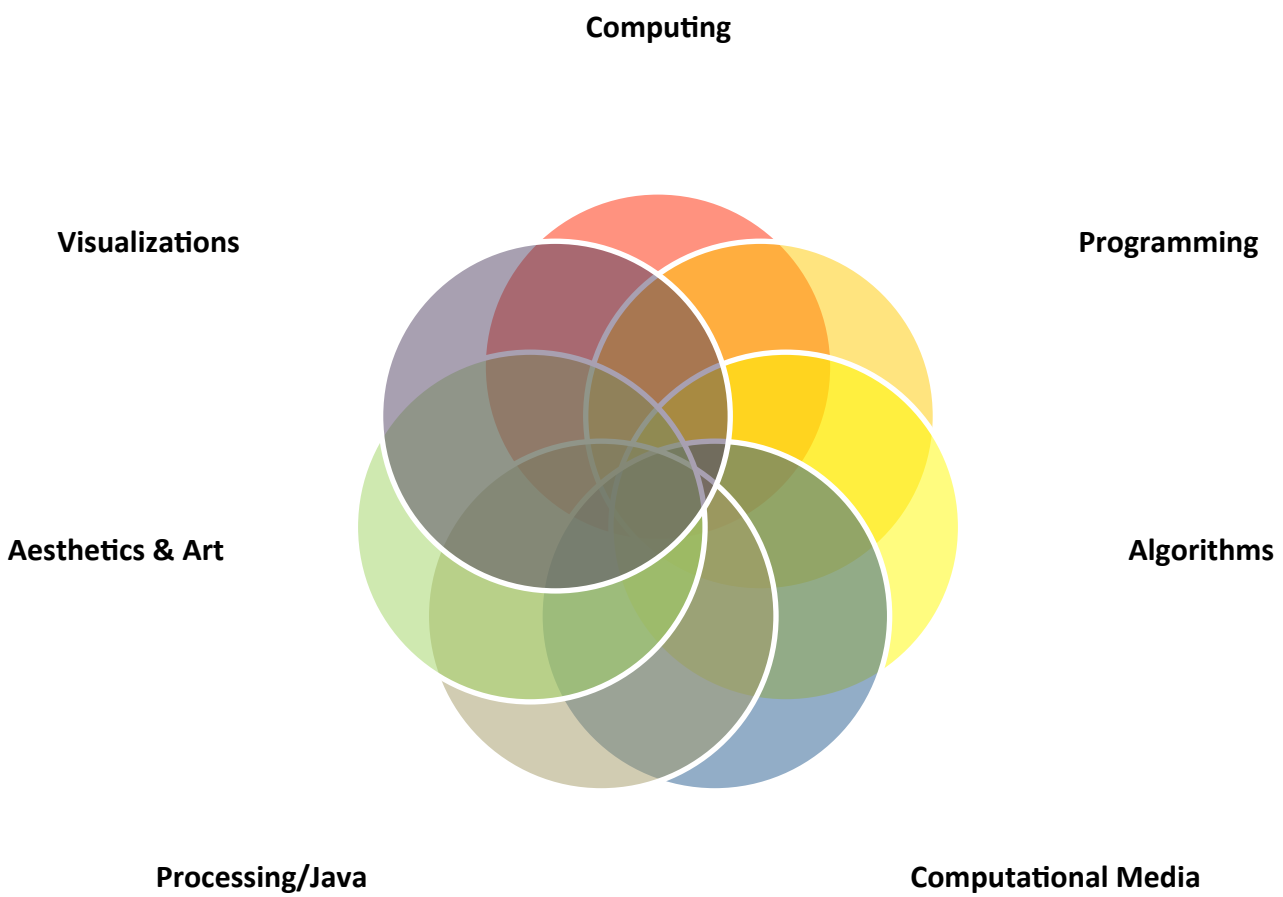
```
class Eye
{
  int ex, ey;
  int size;
  float angle = 0.0;

  Eye(int x, int y, int s) {
    ex = x;
    ey = y;
    size = s;
  }

  void update(int mx, int my) {
    angle = atan2(my-ey, mx-ex);
  }

  void display() {
    pushMatrix();
    translate(ex, ey);
    fill(255);
    ellipse(0, 0, size, size);
    rotate(angle);
    fill(153);
    ellipse(size/4, 0, size/2, size/2);
    popMatrix();
  }
}
```

Our Goal

- Use computing to realize works of art
- Explore new metaphors from computing: images, animation, interactivity, visualizations
- Learn the basics of computing
- Have fun doing all of the above!

Introduction to ^ Computing

Creative

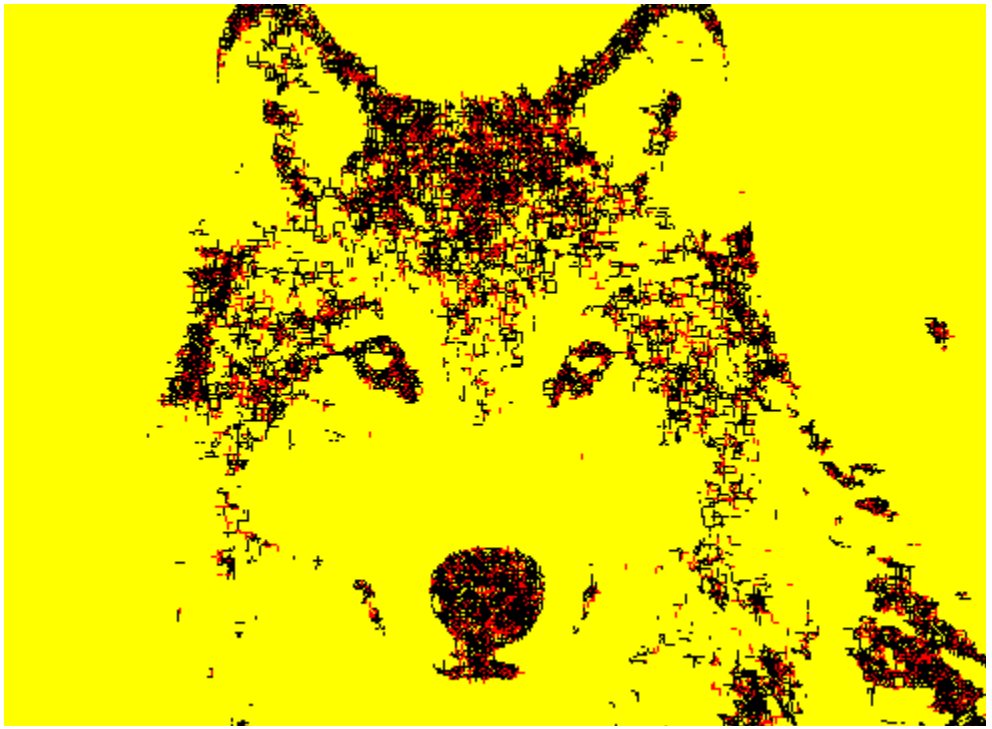


Examples

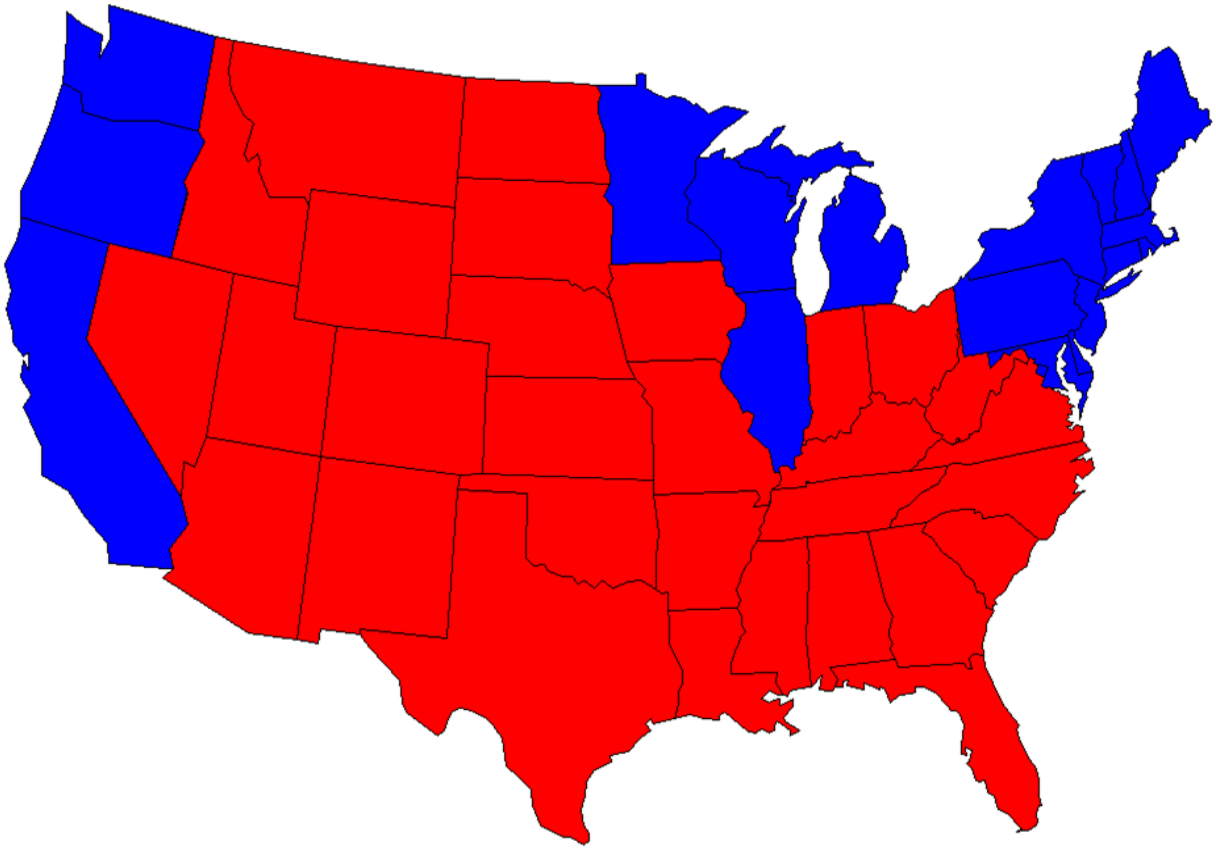
Shepard Fairey


Baikal-1

Abstract Art



Red & Blue States



Summertime

Summertime,
And the livin' is easy
Fish are jumpin'
And the cotton is high

Your daddy's rich
And your mamma's good lookin'
So hush little baby
Don't you cry

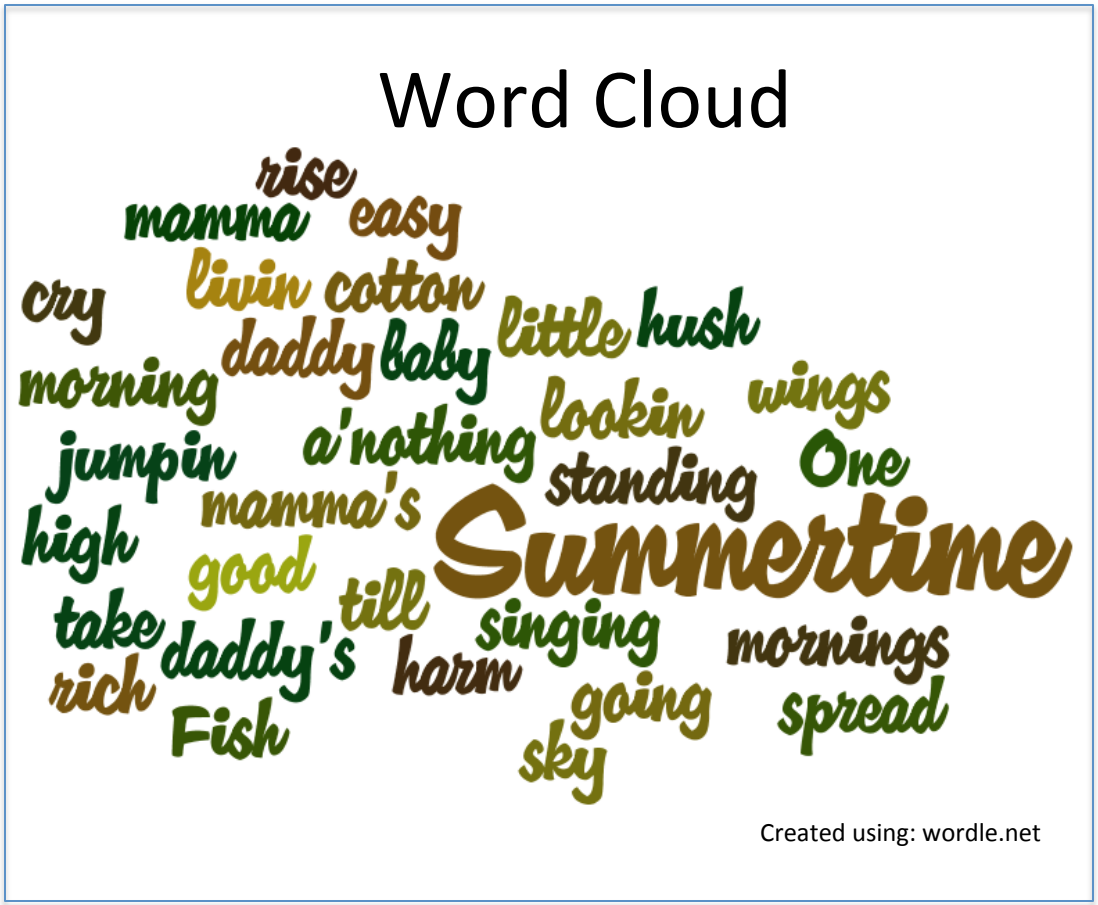
One of these mornings
You're going to rise up singing
Then you'll spread your wings
And you'll take to the sky

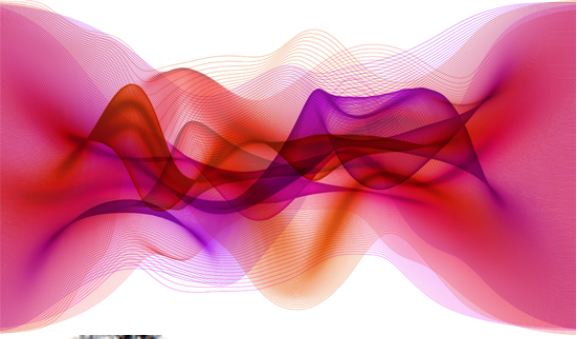
But till that morning
There's a'nothing can harm you
With daddy and mamma standing by

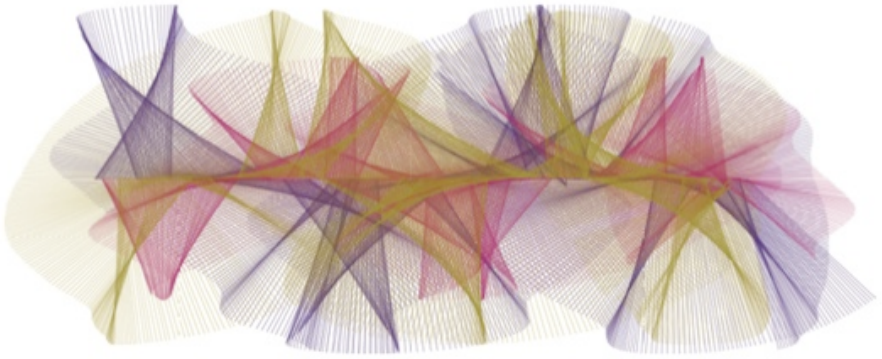
Summertime,
And the livin' is easy
Fish are jumpin'
And the cotton is high

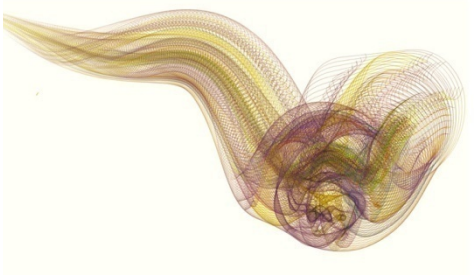
Your daddy's rich
And your mamma's good lookin'
So hush little baby
Don't you cry

Lyrics by George Gershwin

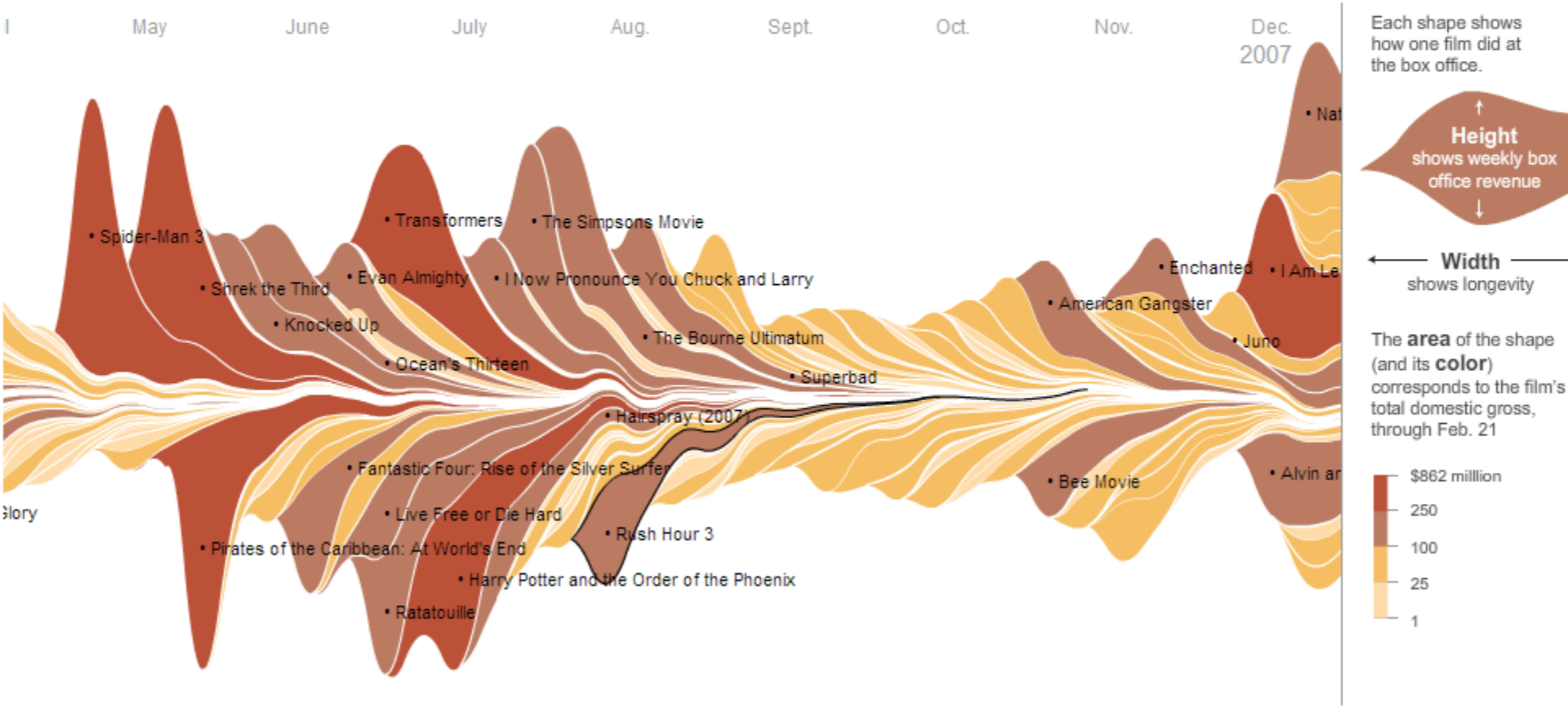








Box Office Earnings



From: The Ebb and Flow of Movies: Box Office Receipts 1986 — 2008
nytimes.com
February 23, 2008

Let’s get started…

Software

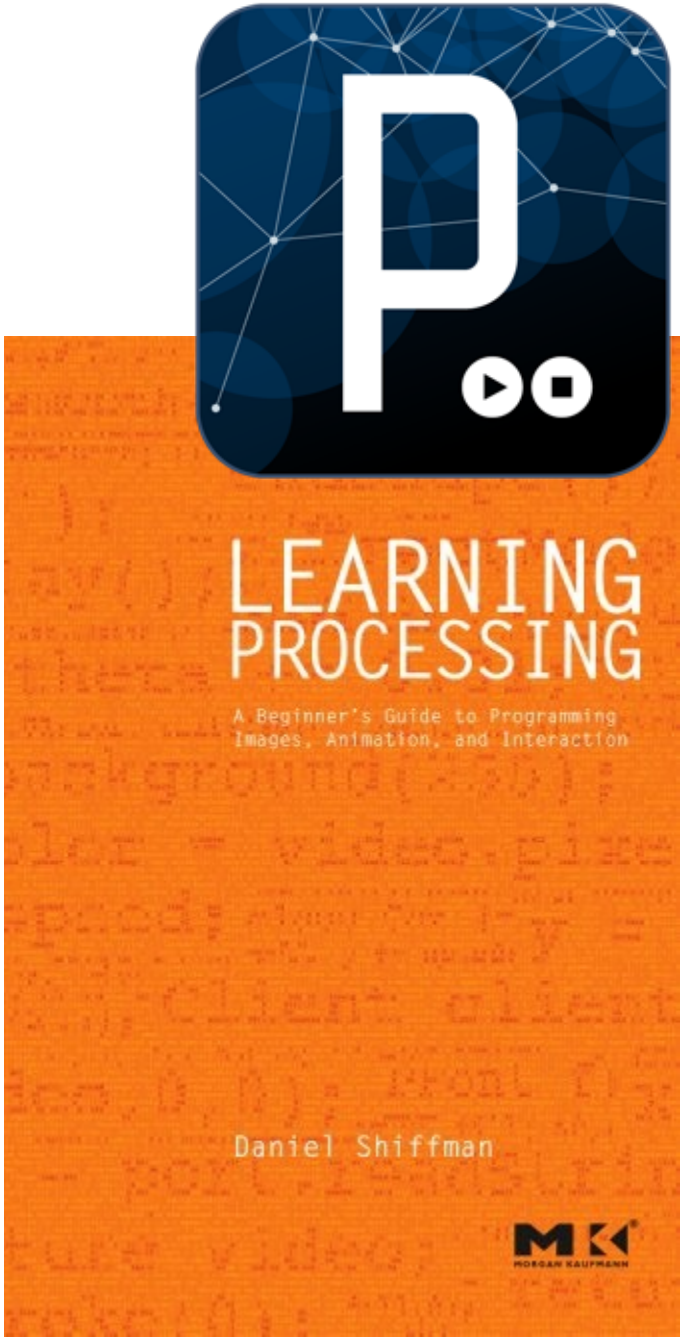
Processing

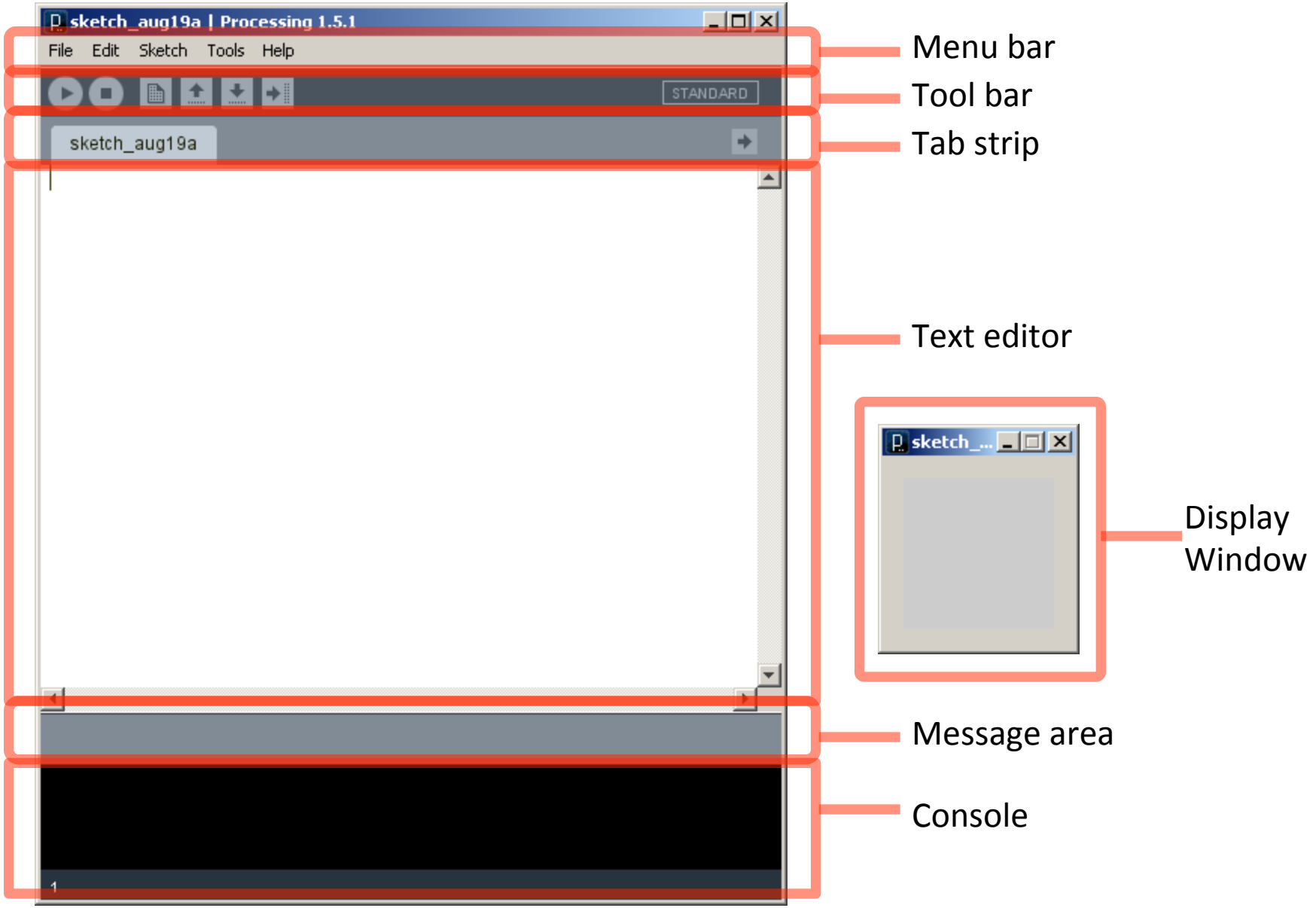
- Already installed in the CS Lab
- Also available for your own computer @ www.processing.org
- Processing == Java

Book

Learning Processing: A Beginner's Guide to Programming Images, Animation, and Interaction by Daniel Shiffman, Morgan Kaufmann Publishers, 2008. Available at the Campus Bookstore.

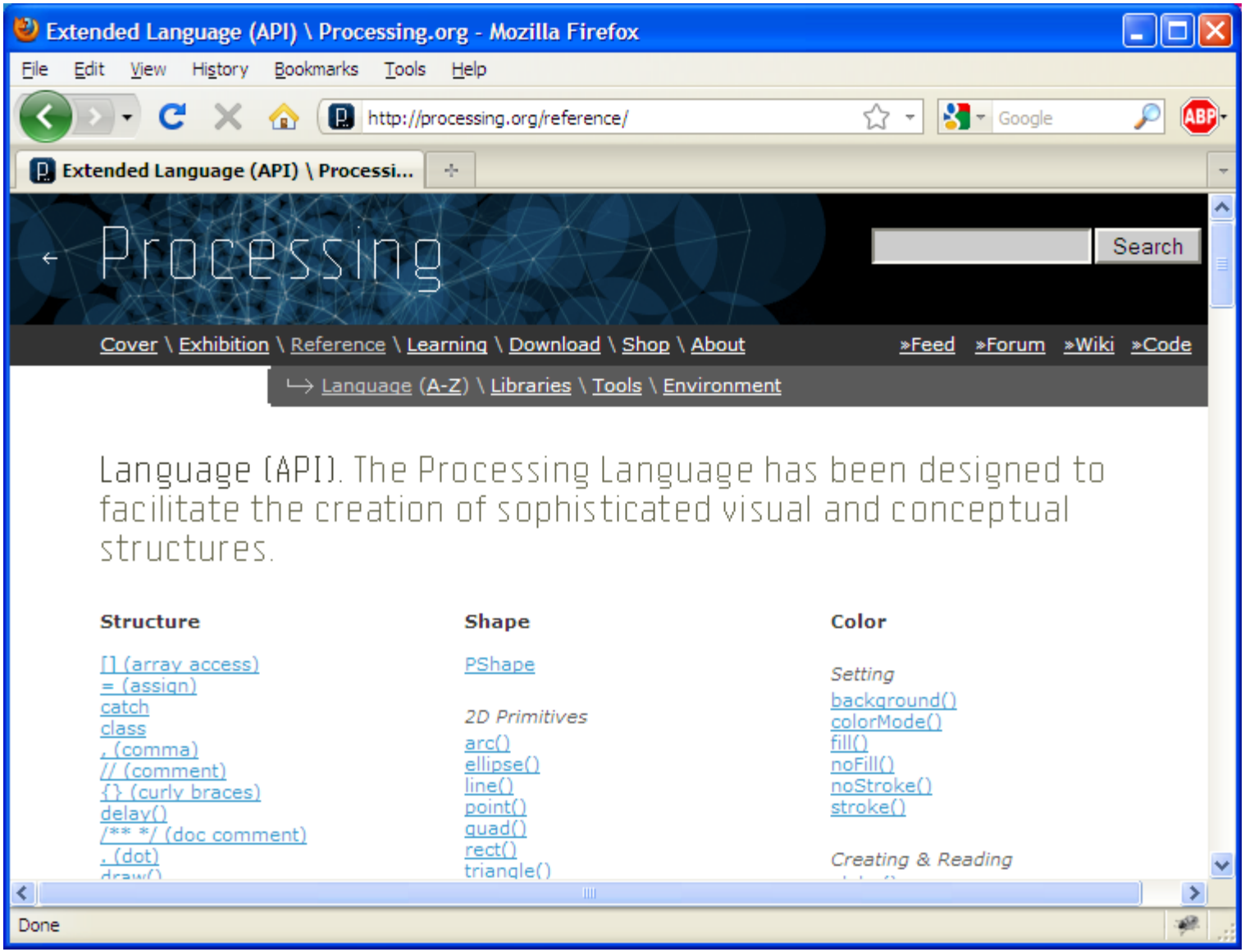
http://www.learningprocessing.com/




sketch_aug19a | Processing 1.5.1
File Edit Sketch Tools Help
STANDARD
sketch_aug19a
sketch_...
Menu bar
Tool bar
Tab strip
Text editor
Display Window
Message area
Console

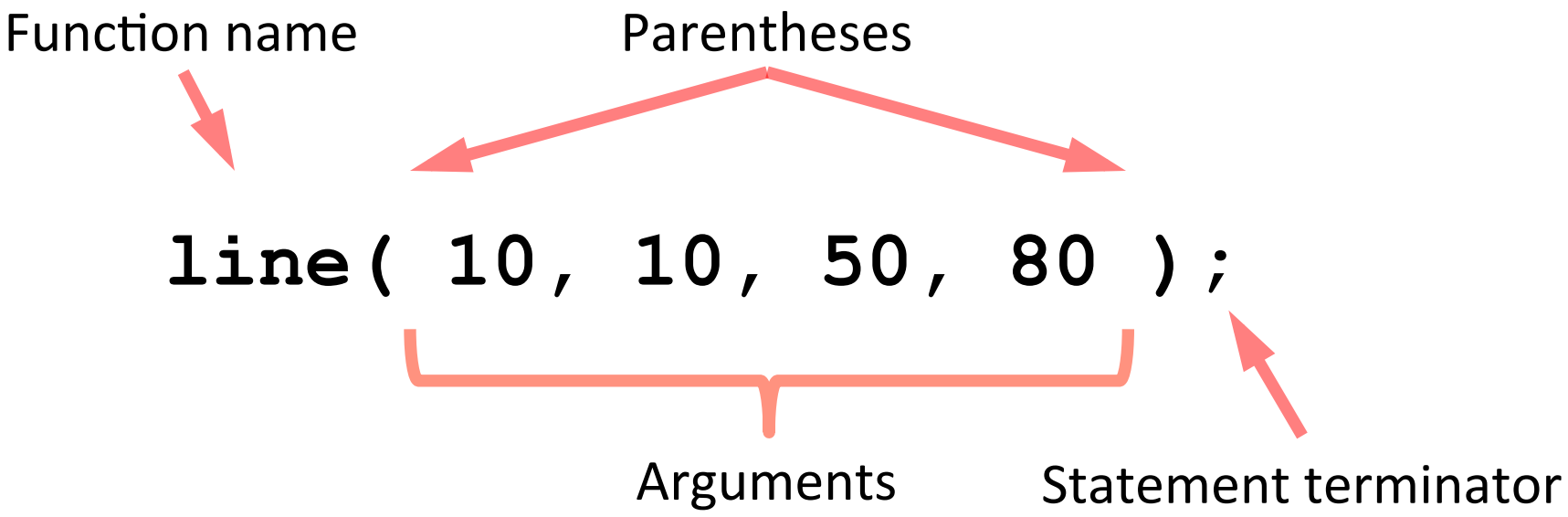
Primitive 2D Shapes

- point
- line
- triangle
- rect (rectangle)
- quad (quadrilateral, four-sided polygon)
- ellipse
- arc (section of an ellipse)
- curve (Catmull-Rom spline)
- bezier (Bezier curve)

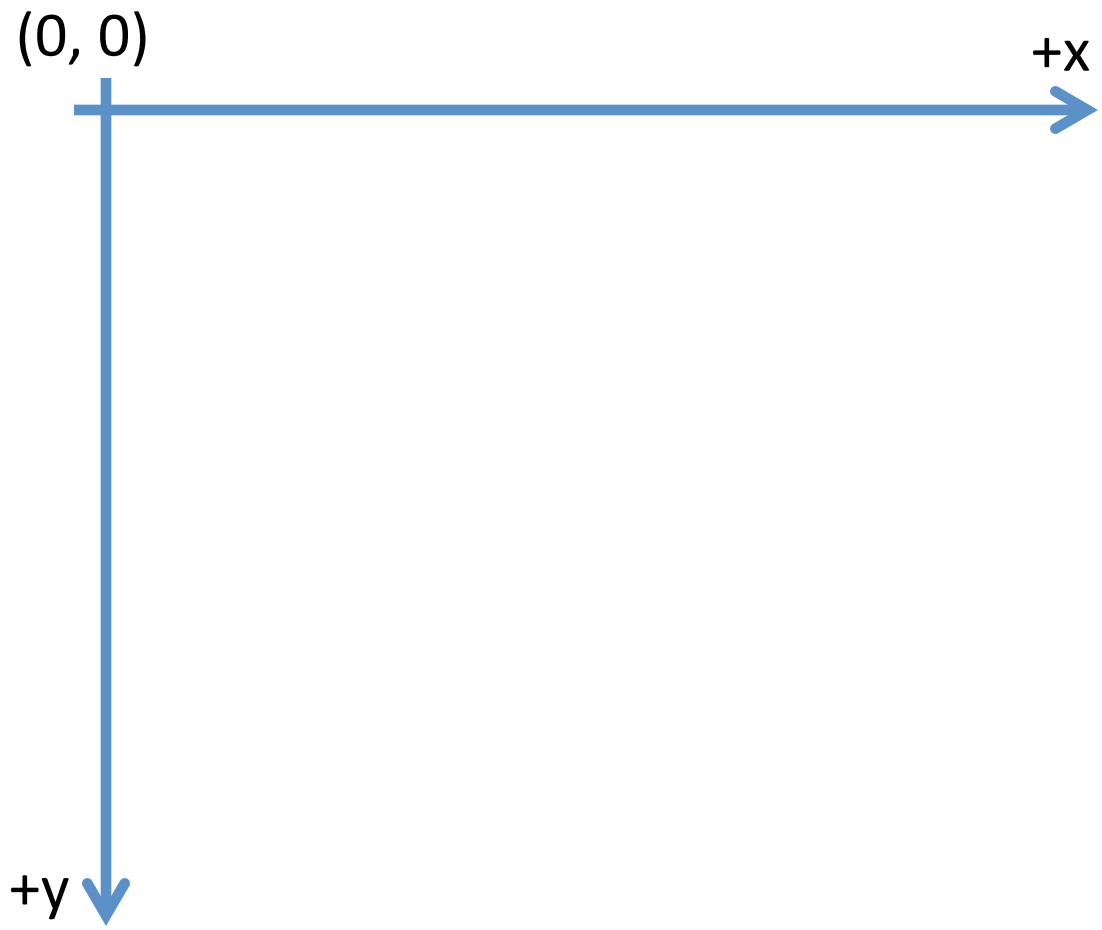


http://processing.org/reference/

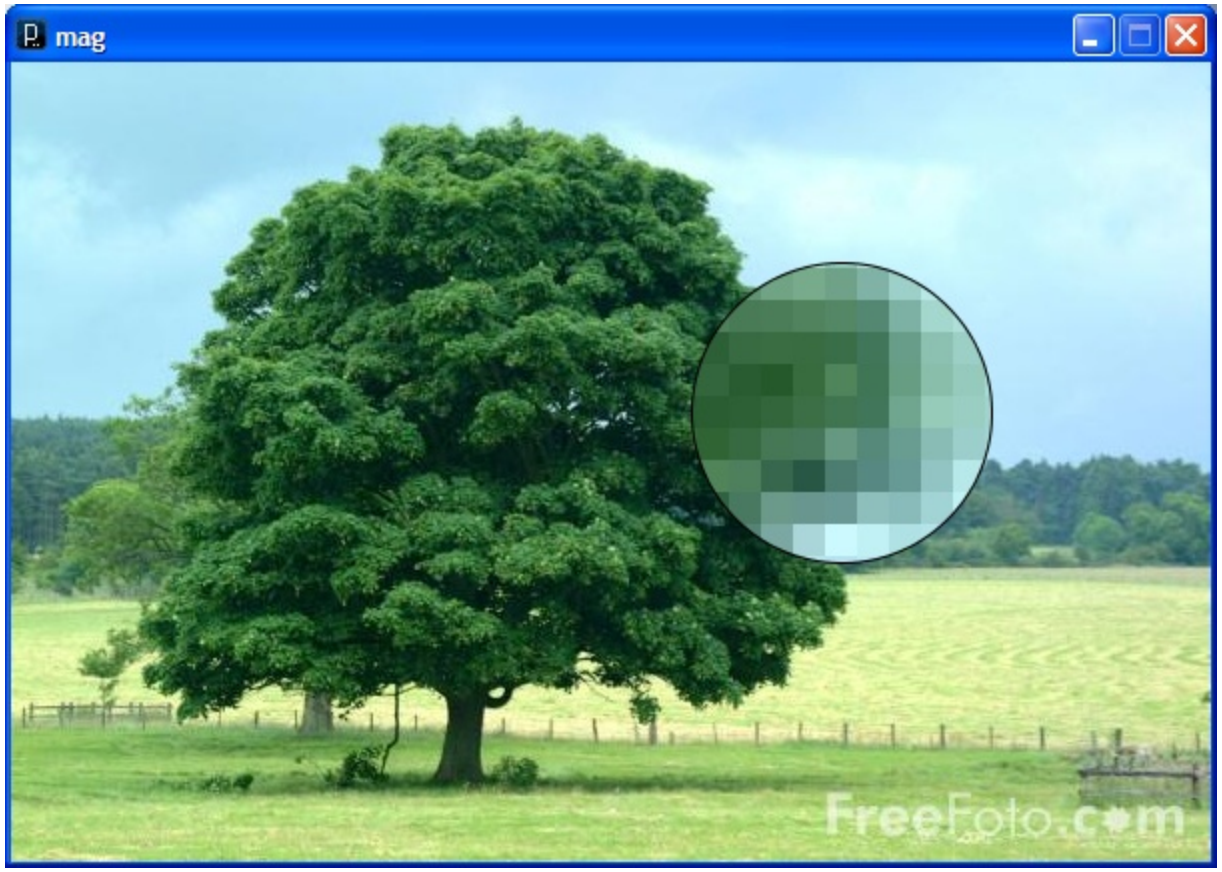
Anatomy of a Function Call



Coordinate System



Pixels



Processing Canvas

`size(` *`width, height`* **`);`**

Set the size of the canvas.

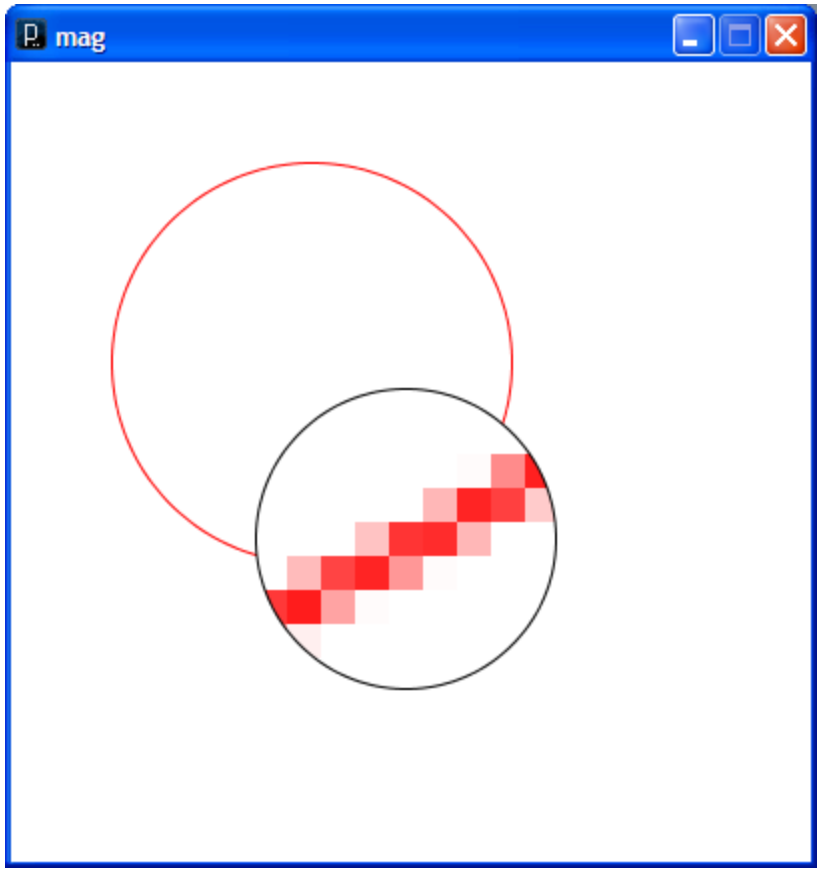
`background(` *`[0..255]`* **`);`**

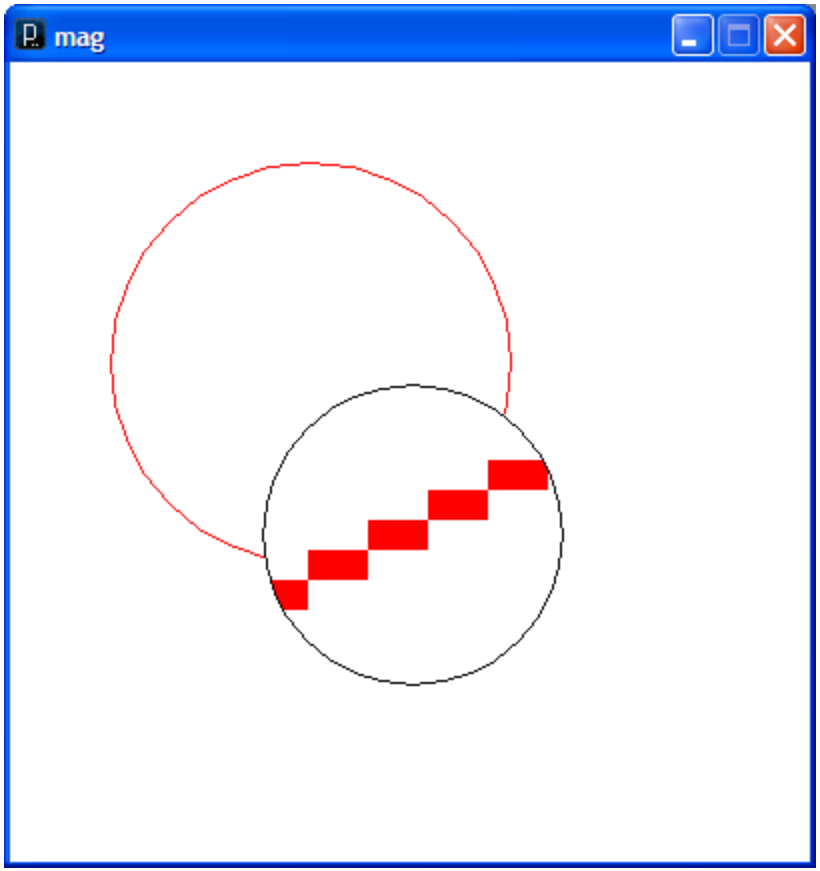
Set the background grayscale color.

Drawing Primitives

```
point( x, y );

line( x1, y1, x2, y2 );

triangle( x1, y1, x2, y2, x3, y3 );

quad( x1, y1, x2, y2, x3, y3, x4, y4 );

rect( x, y width, height );

ellipse( x, y, width, height );
```

smooth() vs. noSmooth()





Colors

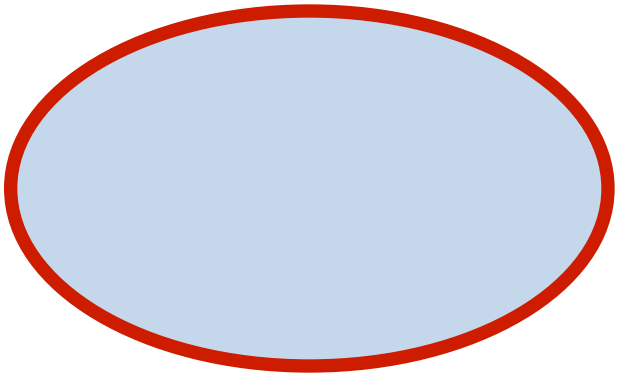
Composed of four elements:

1. Red
2. Green
3. Blue
4. Alpha (Transparency)

Why 0 .. 255?

Shape Formatting

1. Fill color
2. Line thickness
3. Line color



These are properties of your <u>paintbrush,</u> not of the object you are painting.

Fill Color

```
fill(gray);
fill(gray, alpha);
fill(red, green, blue);
fill(red, green, blue, alpha);

noFill();
```

Stroke (Line) Color

```
stroke(gray);
stroke(gray, alpha);
stroke(red, green, blue);
stroke(red, green, blue, alpha);

noStroke();
```

strokeCap()

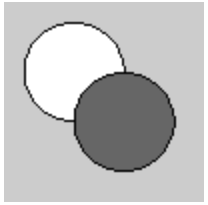
```
smooth();
strokeWeight(12.0);
strokeCap(ROUND);
line(20, 30, 80, 30);
strokeCap(SQUARE);
line(20, 50, 80, 50);
strokeCap(PROJECT);
line(20, 70, 80, 70);
```

strokeWeight()

```
smooth();
strokeWeight(1);   // Default
line(20, 20, 80, 20);
strokeWeight(4);   // Thicker
line(20, 40, 80, 40);
strokeWeight(10);  // Beastly
line(20, 70, 80, 70);
```

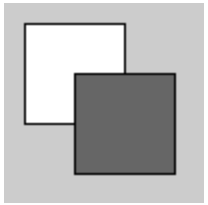
http://processing.org/reference/strokeCap_.html
http://processing.org/reference/strokeWeight_.html

ellipseMode



```
ellipseMode(CENTER);
ellipse(35, 35, 50, 50);
ellipseMode(CORNER);
fill(102);
ellipse(35, 35, 50, 50);
```

rectMode



```
rectMode(CENTER);
rect(35, 35, 50, 50);
rectMode(CORNER);
fill(102);
rect(35, 35, 50, 50);
```

http://processing.org/reference/ellipseMode_.html
http://processing.org/reference/rectMode_.html

Processing.JS

- A Javascript implementation of Processing
- Runs in any modern web browser
  - Does not run well in IE8 and under
- Most of Processing is implemented
  - Images are processed slowly
  - No file IO
- http://processing**js**.org

Studio Sketchpad

- Collaboratively edit, run and chat about a Processing.js program

- http://sketchpad.cc/