2D Shapes

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

Did you do this?

- Read Chapter 2 (pages 33-50)
- Read and do the **Coordinate Systems & Shapes** and **Color** tutorials on processing.org
- Review Processing commands:

```
size(), background(), 2D shapes: point(), line(),
triangle(), rectangle(), quad(), ellipse(). Attributes
and modes: stroke(), noStroke(), strokeWeight(), fill(),
noFill(), rectMode(), ellipseMode().
```

  Color values (grayscale and RGB) and trasparency.
- Understand the concept of an algorithm, psuedocode, syntax, and sequencing
- Have an idea for the design of your Assignment#1?

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

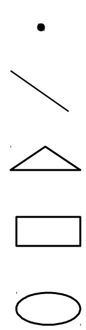
- Point point(x, y);
- Line line(x1, y1, x2, y2);
- Triangle triangle(x1, y1, x2, y2, x3, y3);
- Rectangle rect(x, y, width, height);
- Ellipse ellipse(x, y, width, height);

Drawing & Shape Attributes

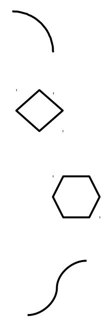
- **Anti-aliasing**
  - smooth();
  - noSmooth();
- **Stroke**
  - noStroke();
  - strokeWeight(<pixel width>);
  - stroke(<stroke color>);
- **Fill**
  - noFill();
  - fill(<fill color>);

Drawing Tools - Basic Shapes

- Point
- Line
- Triangle
- Rectangle
- Ellipse

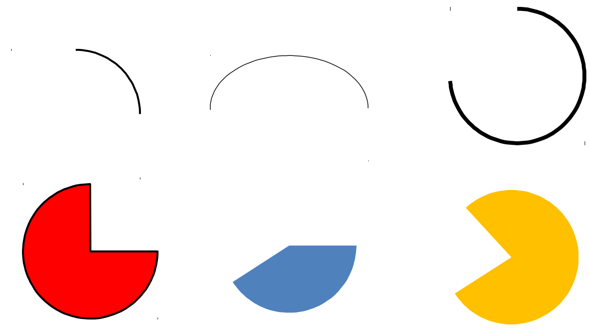


- Arc
- Quad
- Polygon
- Curve



Basic Shapes: Arcs

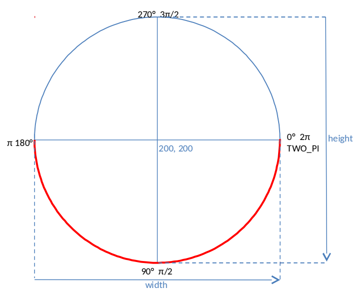
- What is an arc?



Basic Shapes: Arcs

```
arc(x, y, width, height, startAngle, endAngle);
```

- degrees *vs* radians

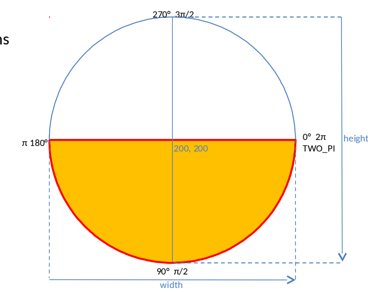



```
noFill();
stroke(255, 0, 0);
arc(200, 200, 150, 150, 0, PI);
```


Basic Shapes: Arcs

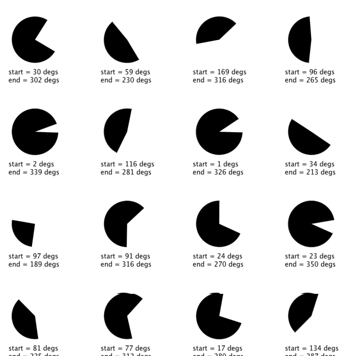
```
arc(x, y, width, height, startAngle, endAngle);
```

- degrees *vs* radians




```
fill(255, 255, 0);
stroke(255, 0, 0);
arc(200, 200, 150, 150, 0, PI);
```


Basic Shapes: Arcs



Basic Shapes: Quadrilaterals

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

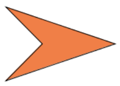
```
noStroke();
fill(12, 37, 80);
quad(100, 50, 150, 100, 100, 150, 50, 100);
```

```
fill(240, 127, 71);
quad(100, 50, 200, 50, 250, 100, 50, 100);
```

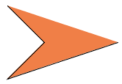
```
noStroke();
fill(163, 208, 193);
quad(100, 50, 150, 100, 100, 150, 250, 100);
```

Basic Shapes: Polygons

```
beginShape();
vertex(x1, y1);
…
vertex(xN, yN);
endShape(CLOSE);
```



```
fill(240, 127, 71);
beginShape();
 vertex(100, 50);
 vertex(150, 100);
 vertex(100, 150);
 vertex(250, 100);
endShape(CLOSE);
```



```
fill(240, 127, 71);
beginShape();
 vertex(100, 50);
 vertex(150, 100);
 vertex(100, 150);
 vertex(250, 100);
endShape();
```

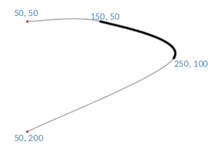

Basic Shapes: Curves

```
curve(cpx1, cpy1, x1, y1, x2, y2, cpx2, cpy2);
```

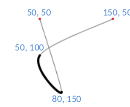
cpx1,cpy1- control point#1
x1, y1 - start of curve
x2, y2 - end of curve
cpx2,cpy2- control point#2

Draws a Catmull-Rom Spline between x1, y1 and x2, y2

Examples:



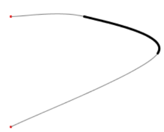
`curve(50, 50, 150, 50, 250, 100, 50, 200);`



`curve(50, 50, 80, 150, 50, 100, 150, 50);`

More Complex Curves

```
beginShape();
curveVertex(x1, y1);
…
curveVertex(xN, yN);
endShape(CLOSE);
```



`curve(50, 50, 150, 50, 250, 100, 50, 200);`

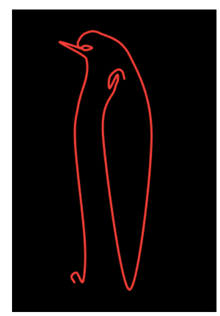
```
beginShape();
curveVertex(50, 50);
curveVertex(150, 50);
curveVertex(250, 100);
curveVertex(50, 200);
endShape();
```


Example: A Penguin

```
// penguin
size(400, 500);
smooth();

background(0);
stroke(245, 63, 55);
strokeWeight(3);
fill(0);
```

```
beginShape();
curveVertex(105, 400);
curveVertex(105, 400);
curveVertex(101, 392);
curveVertex(108, 387);
curveVertex(117, 398);
curveVertex(119, 342);
curveVertex(106, 210);
curveVertex(110, 160);
curveVertex(121, 120);
curveVertex(122, 99);
curveVertex(116, 90);

curveVertex(85, 72);
curveVertex(112, 80);
curveVertex(120, 83);
curveVertex(129, 80);
curveVertex(120, 77);
```

```
curveVertex(112, 80);
curveVertex(110, 72);
curveVertex(120, 60);
curveVertex(140, 60);
curveVertex(180, 90);

curveVertex(210, 200);
curveVertex(180, 410);
curveVertex(144, 200);
curveVertex(160, 136);
curveVertex(164, 125);
curveVertex(163, 117);
curveVertex(153, 135);
curveVertex(153, 120);
curveVertex(163, 110);
curveVertex(170, 112);
curveVertex(173, 122);
curveVertex(173, 122);

endShape();
```



Review: Drawing Basics

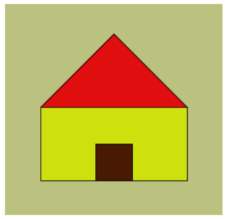
- **Canvas**
  `size(width, height)`
- **Drawing Tools**
  ```
  point(x, y)
  line(x1, y1, x2, y2)
  triangle(x1, y1, x2, y2, x3, y3)
  quad(x1, y1, x2, y2, x3, y3, x4, y4)
  rect(x, y width, height)
  ellipse(x, y, width, height)
  arc(x, y, width, height, startAngle, endAngle)
  curve(cpx1, cpy1, x1, y1, x2, y2, cpx2, cpy2)
  beginShape()
  endShape(CLOSE)
  vertex(x, y)
  curveVertex(x, y)
  ```
- **Colors**
  grayscale [0..255], **RGB** [0..255],[0..255],[0..255], **alpha** [0..255]
  `background(color)`
- **Drawing & Shape Attributes**
  ```
  smooth(), noSmooth()
  stroke(color), noStroke(), strokeWeight(pixelWidth)
  fill(color), noFill()
  ```


Simple Program Structure

```
// Create and set canvas
size(width, height);
smooth();
background(color);

// Draw something
…
// Draw something else
…
// etc.
```

Simple Program Structure

```
// Draw a simple house
// Create and set canvas

size(300, 300);
smooth();
background(187, 193, 127);

// wall
fill(206, 224, 14);
rect(50, 150, 200, 100);

// Draw Door
fill(72, 26, 2);
rect(125, 200, 50, 50);

// Draw roof
fill(224, 14, 14);
triangle(50, 150, 150, 50, 250, 150);
```



Variables: Naming Values

- **Values**
  42, 3.14159, 2013, "Hi, my name is Joe!", true, false, etc.
  - **Numbers**
    - **Integers**
      `int meaningOfLife = 42;`
      `int year = 2013;`
    - **Floating point numbers**
      `float pi = 3.14159;`
  - **Strings**
    `String greeting = "Hi, my name is Joe!";`
  - **Boolean**
    `boolean keyPressed = true;`

Variables: Naming Values

Variables have a Type

- **Values**
  42, 3.14159, 2013, "Hi, my name is Joe!", true, false, etc.
  - **Numbers**
    - **Integers**
      `int meaningOfLife = 42;`
      `int year = 2013;`
    - **Floating point numbers**
      `float pi = 3.14159;`
  - **Strings**
    `String greeting = "Hi, my name is Joe!";`
  - **Boolean**
    `boolean keyPressed = true;`

Variables: Naming Values

Variables have a Name

- **Values**
  42, 3.14159, 2013, "Hi, my name is Joe!", true, false, etc.
  - **Numbers**
    - **Integers**
      `int meaningOfLife = 42;`
      `int year = 2013;`
    - **Floating point numbers**
      `float pi = 3.14159;`
  - **Strings**
    `String greeting = "Hi, my name is Joe!";`
  - **Boolean**
    `boolean keyPressed = true;`

Variables: Naming Rules & Conventions

- Names begin with a letter, an underscore (_), or a dollar sign ($)

  Examples: `weight`, `_meaningOfLife`, `$value`

- Names may include numbers, but only after the initial character

  Examples: `value1`, `score5`, ~~`5bestFriends`~~

- No spaces are permitted in names

  Examples: ~~`value 1`~~, ~~`dollar sign`~~

- Processing Conventions
  - Names begin with a lowercase letter

    Example: `meaningOfLife`, `highestScore`

  - Constants are written in all caps

    Example: `DAYS_IN_WEEK`, `PI`

Variables: Declarations & Initialization

- Declaring variables

```
int meaningOfLife;
int year;
float pi;
String greeting;
boolean keyPressed;
```

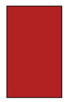
- Initializing values in declarations

```
int meaningOfLife = 42;
int year = 2013;
float pi = 3.14159;
String greeting = "Hi, my name is Joe!";
boolean keyPressed = true;
```

The color type

- Processing has a type called color

```
color firebrick = color(178, 34, 34);
color chartreuse = color(127, 255, 0);
color fuchsia = color(255, 0, 255);


fill(firebrick);
rect(50, 100, 75, 125);
```



Expressions: Doing Arithmetic

- **Assignment statement**

```
<variable> = <expression>;
```

Examples:

```
meaningOfLife = 42;
area = length * height;
perc =statePop/totalPop*100.0;
```

- **Operators**

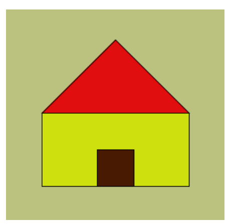
+ (addition)
- (subtraction)
* (multiplication)
/ (division)
% (modulus)

Example:

```
mouth_x = ( (leftIris_x + irisDiam)/2 + eyeWidth )/4;
```

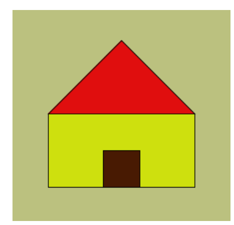

Using Variables

```
// Draw a simple house
// Create and set canvas

size(300, 300);
smooth();
background(187, 193, 127);

// wall
fill(206, 224, 14);
rect(50, 150, 200, 100);

// Draw Door
fill(72, 26, 2);
rect(125, 200, 50, 50);

// Draw roof
fill(224, 14, 14);
triangle(50, 150, 150, 50, 250, 150);
```



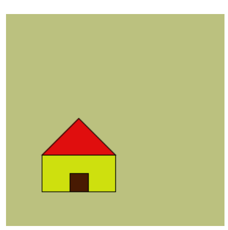
A Better House Sketch

```
// Draw a simple house
int houseX = 50;              // bottom left corner of house
int houseY = 250;

int houseHeight = 200;        // overall width and height of house
int houseWidth = 200;

int wallHeight = houseHeight/2;  // height of wall is 1/2 of house height
int roofHeight = houseHeight/2;
int doorHeight = houseHeight/4;
int doorWidth = houseWidth/4;

// Create and set canvas

size(300, 300);
smooth();
background(187, 193, 127);

// wall
fill(206, 224, 14);
rect(houseX, houseY - wallHeight,
     houseWidth, wallHeight);

// Draw Door
fill(72, 26, 2);
rect(houseX + houseWidth/2 - doorWidth/2, houseY-doorHeight,
     doorWidth, doorHeight);

// Draw roof
fill(224, 14, 14);
triangle(houseX, houseY - wallHeight,
         houseX+houseWidth/2, houseY-houseHeight,
         houseX+houseWidth, houseY-wallHeight);
```



A Better House Sketch

```
// Draw a simple house
int houseX = 50;              // bottom left corner of house
int houseY = 250;

int houseHeight = 100;        // overall width and height of house
int houseWidth = 100;

int wallHeight = houseHeight/2;  // height of wall is 1/2 of house height
int roofHeight = houseHeight/2;
int doorHeight = houseHeight/4;
int doorWidth = houseWidth/4;

// Create and set canvas

size(300, 300);
smooth();
background(187, 193, 127);

// wall
fill(206, 224, 14);
rect(houseX, houseY - wallHeight,
     houseWidth, wallHeight);

// Draw Door
fill(72, 26, 2);
rect(houseX + houseWidth/2 - doorWidth/2, houseY-doorHeight,
     doorWidth, doorHeight);

// Draw roof
fill(224, 14, 14);
triangle(houseX, houseY - wallHeight,
         houseX+houseWidth/2, houseY-houseHeight,
         houseX+houseWidth, houseY-wallHeight);
```



Arithmetic with int and float values

```
int x = 42;      vs  int x = 42.0;

float x = 42.0   vs  float x = 42;

float x = 7/2;   vs  float x = 7.0/2.0;
```

Arithmetic with int and float values

```
int x = 42;     vs int x = 42.0;         // error
float x = 42.0  vs float x = 42;         // same 42.0
float x = 7/2;  vs float x = 7.0/2.0; // 3.0 vs 3.5
```

- Type of variable is important and determines the value that can be assigned to it.
- Result of division depends upon operands

`int/int` yields an integer result
`float/int` yields a float result
`int/float` yields a float result
`float/float` yields a float result

Processing: Predefined Variables

- **`width`, `height`**
  The width & height of the canvas used in the sketch
- **`PI`, `HALF_PI`, `TWO_PI`**
  For different values of π. Note that

```
HALF_PI = PI/2
TWO_PI = 2*PI
```

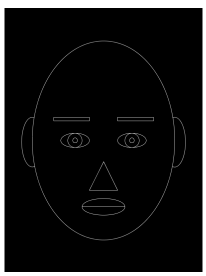
- **`displayWidth`, `displayHeight`**
  The width and height of the monitor being used. This is useful in running fullscreen sketches using:

```
size(displayWidth, displayHeight);
```

- **`mouseX`, `mouseY`**
  The current mouse location in sketch (…coming soon!)

Homework

- Finish reading Chapter 2
- Review and try out all the new commands
- Study the “Face” sketch



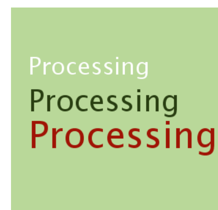
Extra: Drawing Text

`text(string, x, y);`
Draws string with bottom left corner at x, y

`textSize(fontSize);`
Can be used to specify font size

`fill()` can be used to specify color

See Reference for using fonts and other options.




```
size(300, 300);
background(185, 216, 153);

textSize(32);
text("Processing", 25, 100);
textSize(40);
fill(40, 62, 17);
text("Processing", 25, 150);
textSize(50);
fill(160, 20, 5);
text("Processing", 25, 200);
```