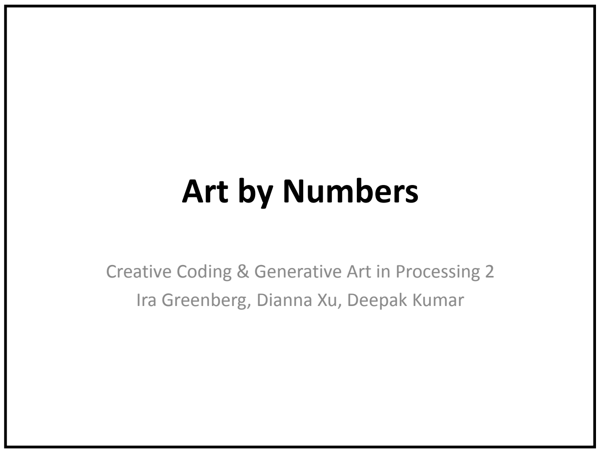


Art by Numbers

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

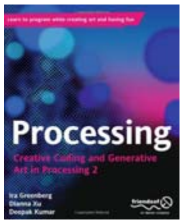
Software

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.



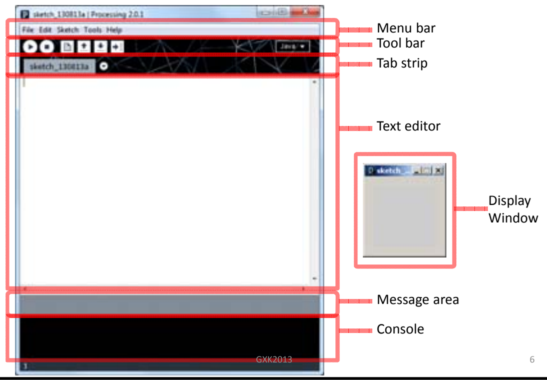
Did you do this?

- 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

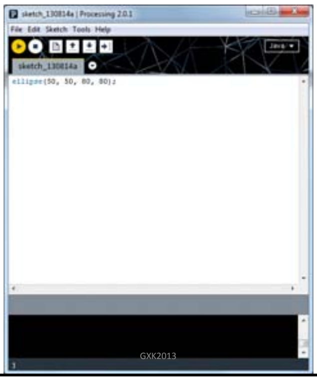
  http://www.processing.org/tutorials/gettingstarted/

- 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

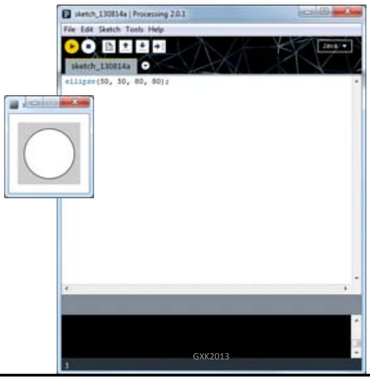


First Processing Program


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

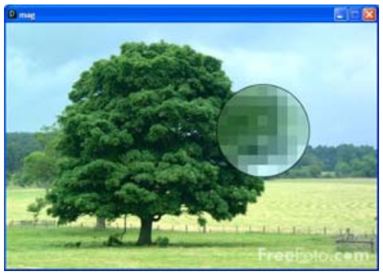
- Canvas
- Drawing Tools
- Colors

Drawing Basics

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

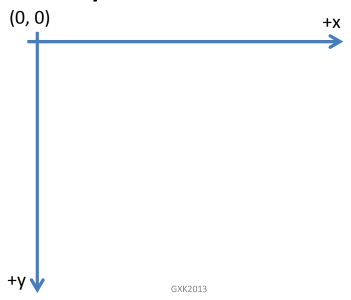
Canvas – Computer Screen

- 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

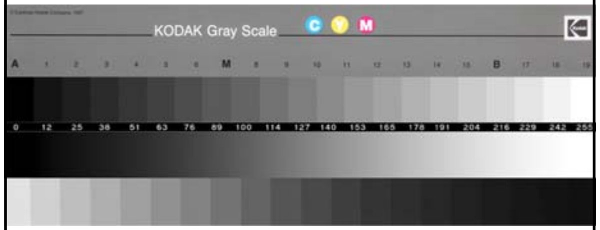
- **Canvas:** Create a 400x400 pixel drawing area

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

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

```
background(125);
```

256 Shades of Gray!



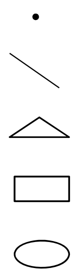
- 0 = black
- 255 = white

Drawing Basics

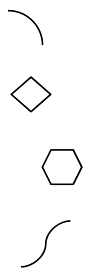
- **Canvas** – computer screen
  `size(width, height);`
- **Drawing Tools** – shape commands
- **Colors** – grayscale or RGB
  `background(125);`

Drawing Tools - Basic Shapes

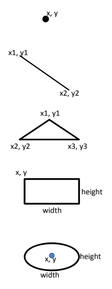
- Point
- Line
- Triangle
- Rectangle
- Ellipse



- Arc
- Quad
- Polygon
- Curve



Drawing Tools - Basic Shapes



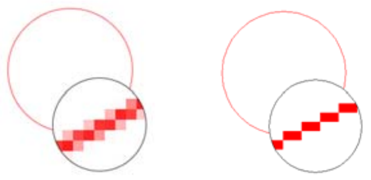
Point	point(x, y);
Line	line(x1, y1, x2, y2);
Triangle	triangle(x1, y1, x2, y2, x3, y3);
Rectangle	rect(x, y, width, height);
Ellipse	ellipse(x, y, width, height);

Drawing & Shape Attributes

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

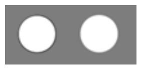
Antialiasing

- smooth();
  vs noSmooth();

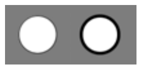


Stroke Attributes

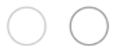
- stroke();
  vs noStroke();



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

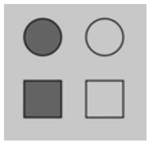


- stroke(125);
  vs stroke(0);



Fill Attributes

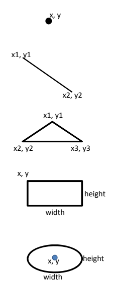
- fill(100);
  vs noFill();



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

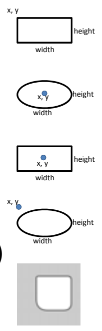
- rect(x, y, width, height);

  ellipse(x, y, width, height);

- rectMode(CENTER);

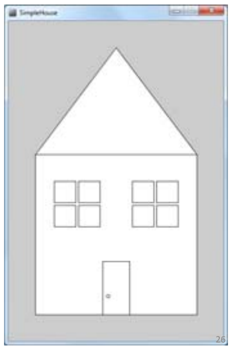
  ellipseMode(CORNER);

- 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

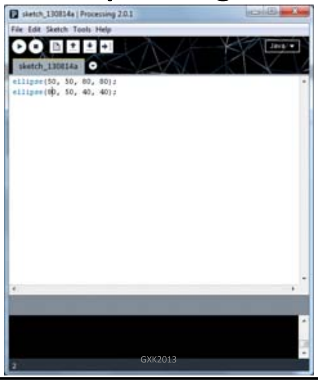
- **Sequencing**

  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.

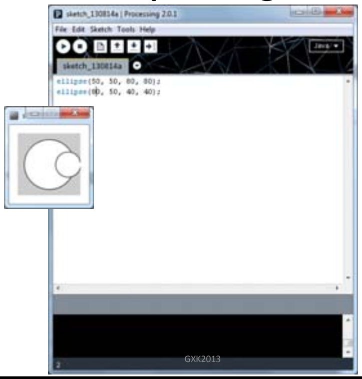
Sequencing…



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

sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

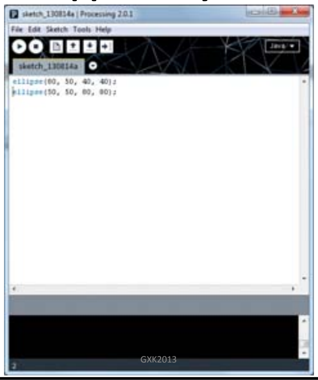
Sequencing…



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

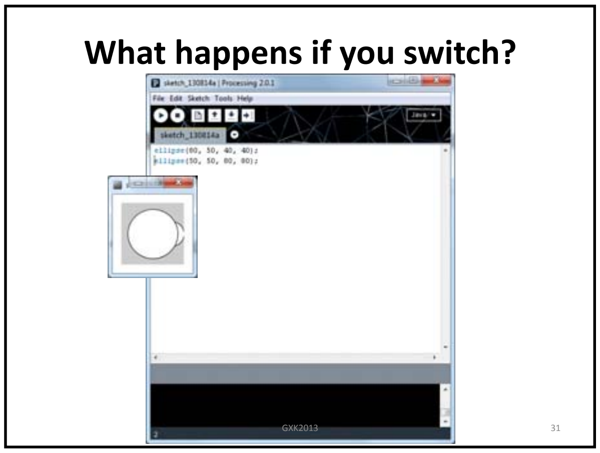
sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

What happens if you switch?

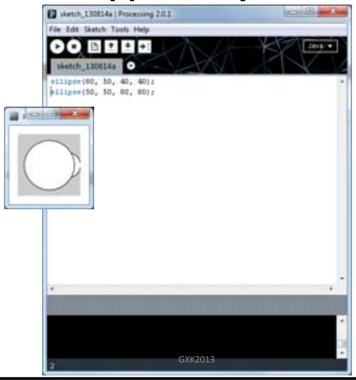


```
ellipse(80, 50, 40, 40);
ellipse(50, 50, 80, 80);
```

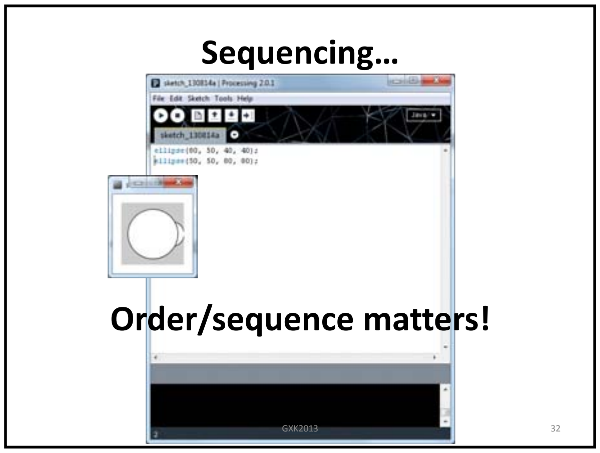
sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a



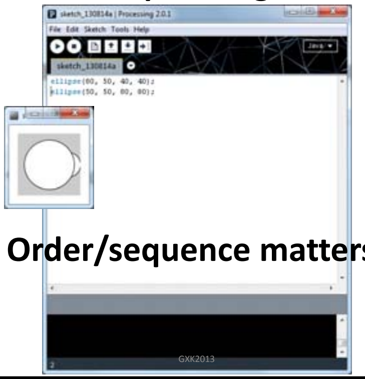
What happens if you switch?


sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

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

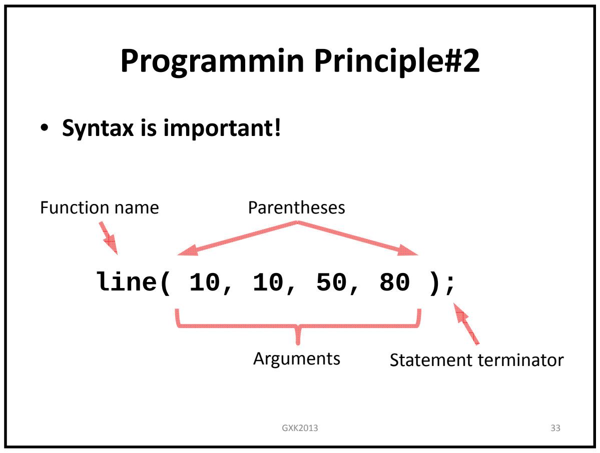


Sequencing…


sketch_130814a | Processing 2.0.1
File Edit Sketch Tools Help
Java
sketch_130814a

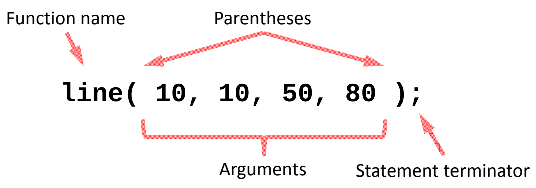
```
ellipse(80, 50, 40, 40);
ellipse(50, 50, 80, 80);
```

Order/sequence matters!



Programmin Principle#2

- Syntax is important!



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

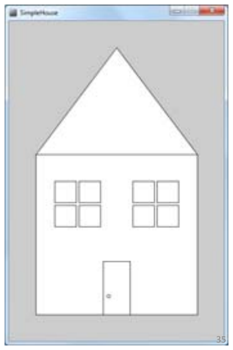
CS Principle: Algorithms

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

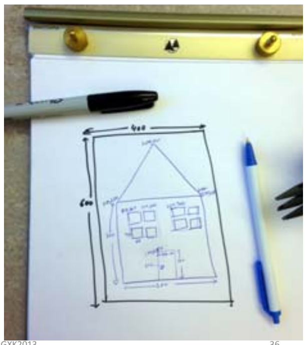
Draw a simple house
- draw the front wall
- draw the roof
- draw the door
- draw the windows



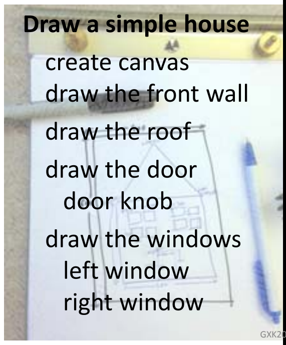
Algorithms to Pseudocode

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);
```

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CS Principle

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

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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!

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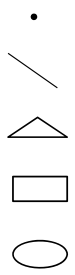
Drawing Basics

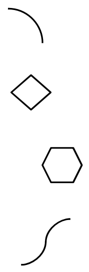
- **Canvas – computer screen**
  `size(width, height);`
- **Drawing Tools – shape commands**
- **Colors – grayscale or RGB**
  `background(125);`

Drawing Tools - Basic Shapes

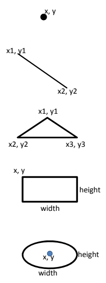
- Point
- Line
- Triangle
- Rectangle
- Ellipse



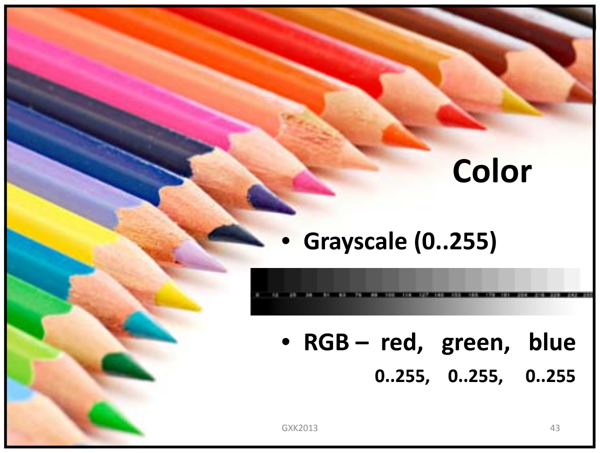
- Arc
- Quad
- Polygon
- Curve



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

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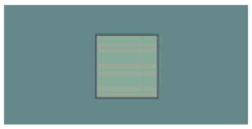
Color

- 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);

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Color Transparency

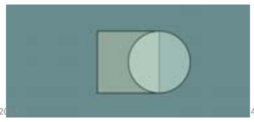
- Alpha values (0..255) specify transparency/opacity

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);
```



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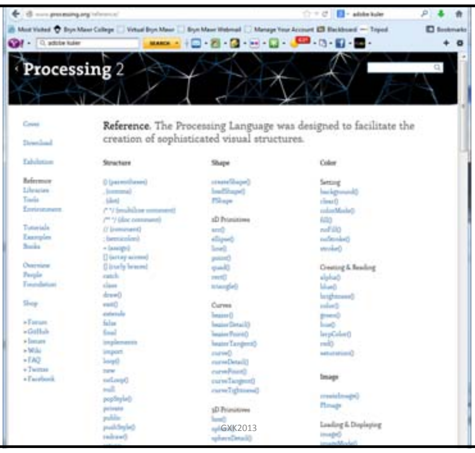
Why 0 .. 255?



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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()

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
createImage()
PImage

Loading & Displaying
image()
imageMode()