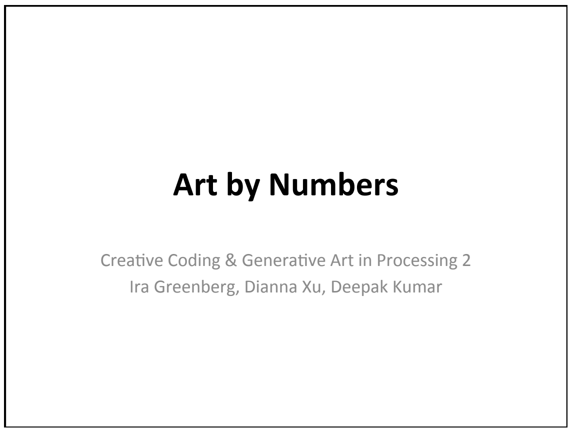
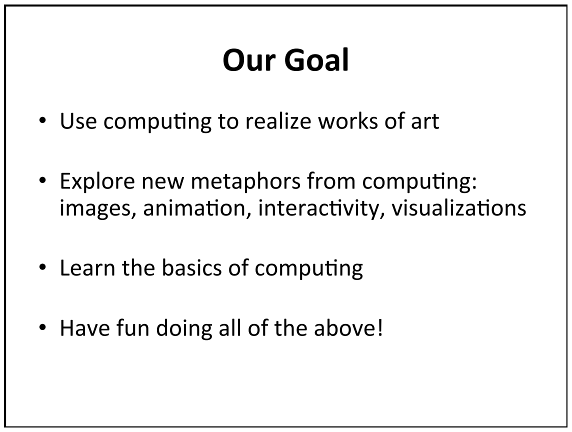


Art by Numbers

Creative Coding & Generative Art in Processing 2
Ira Greenberg, Dianna Xu, Deepak Kumar



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!

Let's get started…

Administrivia

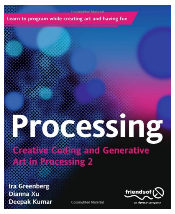
Software

Processing 2.X

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

Book

Creative Coding & Generative Art in Processing 2 by Ira Greenberg, Dianna Xu, Deepak Kumar, friendsofEd/APress, 2013. Available at the Campus Bookstore or amazon.com or other vendors.


Learn to program while creating art and having fun
Processing
Creative Coding and Generative Art in Processing 2
Ira Greenberg
Dianna Xu
Deepak Kumar
friendsof

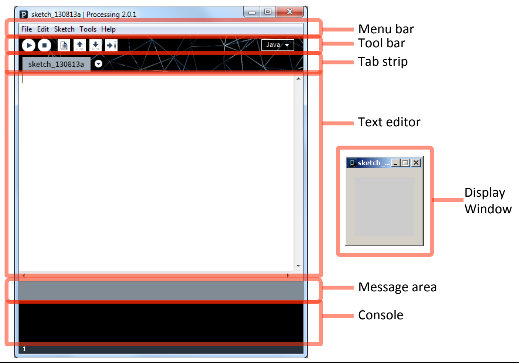
Did you do this?

- Go the CS Computer Lab (Room 231 PSB)
- Log in
- Start the Processing application (Make sure it is Version 2.x)
- In a web browser, go to the Tutorials section of processing.org

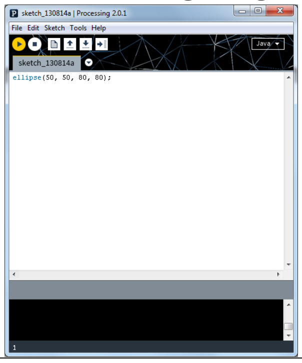
  http://www.processing.org/tutorials/gettingstarted/

- Read the Getting Started tutorial (by Casey Reas & Ben Fry) and try out the two examples of simple Processing programs presented there
- If you'd like, install Processing 2.x on your own computer
- Read Chapter 1 (Read pages 1-12, skim 12-32)

Processing 2.0 IDE

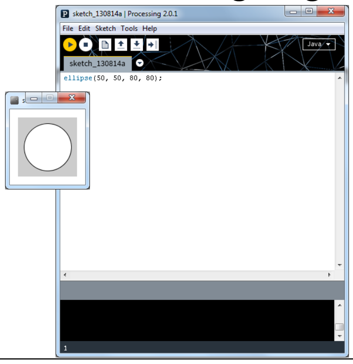


First Processing Program


sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

```
ellipse(50, 50, 80, 80);
```

First Processing Program


sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

```
ellipse(50, 50, 80, 80);
```

Drawing Basics

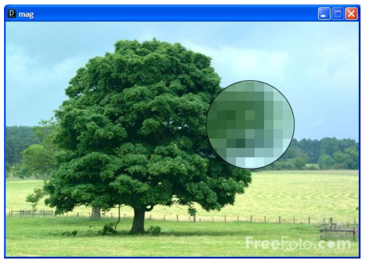
- **Canvas**
- **Drawing Tools**
- **Colors**

Drawing Basics

- **Canvas – computer screen**
- **Drawing Tools – shape commands**
- **Colors – grayscale or RGB**

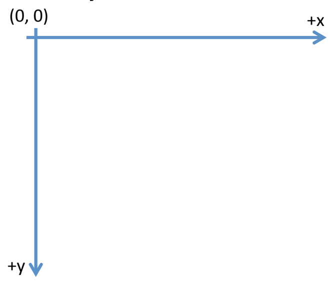
Canvas – Computer Screen

- **Pixels**



Canvas - Computer Screen

- **Coordinate System**



Canvas - Computer Screen

Processing Commands

- **Canvas:** Create a 400x400 pixel drawing area

```
size(400, 400);
```

Canvas - Computer Screen

Processing Commands

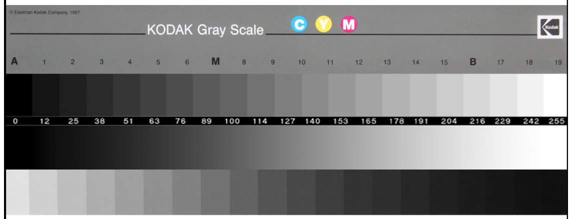
- **Canvas:** Create a 400x400 pixel drawing area

```
size(400, 400);
```

- **Canvas Color:** Canvas is gray in color

```
background(125);
```

256 Shades of Gray!

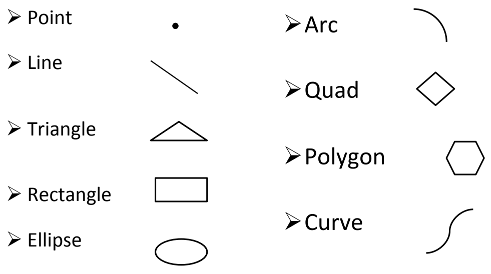


- 0 = black
- 255 = white

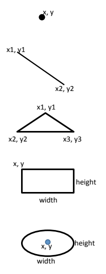
Drawing Basics

- **Canvas – computer screen**
  `size(width, height);`
- **Drawing Tools – shape commands**
- **Colors – grayscale or RGB**
  `background(125);`

Drawing Tools - Basic Shapes



Drawing Tools - Basic Shapes

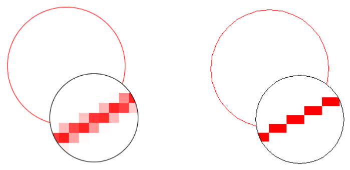
➢ Point		point(x, y);
➢ Line		line(x1, y1, x2, y2);
➢ Triangle		triangle(x1, y1, x2, y2, x3, y3);
➢ Rectangle		rect(x, y, width, height);
➢ Ellipse		ellipse(x, y, width, height);

Drawing & Shape Attributes

- **Anti-aliasing**
  - smooth();
  - noSmooth();
- **Stroke**
  - noStroke();
  - strokeWeight(<pixel width>);
  - stroke(<stroke color>);
- **Fill**
  - noFill();
  - fill(<fill color>);

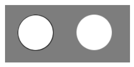
Antialiasing

- smooth();
  vs noSmooth();

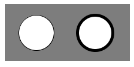


Stroke Attributes

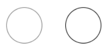
- stroke();
  vs noStroke();



- strokeWeight(1);
  vs strokeWeight(5);

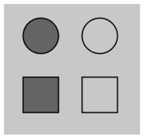


- stroke(125);
  vs stroke(0);



Fill Attributes

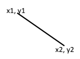
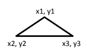
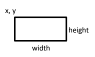
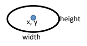
- fill(100);
  vs noFill();



Drawing & Shape Attributes

- **Anti-aliasing**
  - smooth();
  - noSmooth();
- **Stroke**
  - noStroke();
  - strokeWeight(<pixel width>);
  - stroke(<stroke color>);
- **Fill**
  - noFill();
  - fill(<fill color>);

Drawing Tools - Basic Shapes

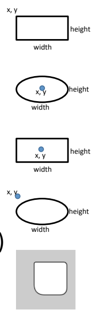
➢ Point		point(x, y);
➢ Line		line(x1, y1, x2, y2);
➢ Triangle		triangle(x1, y1, x2, y2, x3, y3);
➢ Rectangle		rect(x, y, width, height);
➢ Ellipse		ellipse(x, y, width, height);

Modes

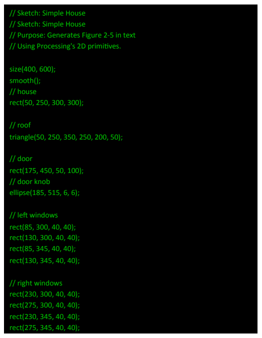
- rect(x, y, width, height);

  ellipse(x, y, width, height);
- rectMode(CENTER);

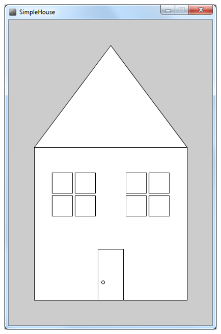
  ellipseMode(CORNER);
- Also CORNERS (see Reference)
- Also rounded rectangles (see Reference)



Structure of a basic program



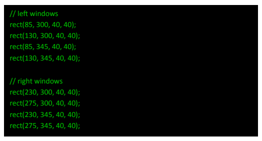
```
// Sketch: Simple House
// Sketch: Simple House
// Purpose: Generates Figure 2-5 in text
// Using Processing's 2D primitives.

size(400, 600);
smooth();
// house
rect(50, 250, 300, 300);

// roof
triangle(50, 250, 350, 250, 200, 50);

// door
rect(175, 450, 50, 100);
// door knob
ellipse(185, 515, 6, 6);

// left windows
rect(85, 300, 40, 40);
rect(130, 300, 40, 40);
rect(85, 345, 40, 40);
rect(130, 345, 40, 40);

// right windows
rect(230, 300, 40, 40);
rect(275, 300, 40, 40);
rect(230, 345, 40, 40);
rect(275, 345, 40, 40);
```



Programming Principle#1

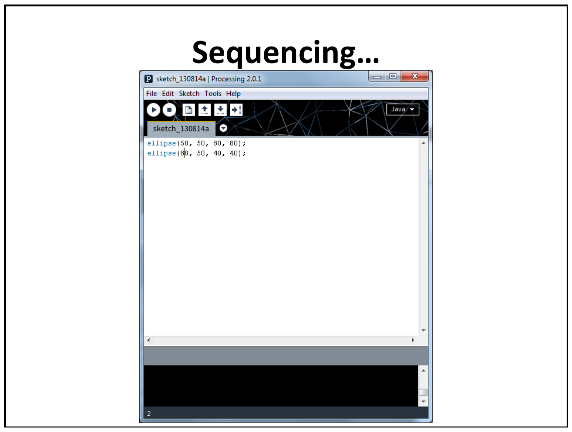
- **Sequencing**

  do this
  and this
  and this
  and this
  …



```
// left windows
rect(85, 300, 40, 40);
rect(130, 300, 40, 40);
rect(85, 345, 40, 40);
rect(130, 345, 40, 40);

// right windows
rect(230, 300, 40, 40);
rect(275, 300, 40, 40);
rect(230, 345, 40, 40);
rect(275, 345, 40, 40);
```

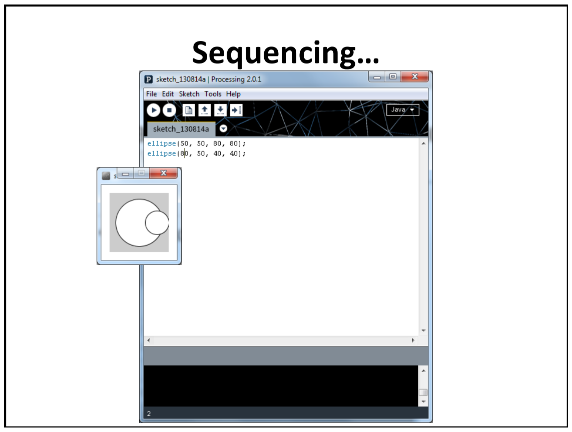
All commands are carried out in the order they are written.



Sequencing…

sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a
2

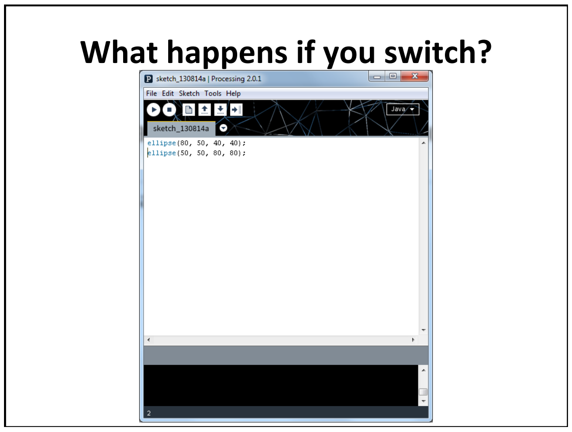
```
ellipse(50, 50, 80, 80);
ellipse(80, 50, 40, 40);
```



Sequencing…

sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a
2

```
ellipse(50, 50, 80, 80);
ellipse(80, 50, 40, 40);
```

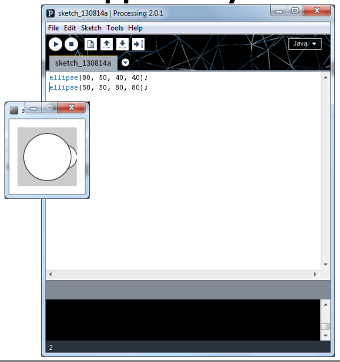


What happens if you switch?

sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a
2

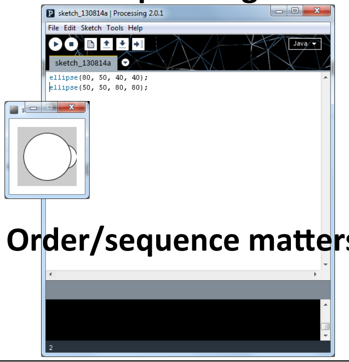
```
ellipse(80, 50, 40, 40);
ellipse(50, 50, 80, 80);
```

What happens if you switch?


sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

```
ellipse(80, 50, 40, 40);
ellipse(50, 50, 80, 80);
```

Sequencing…

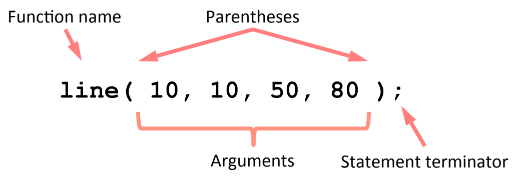

sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

```
ellipse(80, 50, 40, 40);
ellipse(50, 50, 80, 80);
```

Order/sequence matters!

Programming Principle#2

- **Syntax is important!**



```
line( 10, 10, 50, 80 );
```

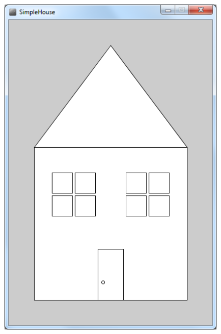
CS Principle: Algorithms

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

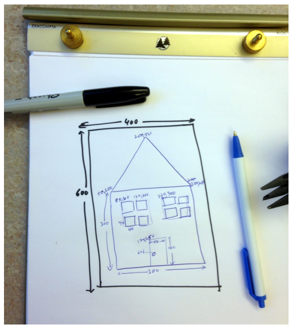
CS Principle: Algorithms

Draw a simple house
- draw the front wall
- draw the roof
- draw the door
- draw the windows

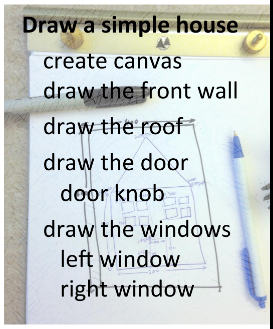


Algorithms to Pseudocode

Draw a simple house
- create canvas
- draw the front wall
- draw the roof
- draw the door
  - door knob
- draw the windows
  - left window
  - right window



Pseudocode to Code



```
Draw a simple house
  create canvas
  draw the front wall
  draw the roof
  draw the door
    door knob
  draw the windows
    left window
    right window
```

```
// Sketch: Simple House
// Sketch: Simple House
// Purpose: Generates Figure 2-5 in text
// Using Processing's 2D primitives.

size(400, 600);

// house
rect(50, 250, 300, 300);

// roof
triangle(50, 250, 350, 250, 200, 50);

// door
rect(175, 450, 50, 100);
// door knob
ellipse(185, 515, 6, 6);

// left windows
rect(85, 300, 40, 40);
rect(130, 300, 40, 40);
rect(85, 345, 40, 40);
rect(130, 345, 40, 40);

// right windows
rect(230, 300, 40, 40);
rect(275, 300, 40, 40);
rect(230, 345, 40, 40);
rect(275, 345, 40, 40);
```

CS Principle

To solve any problem on a computer
- First **analyze** the problem
- Then design an **algorithm**
- Write **pseudocode**
- **Code** it
- **Test** and **debug**

CS Principle

To solve any problem on a computer
- First **analyze** the problem
- Then design an **algorithm**
- Write **pseudocode**
- **Code** it
- **Test** and **debug**

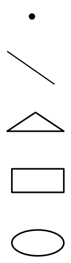
Much work happens on paper!

Drawing Basics

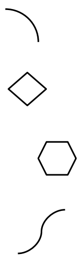
- **Canvas –** **computer screen**
  `size(width, height);`
- **Drawing Tools –** **shape commands**
- **Colors –** **grayscale or RGB**
  `background(125);`

Drawing Tools - Basic Shapes

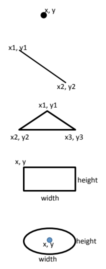
- Point
- Line
- Triangle
- Rectangle
- Ellipse



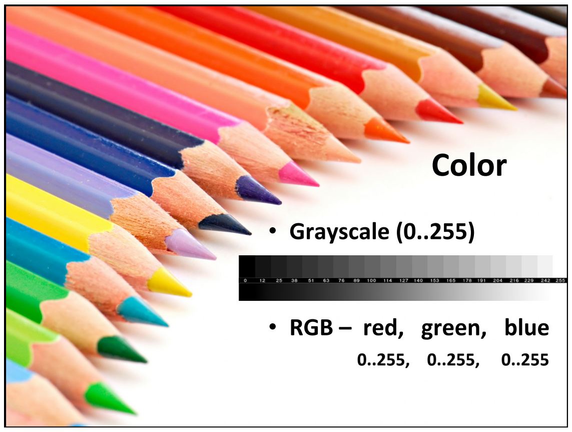
- Arc
- Quad
- Polygon
- Curve



Drawing Tools - Basic Shapes

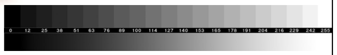


Point	point(x, y);
Line	line(x1, y1, x2, y2);
Triangle	triangle(x1, y1, x2, y2, x3, y3);
Rectangle	rect(x, y, width, height);
Ellipse	ellipse(x, y, width, height);



Color

- **Grayscale (0..255)**



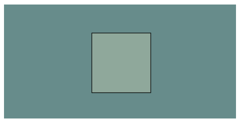
- **RGB – red, green, blue**

  0..255, 0..255, 0..255

Color

- Example:

```
size(400, 200);
smooth();
background(103, 140, 139);
fill(143, 168, 155);
rect(150, 50, 100, 100);
```



- Any command that takes a grayscale value, can also take RGB color values:

background(<grayscale value>);
background(R, G, B);
stroke (<grayscale value>);
stroke(R, G, B);
fill(<grayscale value>);
fill(R, G, B);

Color Transparency

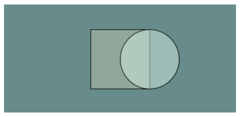
- Alpha values (0..255) specify transparency/opacity

ALPHA = 0	means completely transparent
ALPHA = 255	means completely opaque

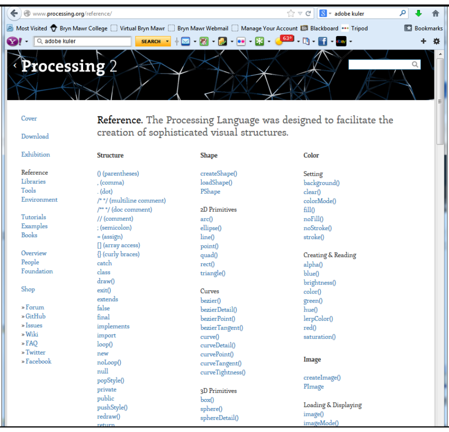
background(<grayscale value>, **ALPHA**);
background(R, G, B, **ALPHA**);
stroke (<grayscale value>, **ALPHA**);
stroke(R, G, B, **ALPHA**);
fill(<grayscale value>, **ALPHA**);
fill(R, G, B, **ALPHA**);

- Example:

```
background(103, 140, 139);
fill(143, 168, 155);
rect(150, 50, 100, 100);
// Fill with alpha value
fill(208, 237, 222, 127);
ellipse(250, 100, 100, 100);
```



Why 0 .. 255?



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Reference. The Processing Language was designed to facilitate the creation of sophisticated visual structures.

Structure

() (parentheses)
, (comma)
. (dot)
/* */ (multiline comment)
/** */ (doc comment)
// (comment)
; (semicolon)
= (assign)
[] (array access)
{} (curly braces)
catch
class
draw()
exit()
extends
false
final
implements
import
loop()
new
noLoop()
null
popStyle()
private
public
pushStyle()
redraw()
return

Shape

createShape()
loadShape()
PShape

2D Primitives
arc()
ellipse()
line()
point()
quad()
rect()
triangle()

Curves
bezier()
bezierDetail()
bezierPoint()
bezierTangent()
curve()
curveDetail()
curvePoint()
curveTangent()
curveTightness()

3D Primitives
box()
sphere()
sphereDetail()

Color

Setting
background()
clear()
colorMode()
fill()
noFill()
noStroke()
stroke()

Creating & Reading
alpha()
blue()
brightness()
color()
green()
hue()
lerpColor()
red()
saturation()

Image

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PImage

Loading & Displaying
image()
imageMode()