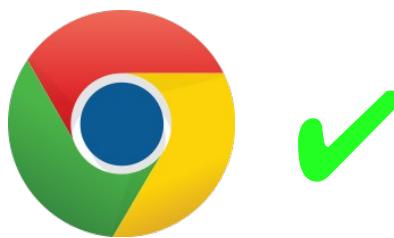
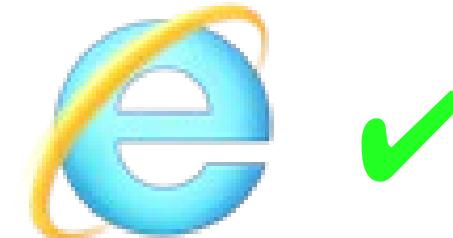


Drawing Using HTML5 Canvas

- Go to <http://o.ooli.ca/canvasjsbin>
- *Presentation copy http://*



Overview

- Main Topics

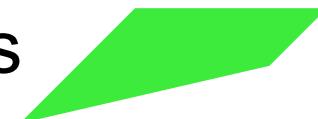
- Lines



- Color



- Shapes



- Images



- Optional

- Curves

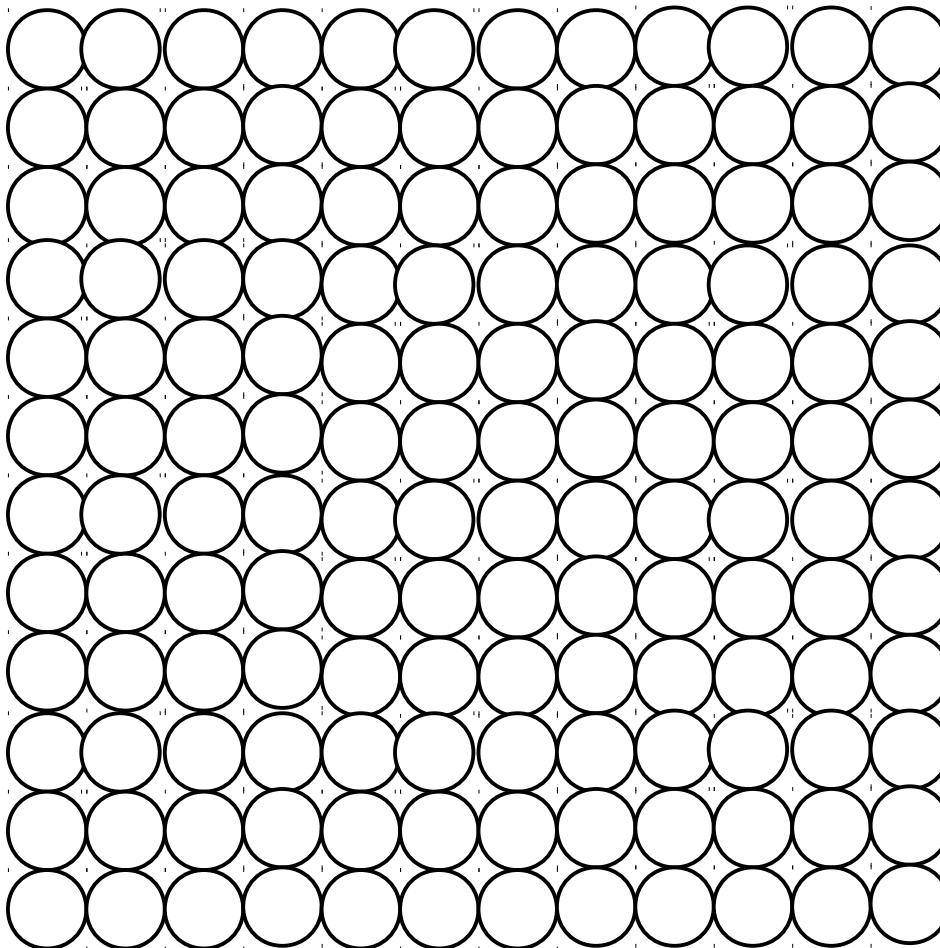


- Bezier curves

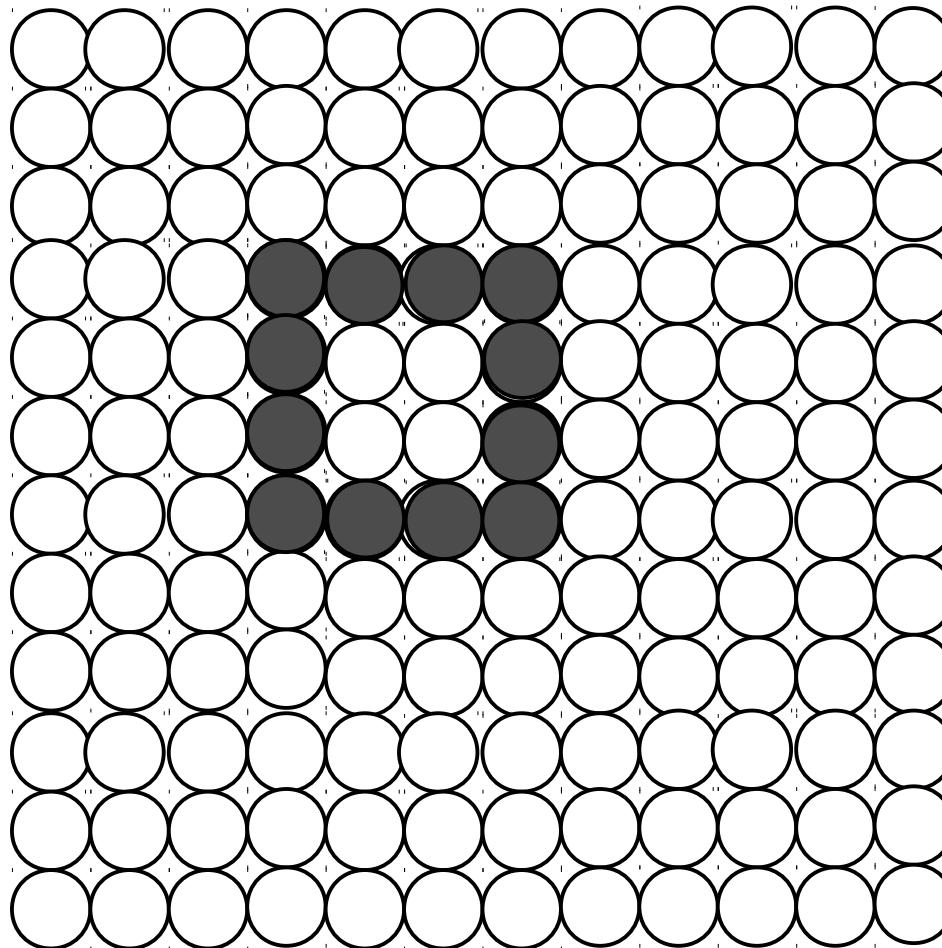


- Text

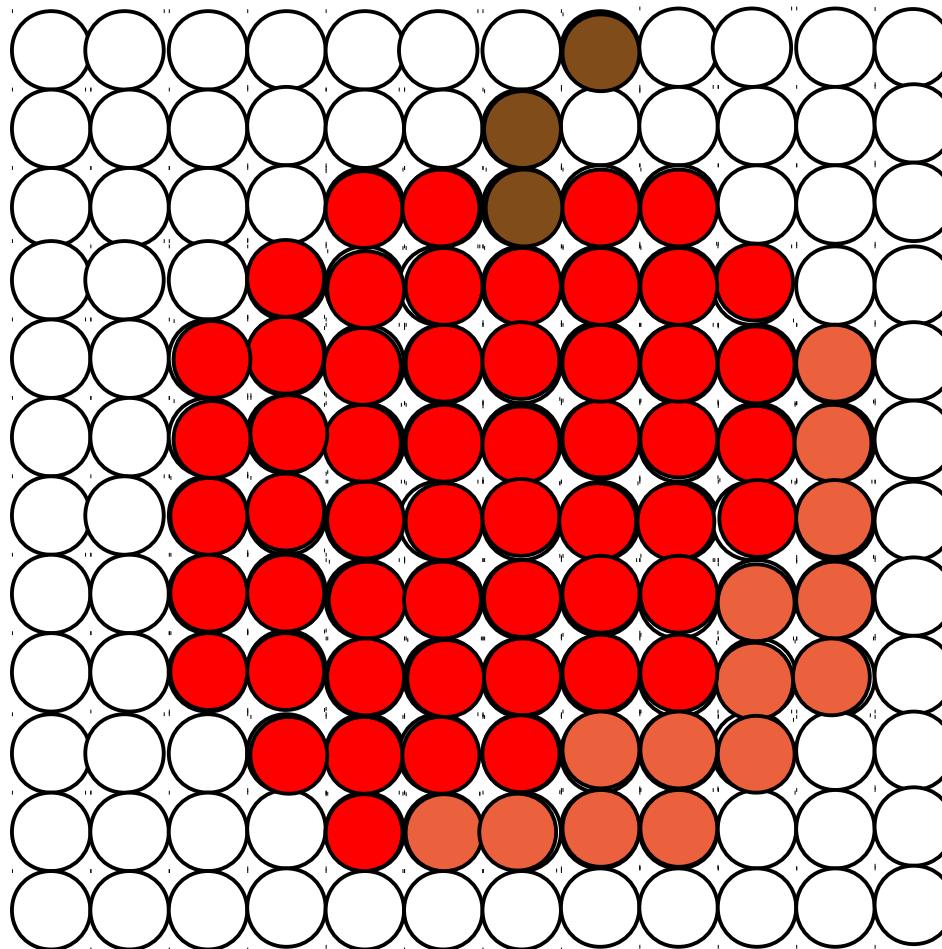
Computer screens = dots



Change colors of the dots to make pictures



Change colors of the dots to make pictures



Dots = pixels



8 megapixels

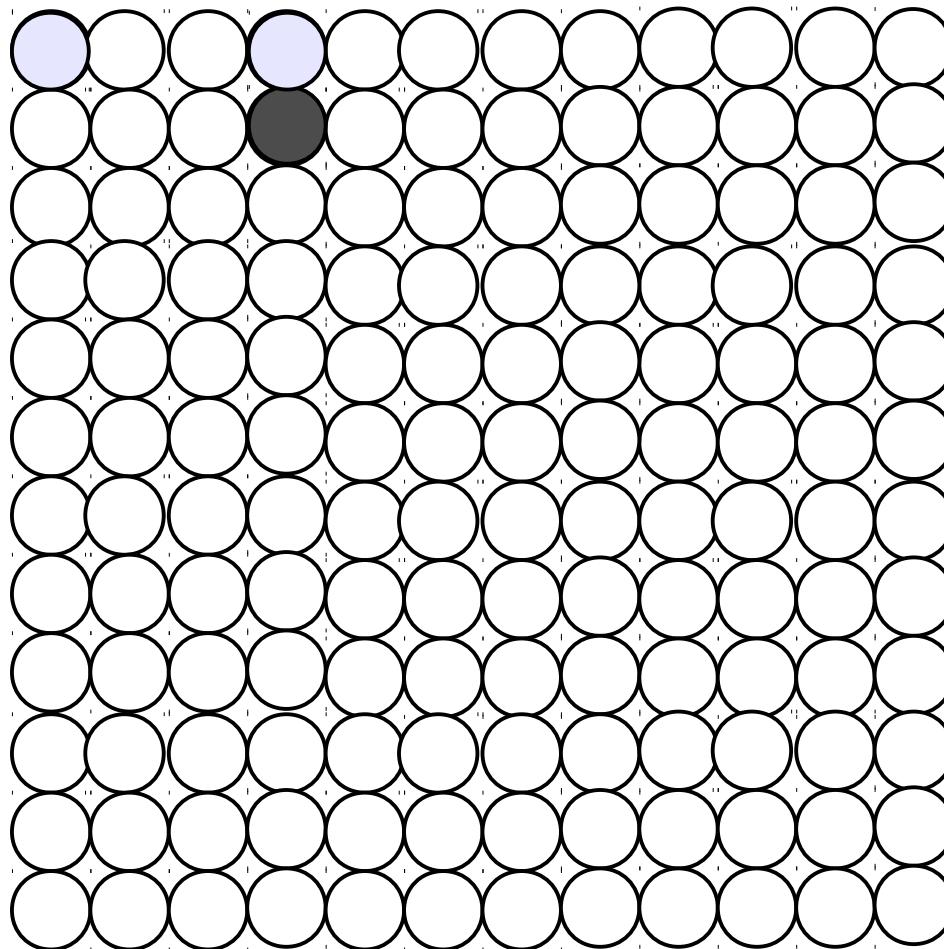


800 x 480

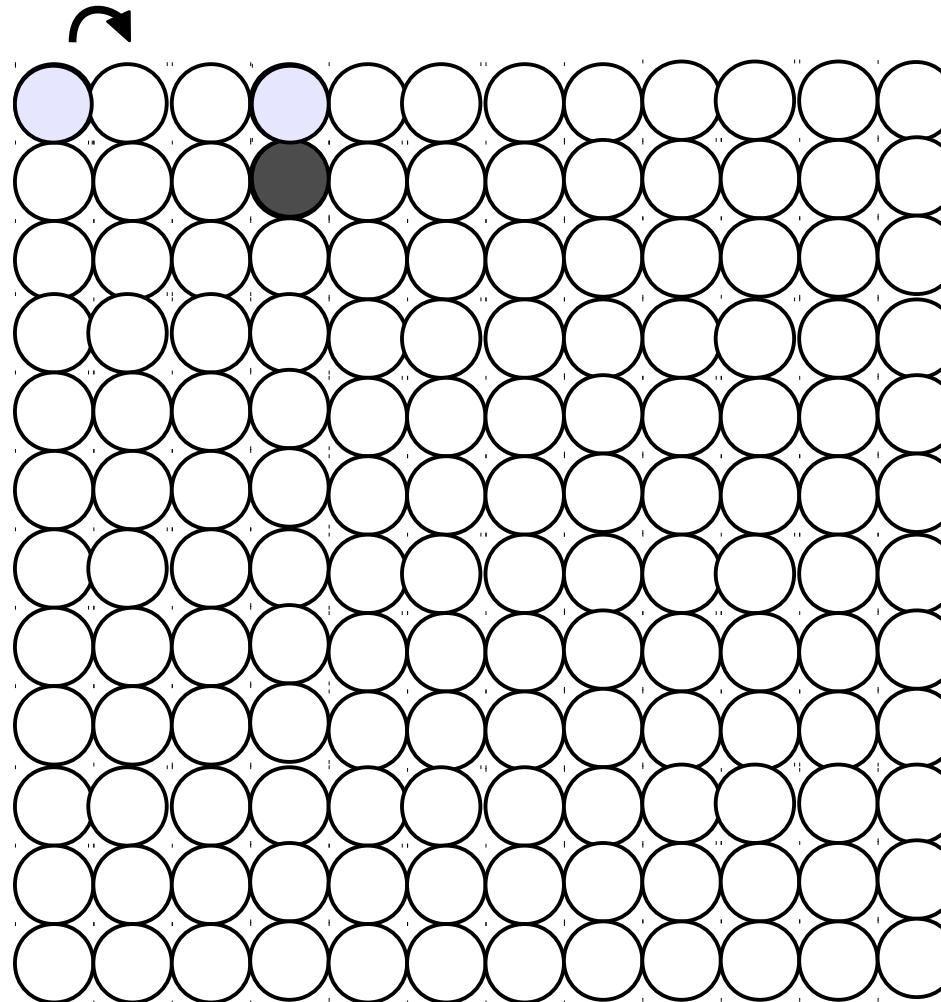


720p HD

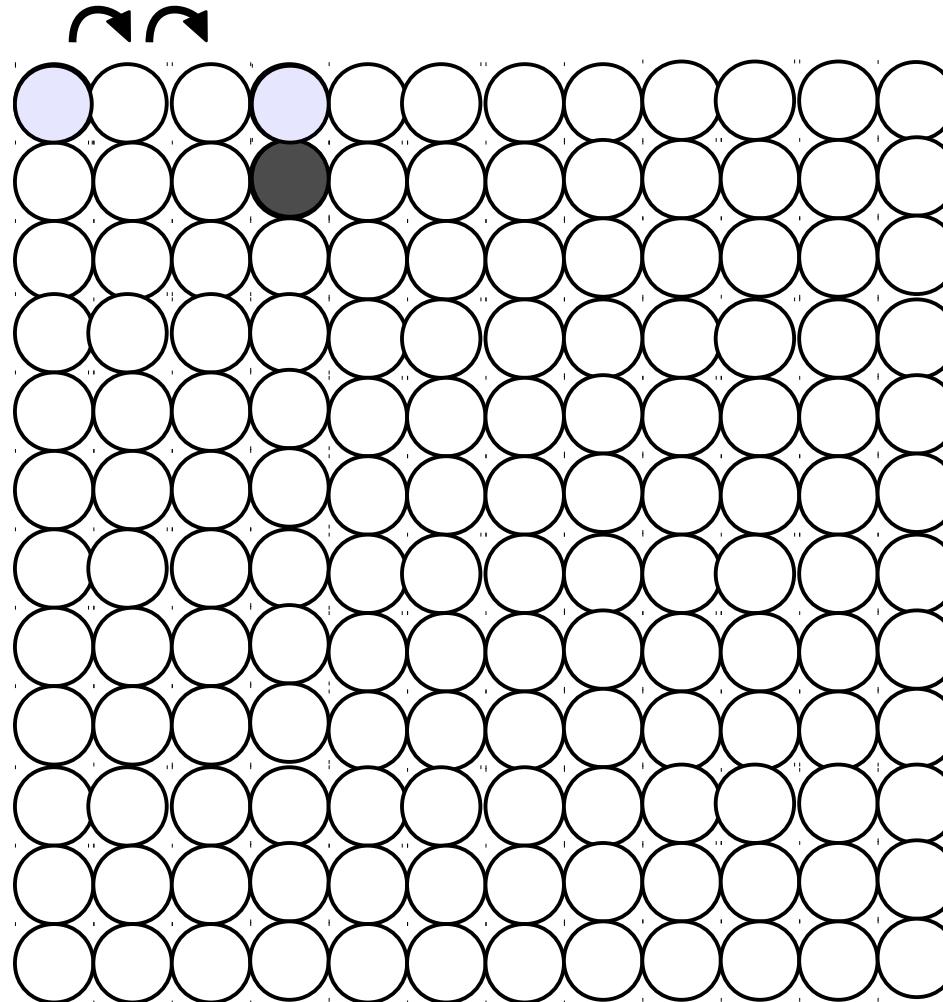
Where is the dot?



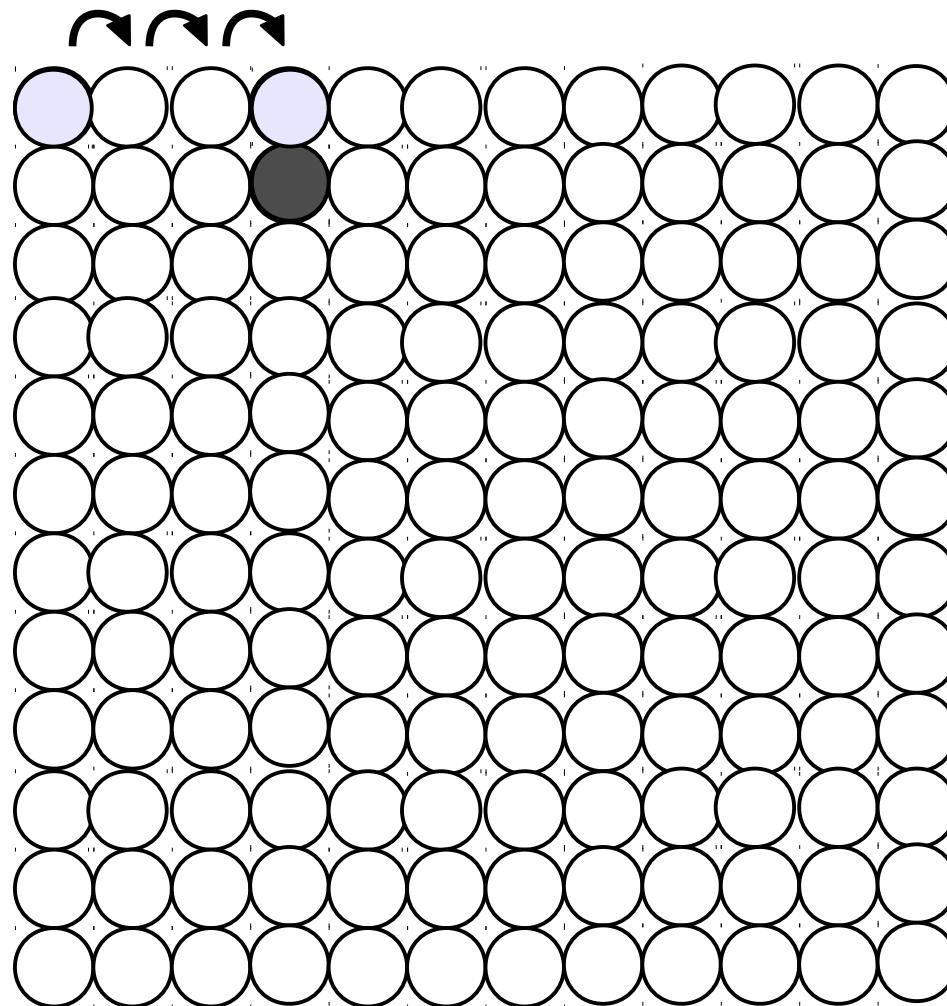
Where is the dot?



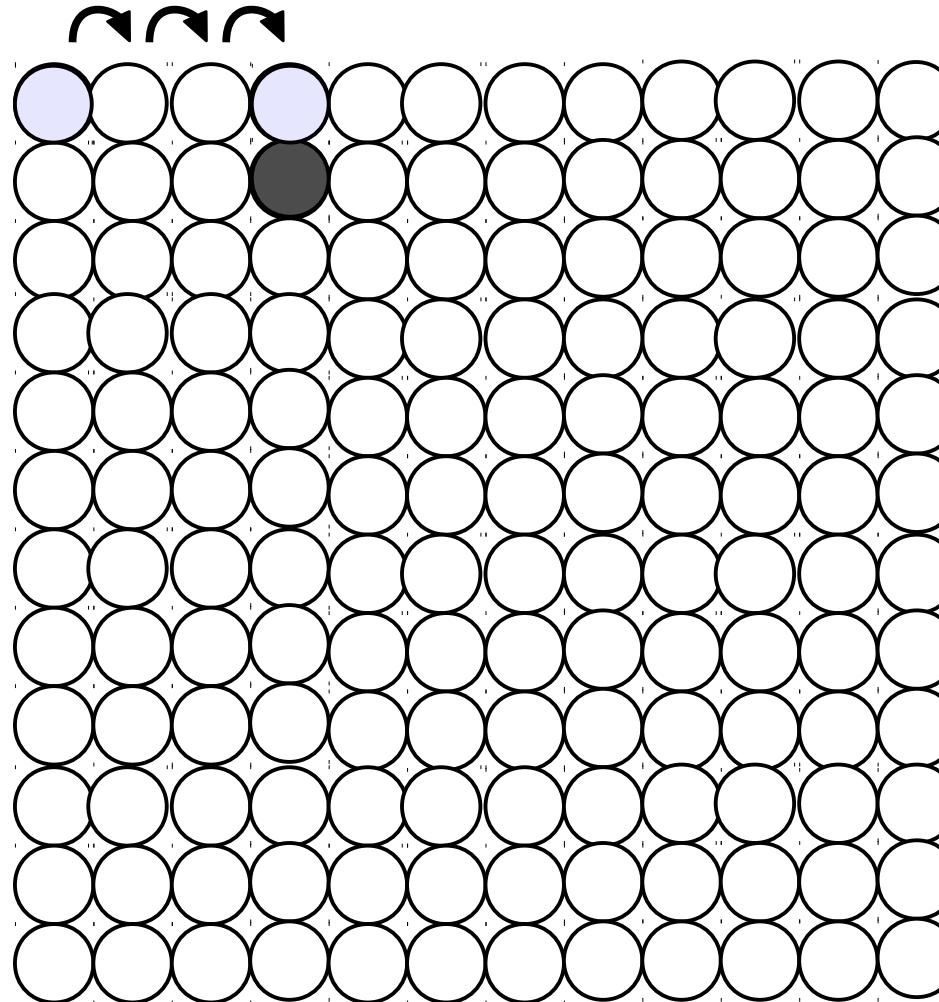
Where is the dot?



Where is the dot?

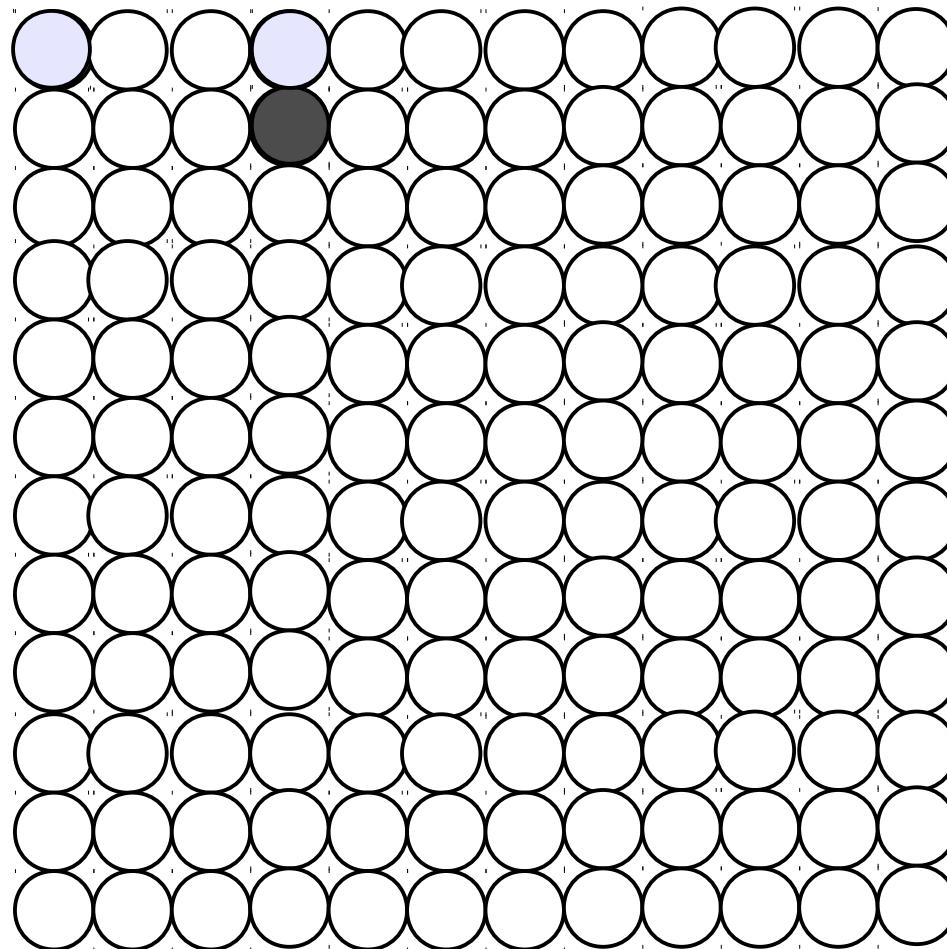


Where is the dot?



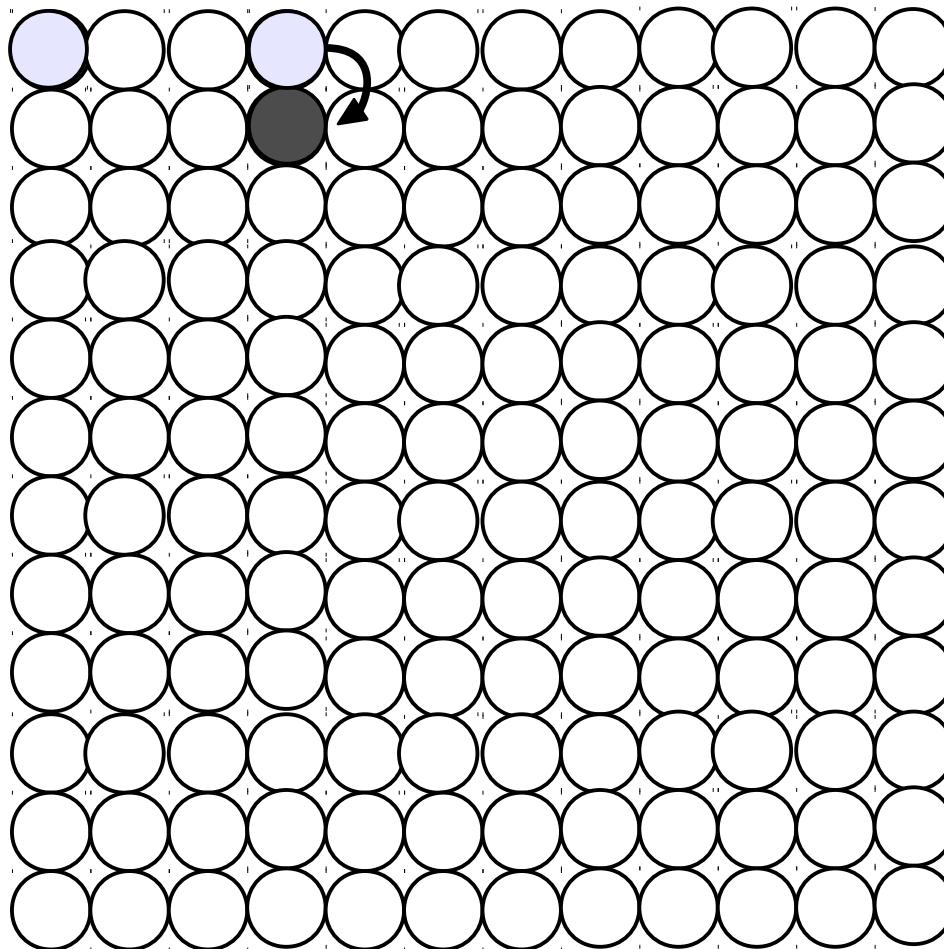
3

Where is the dot?



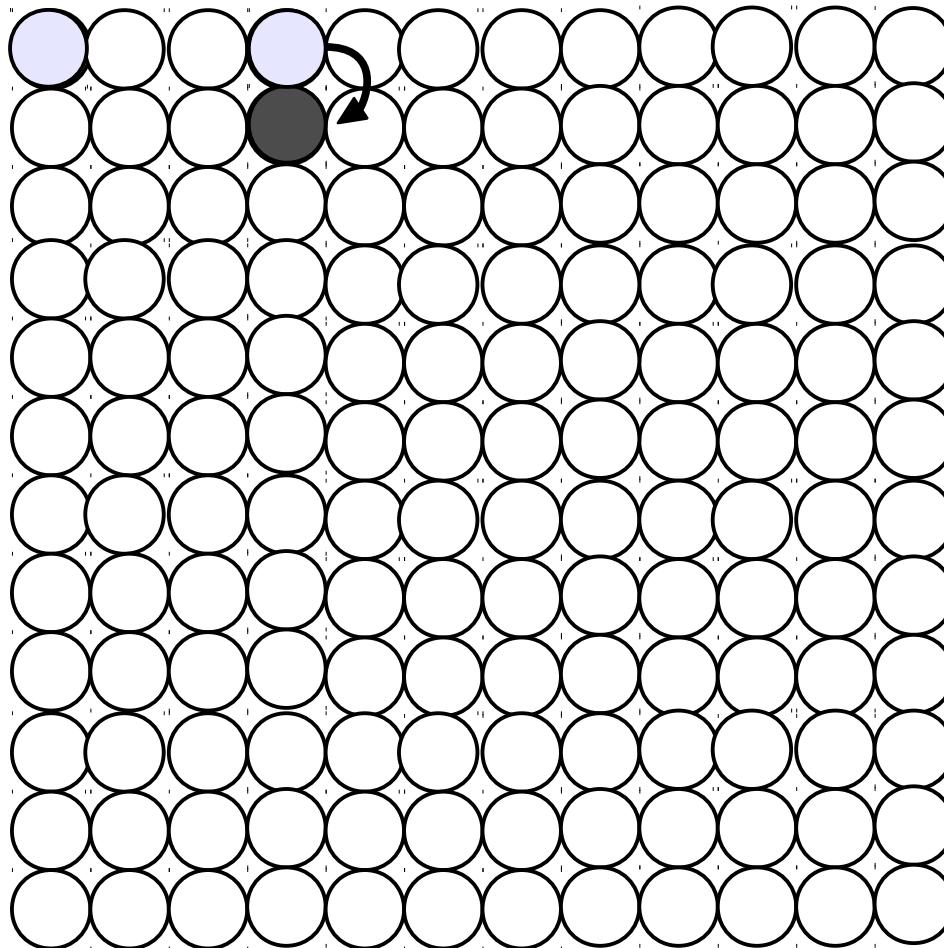
3

Where is the dot?



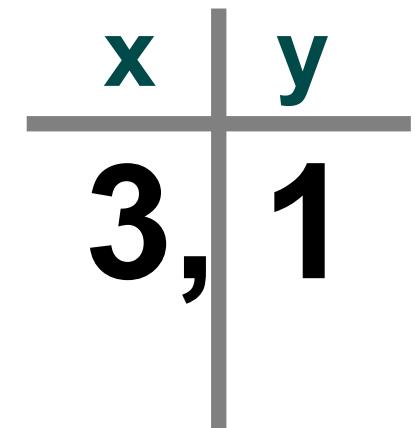
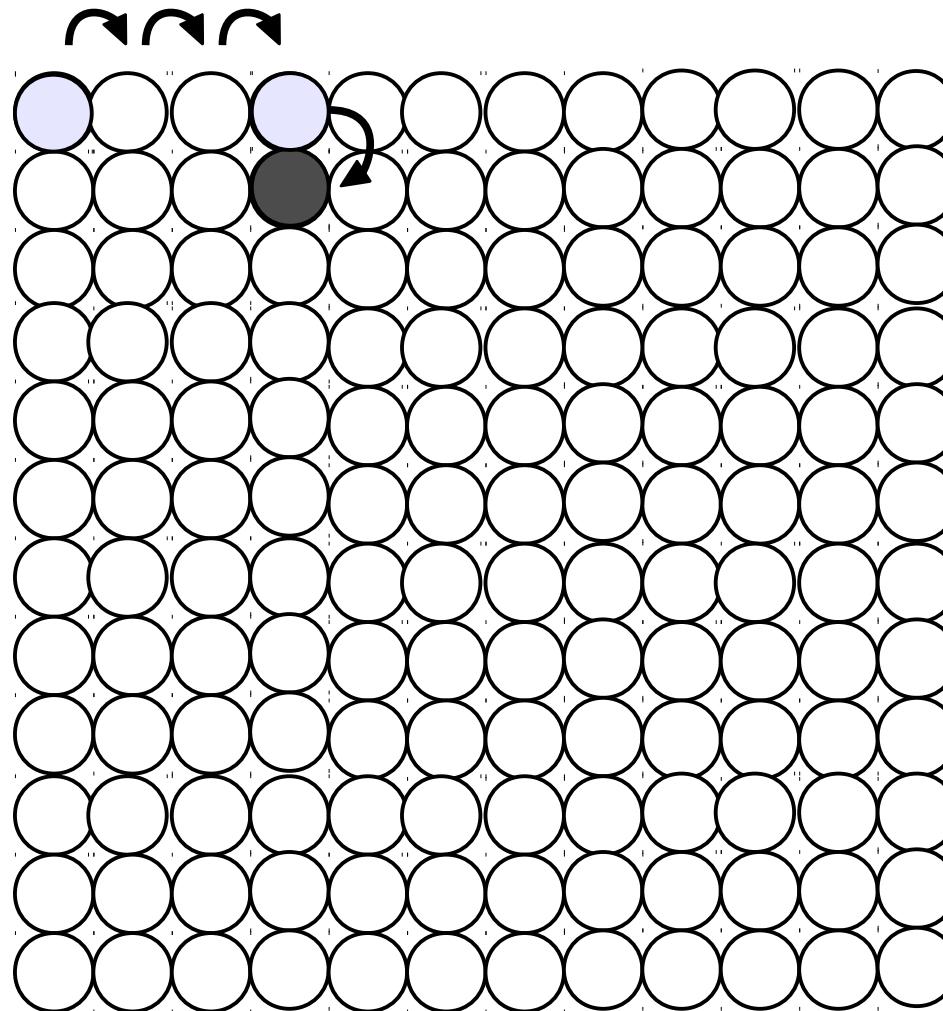
3

Where is the dot?



3, 1

Math it up!



Let's Start Programming: jsbin

<http://o.olli.ca/canvasjsbin>

The screenshot shows the jsbin interface with the following components:

- JS Bin** tab (selected)
- Add library
- Share
- HTML (selected)
- CSS
- JavaScript
- Console
- Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

JavaScript ▼

```
canvas = document.getElementById('canvas');
c = canvas.getContext('2d');
```

Output

Run with JS

Auto-run JS

jsbin

<http://o.ooli.ca/canvasjsbin>

The screenshot shows the jsbin interface with the following components:

- JS Bin** tab (selected)
- Add library
- Share
- HTML tab (selected)
- CSS
- JavaScript tab (selected)
- Console
- Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
  canvas =
document.getElementById('canvas');
  c =
  canvas.getContext('2d');
```

JavaScript ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500"></canvas>
<script>
  canvas = document.getElementById('canvas');
  c = canvas.getContext('2d');
  function wait(fn) {window.setTimeout(fn, 250); }
</script>
```

Output

Run with JS

Auto-run JS

Let's Draw Something

<http://o.olli.ca/canvasjsbin>

The screenshot shows the JS Bin editor interface. The top navigation bar includes tabs for JS Bin, Add library, Share, HTML (which is selected), CSS, JavaScript (with a cursor icon), Console, and Output.

The left panel, labeled "HTML ▾", contains the following HTML code:

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

The middle panel, labeled "JavaScript ▾", contains the following JavaScript code:

```
c.moveTo(20,90);
c.lineTo(90,90);
c.stroke();
```

The right panel, labeled "Output", contains a "Run with JS" button and an "Auto-run JS" checkbox. Below these is a large empty area where the output would be displayed.

Let's Draw Something

<http://o.olli.ca/canvasjsbin>

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▾

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

JavaScript ▾

```
canvas = document.getElementById('canvas');
c = canvas.getContext("2d");
c.moveTo(20, 90);
c.lineTo(90, 90);
c.stroke();
```

Output

Run with JS

Auto-run JS

Let's Draw Something

<http://o.olli.ca/canvasjsbin>

The screenshot shows the JS Bin interface. The top navigation bar includes tabs for JS Bin, Add library, Share, HTML (which is selected), CSS, JavaScript, Console, and Output. The HTML tab displays the following code:

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

The JavaScript tab contains the following code:

```
var c = document.getElementById("canvas").getContext("2d");
c.moveTo(20, 90);
c.lineTo(90, 90);
c.stroke();
```

The Output panel on the right shows a red line drawn from (20, 90) to (90, 90) on a 500x500 canvas.

Checking for Errors



F12



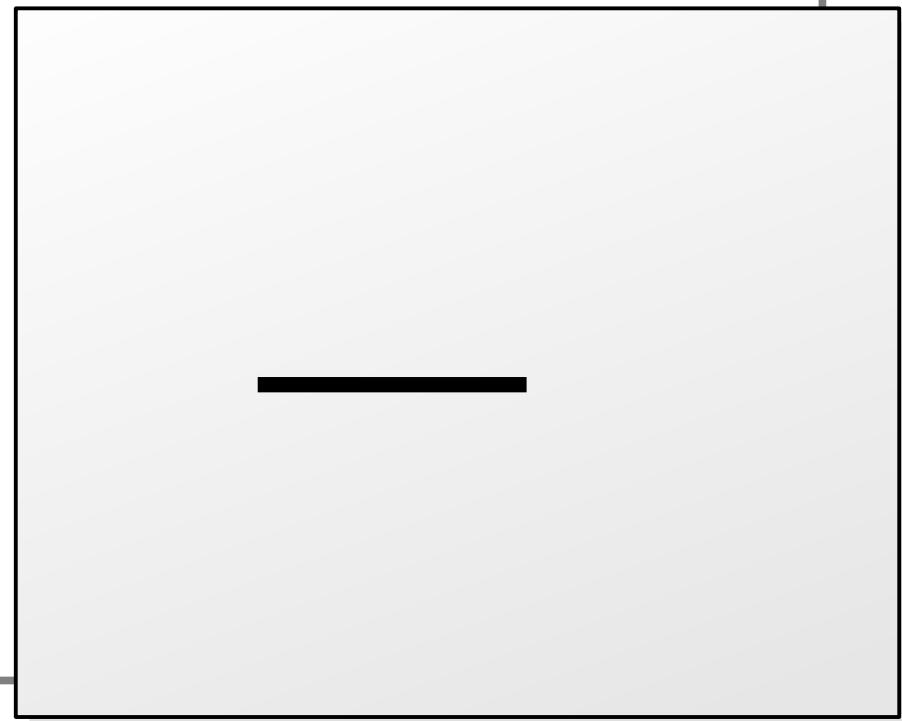
ctrl - shift ⌘ J



cmd ⌘ - option ⌘ alt - C

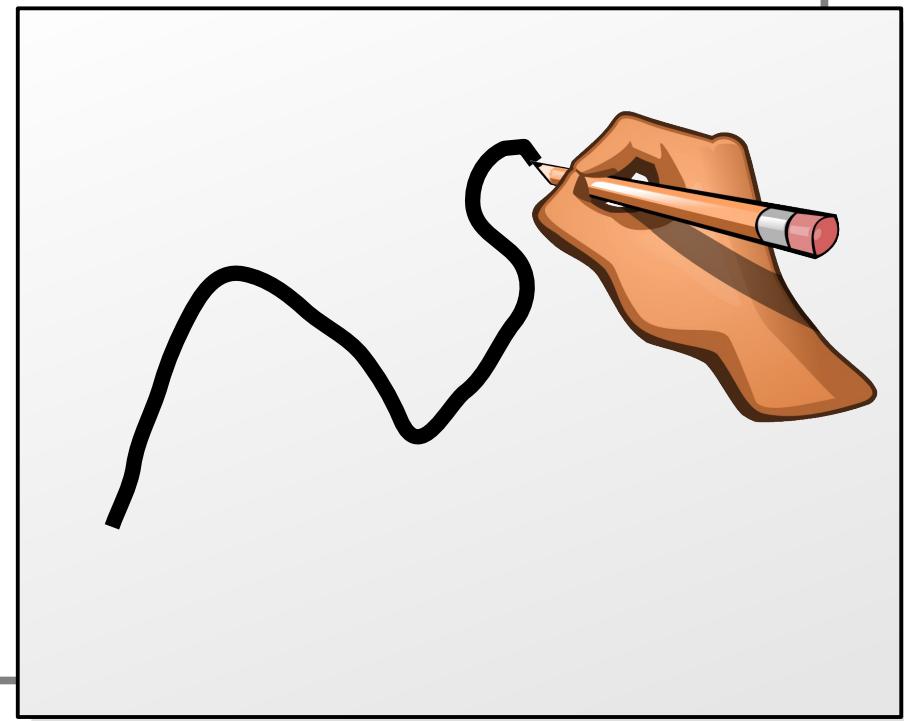
What's Going On?

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```



Canvas

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```

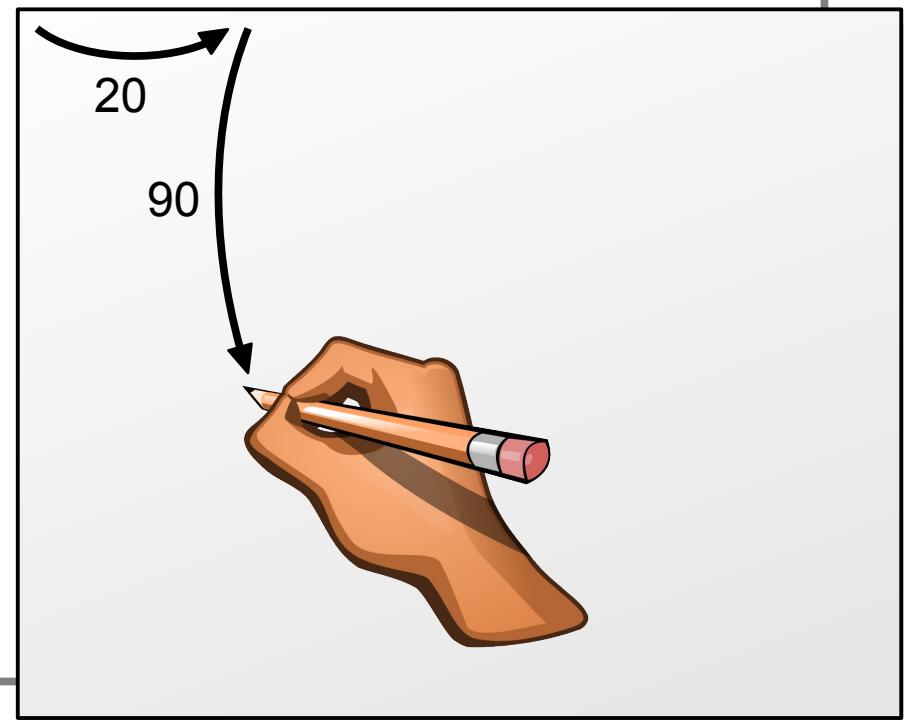


Move Pen

```
c.moveTo(20, 90);
```

```
c.lineTo(90, 90);
```

```
c.stroke();
```

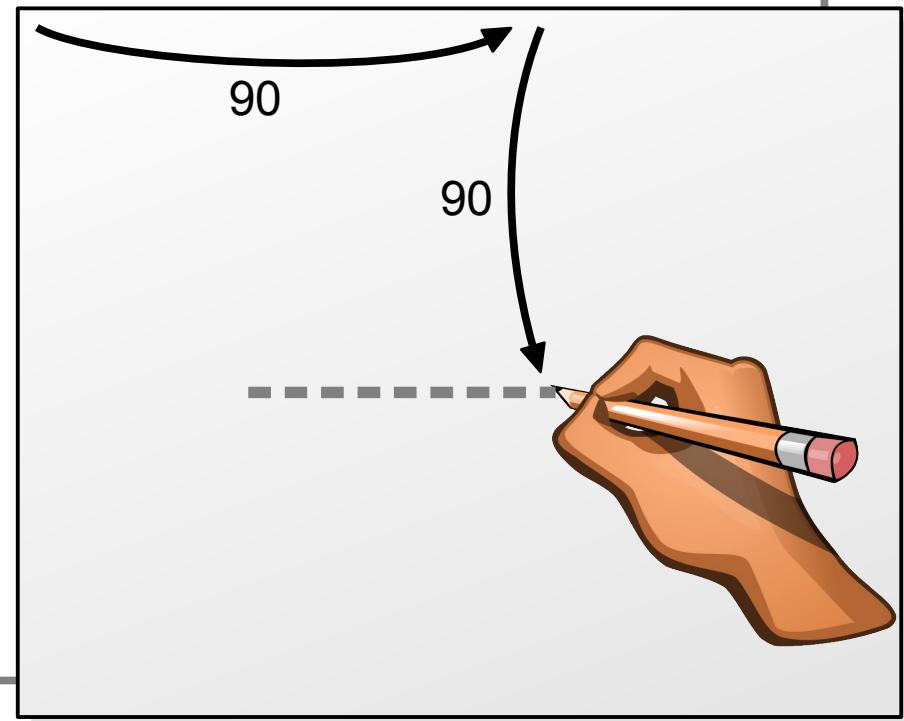


Tell Computer Where You Want a Line

```
c.moveTo(20,90);
```

```
c.lineTo(90,90);
```

```
c.stroke();
```



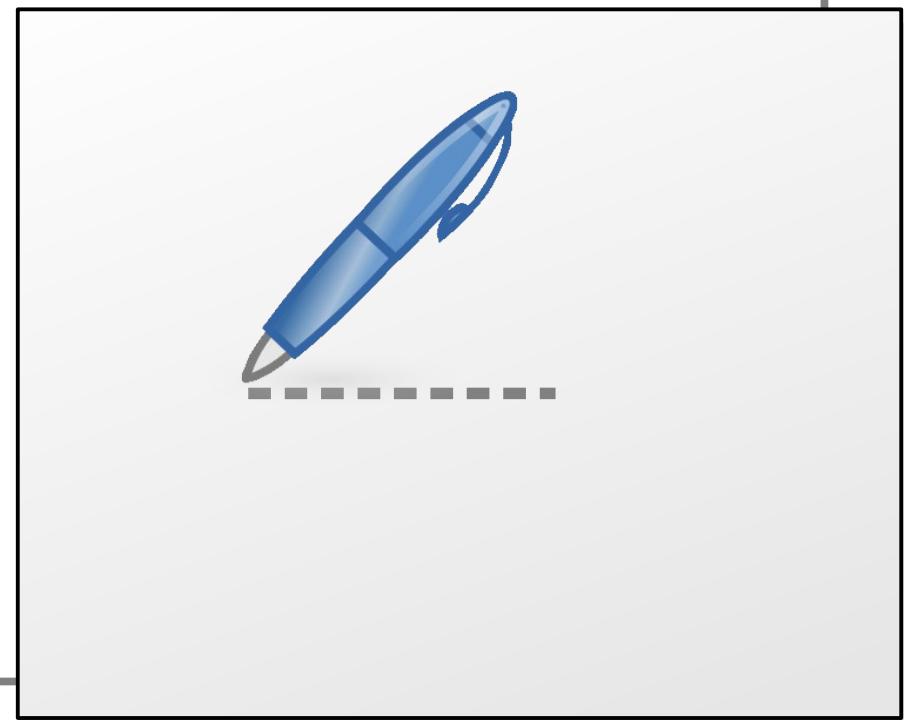
Tell Computer to Draw the Line

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```



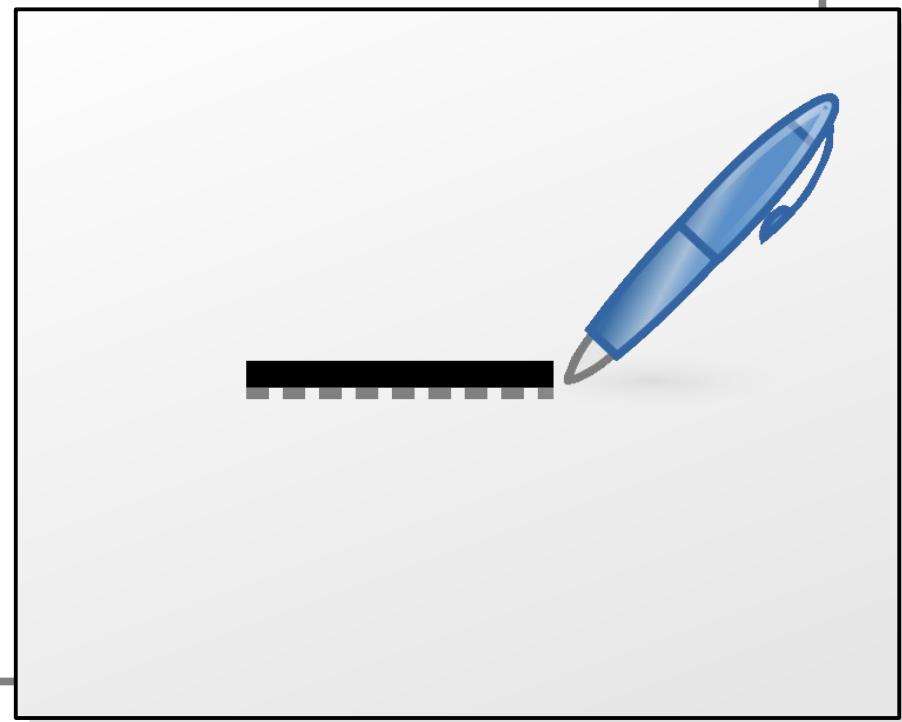
Tell Computer to Draw the Line

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```



Tell Computer to Draw the Line

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```



Make Your Own Picture

JS Bin Add library Share **HTML** CSS **JavaScript** Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

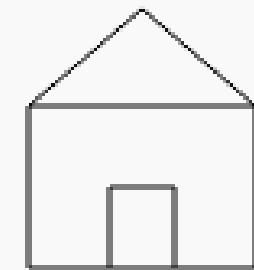
JavaScript ▼

```
c.moveTo(20,90);  
c.lineTo(90,90);  
c.lineTo(90,140);  
c.lineTo(20,140);  
c.lineTo(20,90);  
c.lineTo(55,60);  
c.lineTo(90,90);  
  
c.moveTo(45,140);  
c.lineTo(45,115);  
c.lineTo(65,115);  
c.lineTo(65,140);  
c.stroke();
```

Output

Run with JS

Auto-run JS 



Make Your Own Picture

The screenshot shows a web-based code editor interface titled "JS Bin". The top navigation bar includes tabs for "JS Bin", "Add library", "Share", "HTML" (which is selected), "CSS", "JavaScript", "Console", and "Output".

The "HTML" section contains the following code:

```
<!DOCTYPE html>
<html>
<canvas
id="canvas"
width="500"
height="500">
</canvas>
<script>
```

The "JavaScript" section is currently empty.

The "Output" section includes a "Run with JS" button and an "Auto-run JS" checkbox, which is checked.

The bottom right corner of the interface has the number "29".

Make Your Own Picture

The screenshot shows a web-based code editor interface for creating small programs, specifically for drawing on a canvas.

JS Bin tab is selected in the top navigation bar.

HTML section contains the following code:

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

JavaScript section contains the following code:

```
c.moveTo(20, 90);
```

Output section displays the result of the execution:

- Run with JS
- Auto-run JS
- (A single black dot is shown in the output area.)

Make Your Own Picture

The screenshot shows a web-based code editor interface for creating simple graphics using HTML and JavaScript.

JS Bin tab is selected in the top navigation bar.

HTML section contains the following code:

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

JavaScript section contains the following code:

```
c.moveTo(20, 90);
c.lineTo(90, 90);
```

Output section displays the result of the code execution:

```
Run with JS
Auto-run JS  
```

The output area shows a dashed line starting at (20, 90) and ending at (90, 90), representing a short diagonal line segment.

Make Your Own Picture

JS Bin Add library Share **HTML** CSS **JavaScript** Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

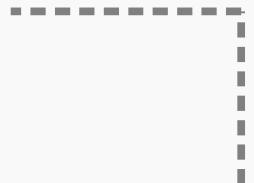
JavaScript ▼

```
c.moveTo(20, 90);
c.lineTo(90, 90);
c.lineTo(90, 140);
```

Output

Run with JS

Auto-run JS 



52

Make Your Own Picture

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

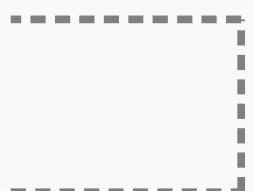
JavaScript ▼

```
c.moveTo(20, 90);
c.lineTo(90, 90);
c.lineTo(90, 140);
c.lineTo(20, 140);
```

Output

Run with JS

Auto-run JS 



33

Make Your Own Picture

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

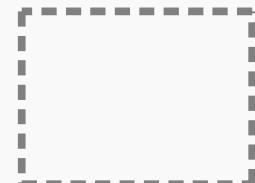
JavaScript ▼

```
c.moveTo(20, 90);
c.lineTo(90, 90);
c.lineTo(90, 140);
c.lineTo(20, 140);
c.lineTo(20, 90);
```

Output

Run with JS

Auto-run JS 



The screenshot shows a JS Bin editor interface. The top navigation bar includes tabs for JS Bin, Add library, Share, HTML (which is selected), CSS, JavaScript, Console, and Output. The HTML tab displays the structure of a simple web page with a canvas element and a script tag. The JavaScript tab contains five calls to a variable 'c' using the moveTo and lineTo methods to draw a dashed rectangle. The Output panel on the right shows a dashed rectangular frame, indicating where the drawing will appear once run.

Make Your Own Picture

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

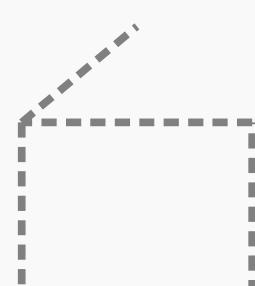
JavaScript ▼

```
c.moveTo(20, 90);
c.lineTo(90, 90);
c.lineTo(90, 140);
c.lineTo(20, 140);
c.lineTo(20, 90);
c.lineTo(55, 60);
```

Output

Run with JS

Auto-run JS 



35

Make Your Own Picture

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

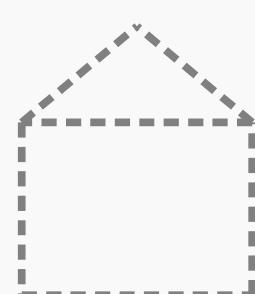
JavaScript ▼

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.lineTo(90, 140);  
c.lineTo(20, 140);  
c.lineTo(20, 90);  
c.lineTo(55, 60);  
c.lineTo(90, 90);
```

Output

Run with JS

Auto-run JS 



36

Make Your Own Picture

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▾

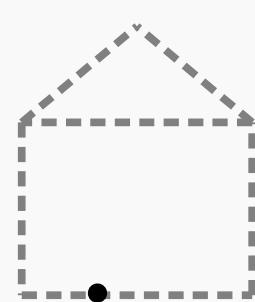
```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

JavaScript ▾

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.lineTo(90, 140);  
c.lineTo(20, 140);  
c.lineTo(20, 90);  
c.lineTo(55, 60);  
c.lineTo(90, 90);  
  
c.moveTo(45, 140);
```

Output

Run with JS Auto-run JS 

Make Your Own Picture

JS Bin Add library Share **HTML** CSS **JavaScript** Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

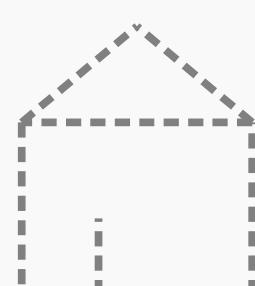
JavaScript ▼

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.lineTo(90, 140);  
c.lineTo(20, 140);  
c.lineTo(20, 90);  
c.lineTo(55, 60);  
c.lineTo(90, 90);  
  
c.moveTo(45, 140);  
c.lineTo(45, 115);
```

Output

Run with JS

Auto-run JS 



Make Your Own Picture

JS Bin Add library Share **HTML** CSS **JavaScript** Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

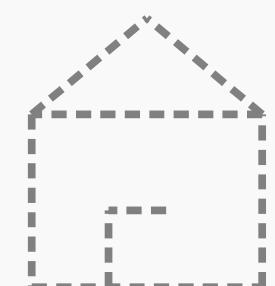
JavaScript ▼

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.lineTo(90, 140);  
c.lineTo(20, 140);  
c.lineTo(20, 90);  
c.lineTo(55, 60);  
c.lineTo(90, 90);  
  
c.moveTo(45, 140);  
c.lineTo(45, 115);  
c.lineTo(65, 115);
```

Output

Run with JS

Auto-run JS 



Make Your Own Picture

JS Bin Add library Share **HTML** CSS **JavaScript** Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

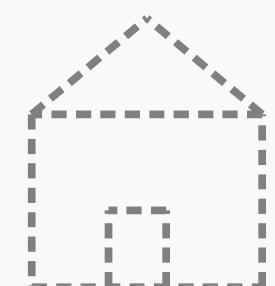
JavaScript ▼

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.lineTo(90, 140);  
c.lineTo(20, 140);  
c.lineTo(20, 90);  
c.lineTo(55, 60);  
c.lineTo(90, 90);  
  
c.moveTo(45, 140);  
c.lineTo(45, 115);  
c.lineTo(65, 115);  
c.lineTo(65, 140);
```

Output

Run with JS

Auto-run JS 



Make Your Own Picture

JS Bin Add library Share **HTML** CSS **JavaScript** Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

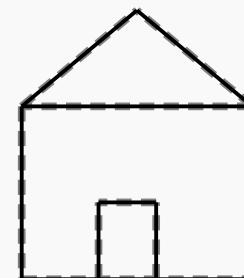
JavaScript ▼

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.lineTo(90, 140);  
c.lineTo(20, 140);  
c.lineTo(20, 90);  
c.lineTo(55, 60);  
c.lineTo(90, 90);  
  
c.moveTo(45, 140);  
c.lineTo(45, 115);  
c.lineTo(65, 115);  
c.lineTo(65, 140);  
c.stroke();
```

Output

Run with JS

Auto-run JS 

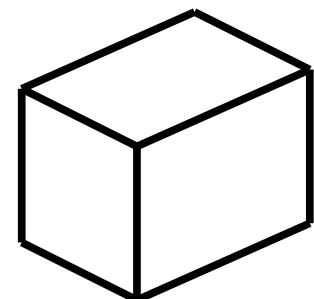


Drawing a Line

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```



Ideas



Checking for Errors



F12

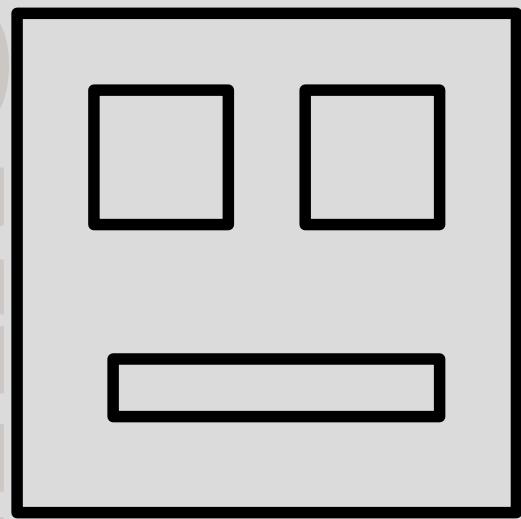


ctrl - shift ⌘ J

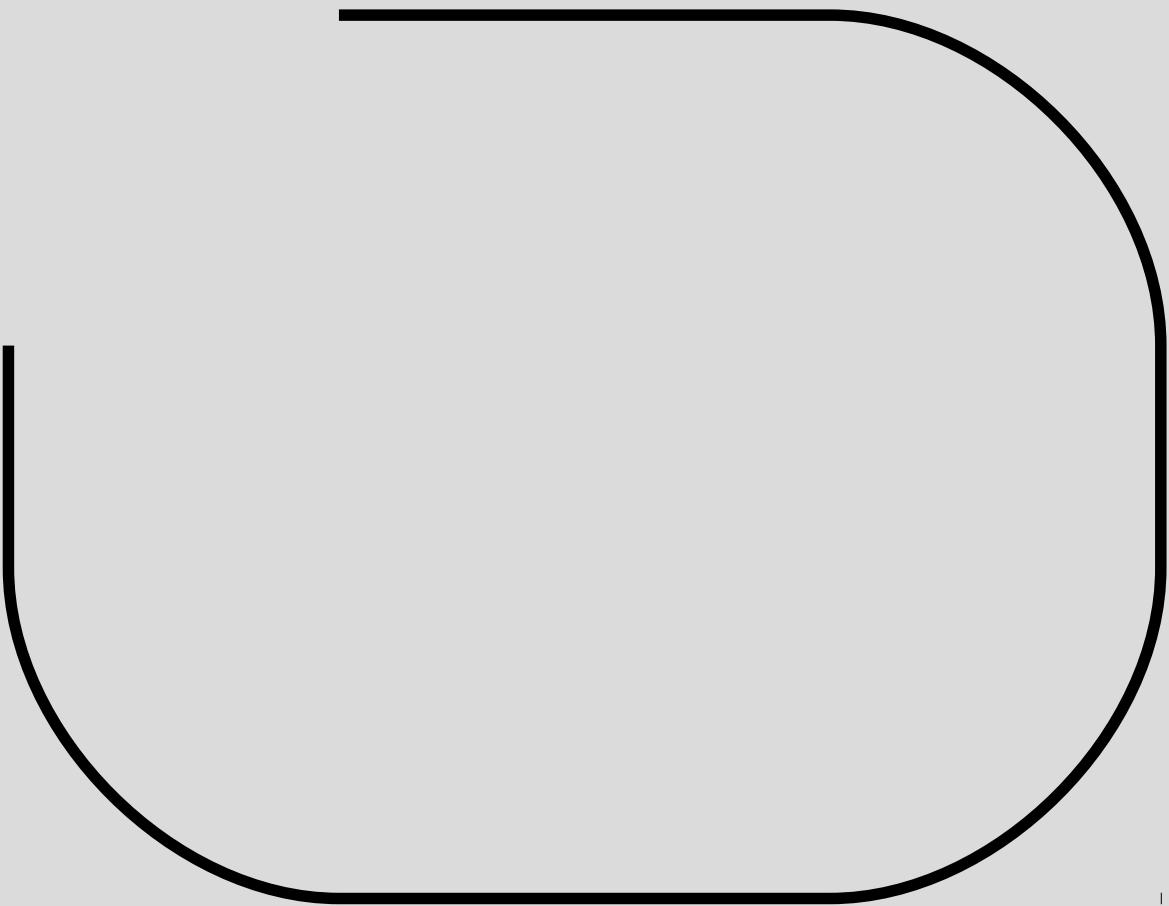


cmd ⌘ - option ⌘ alt - C

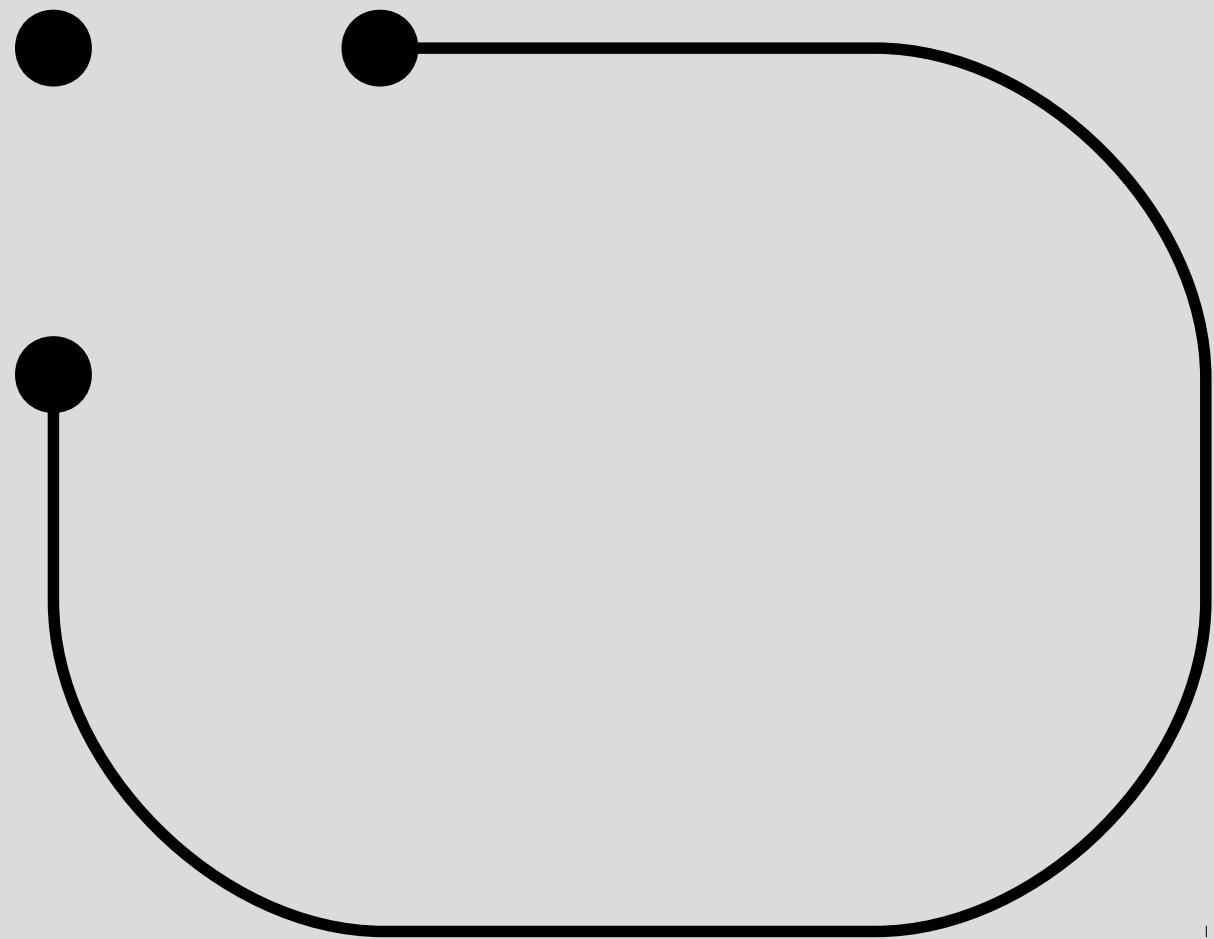
Curves



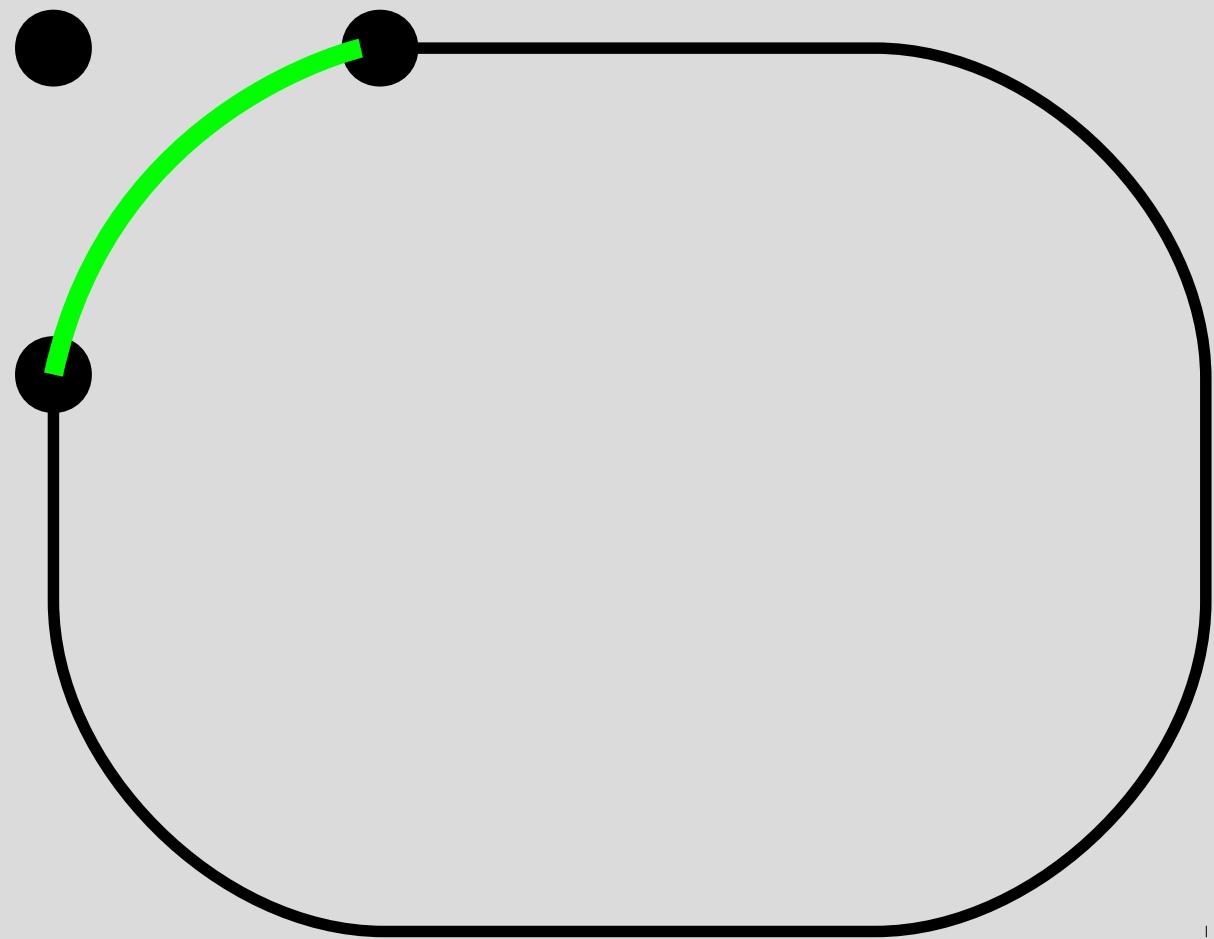
Curves



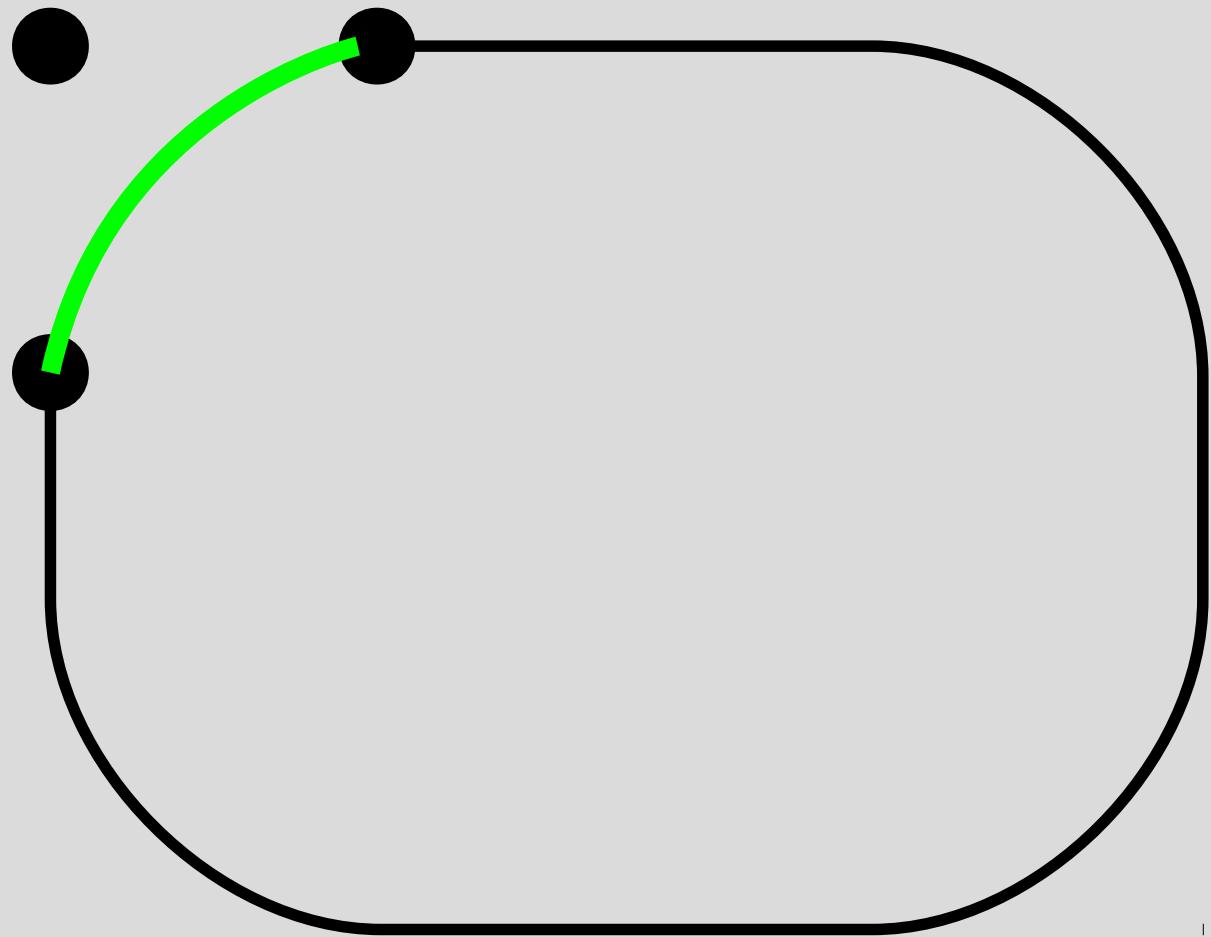
Curves



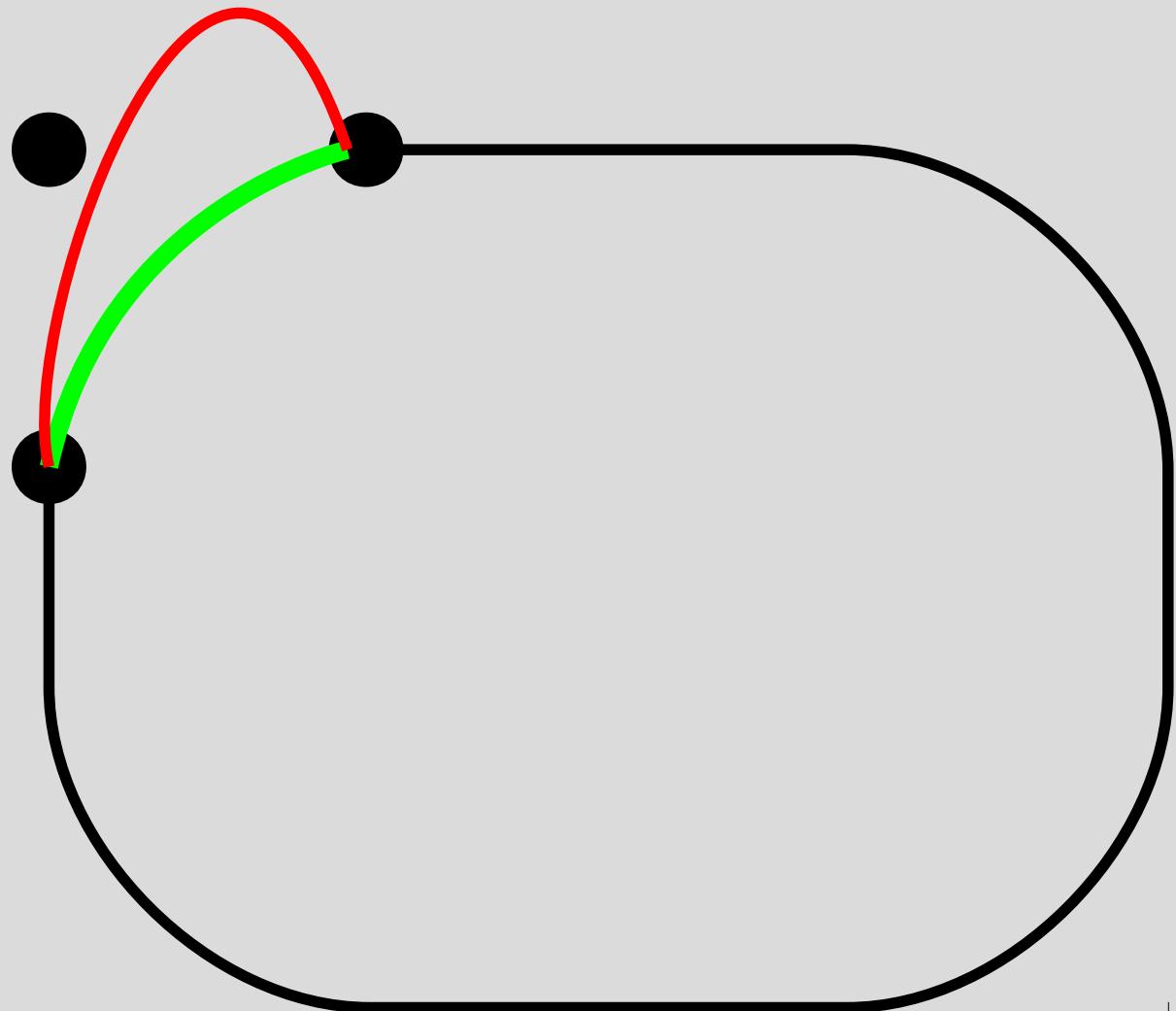
Curves



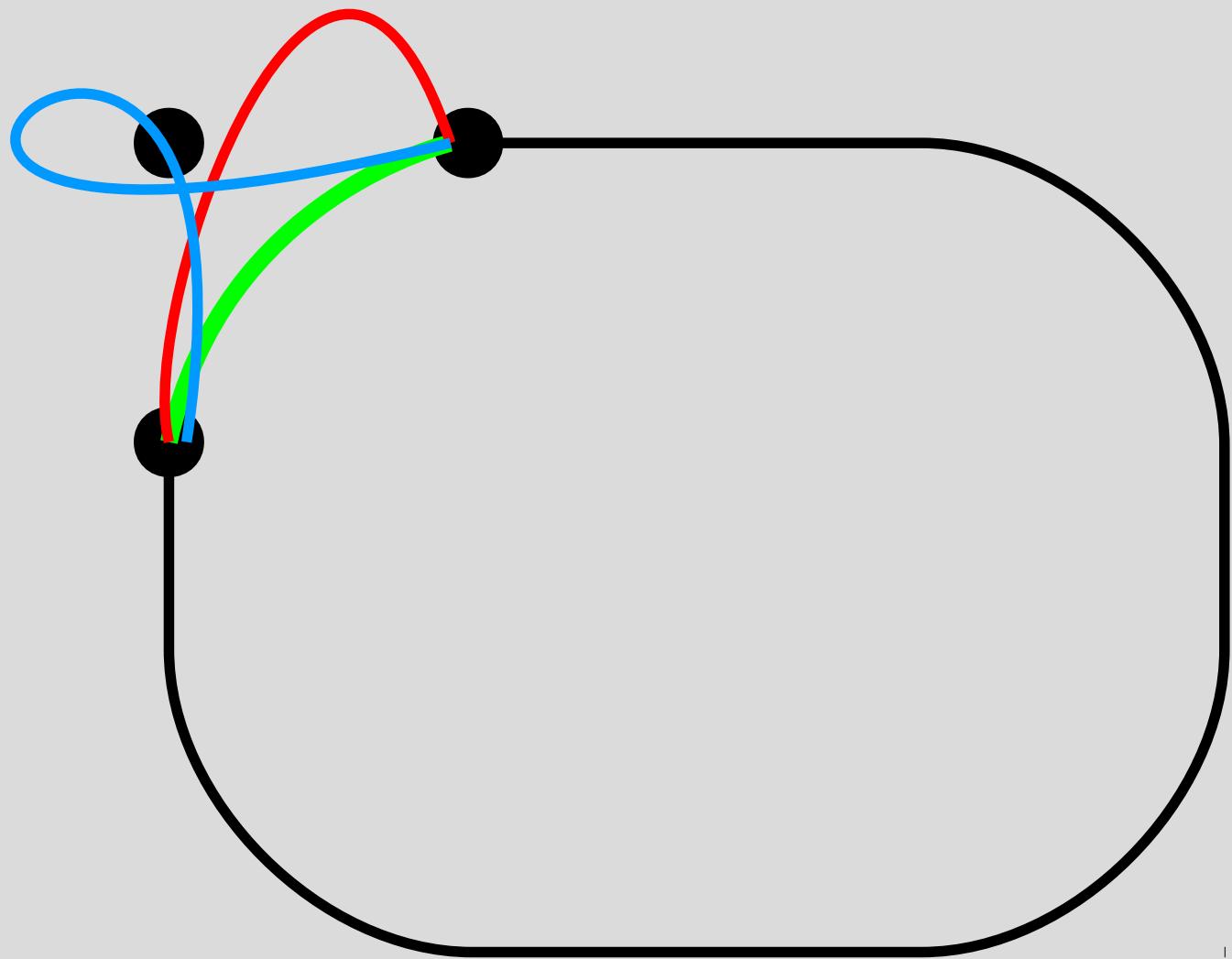
Which Curve?



Which Curve?



Which Curve?

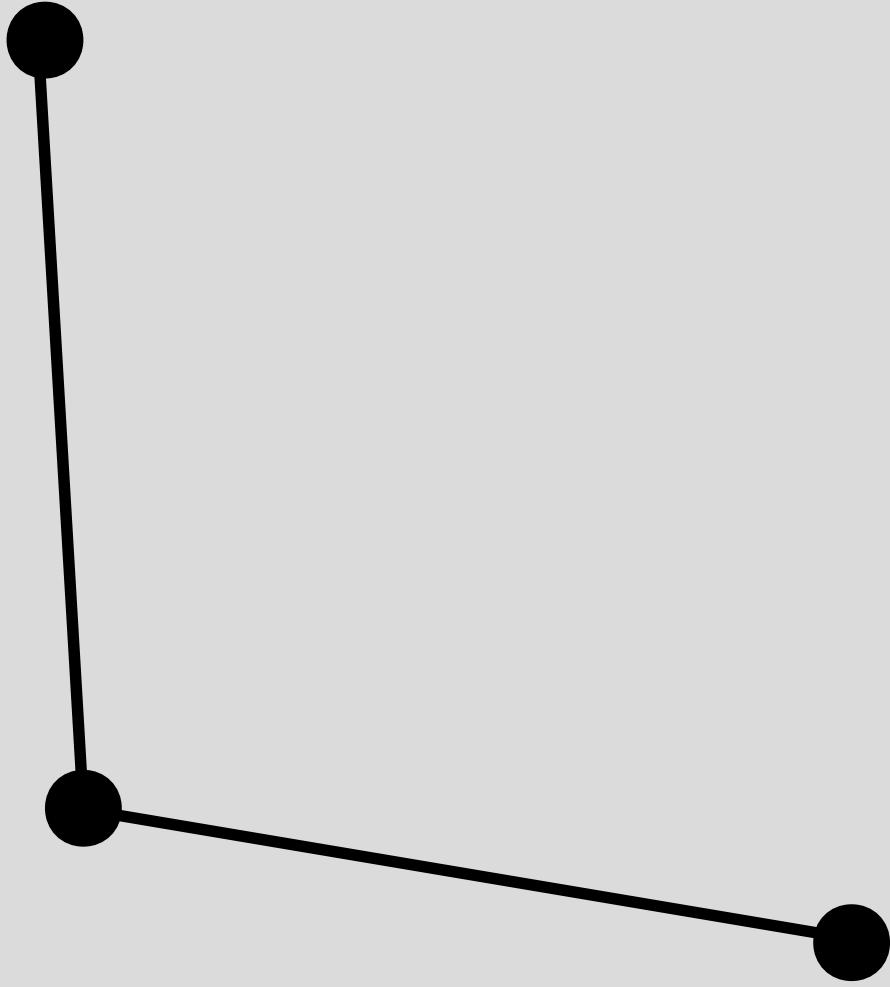


Curves

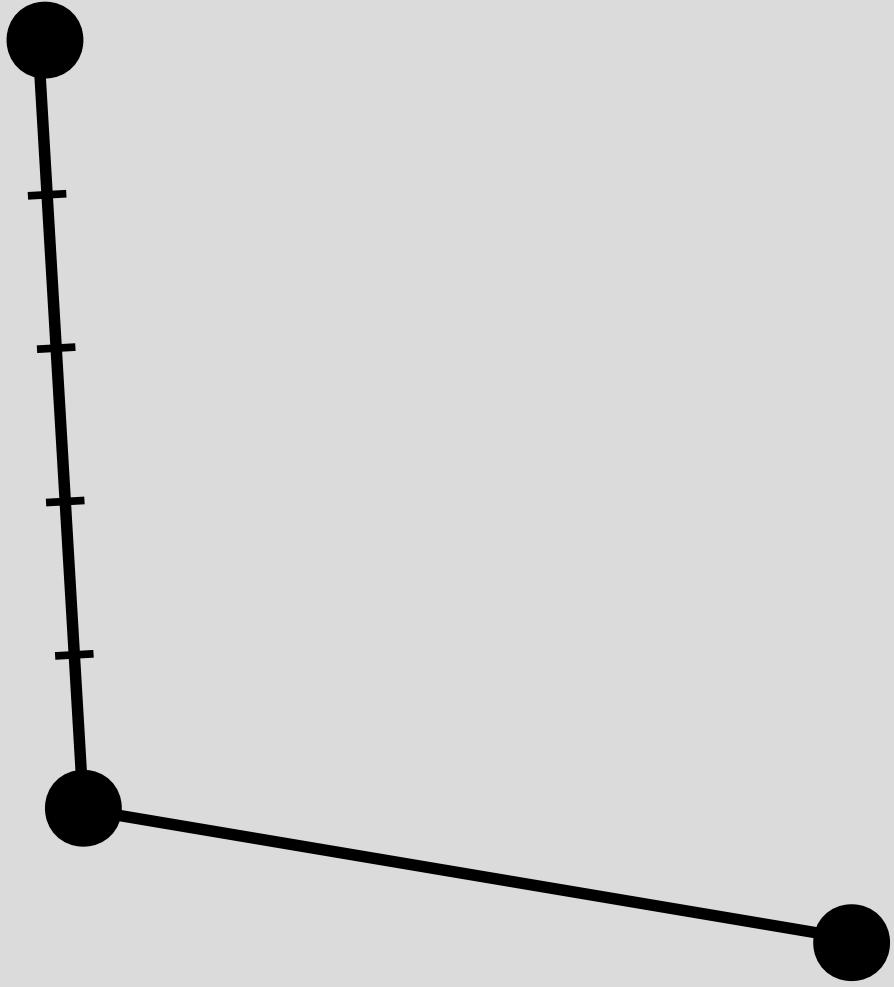


ADVANCE

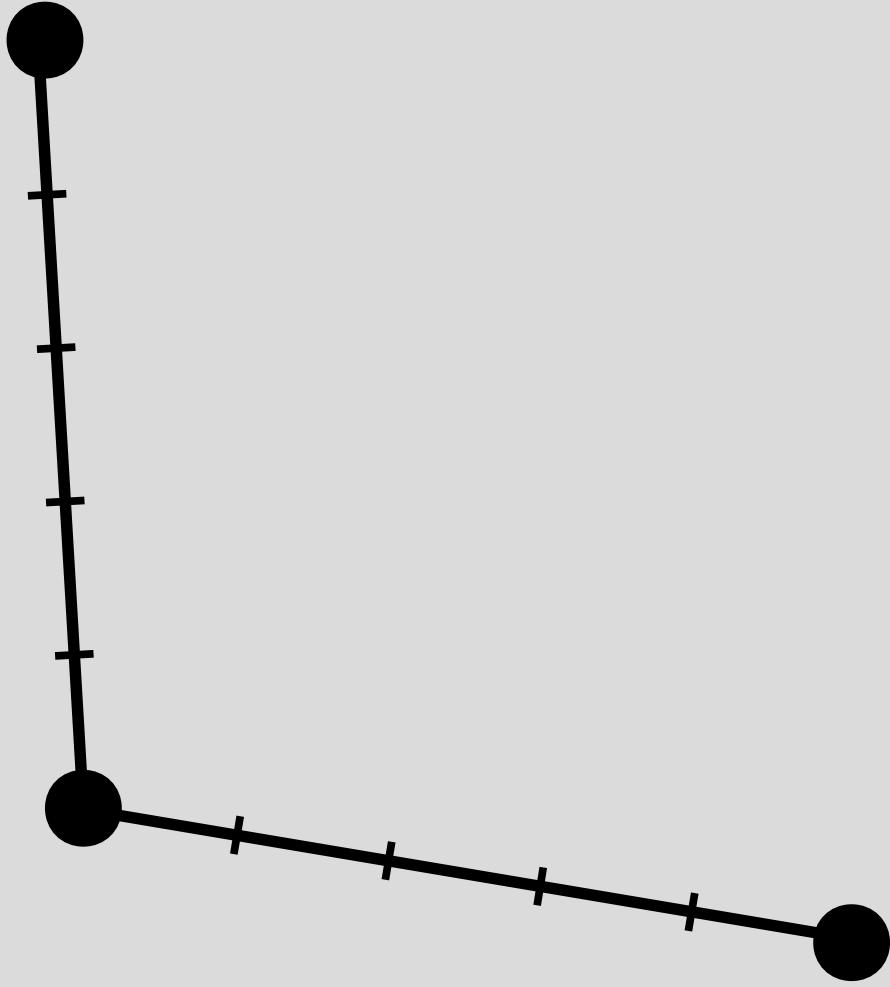
Curves



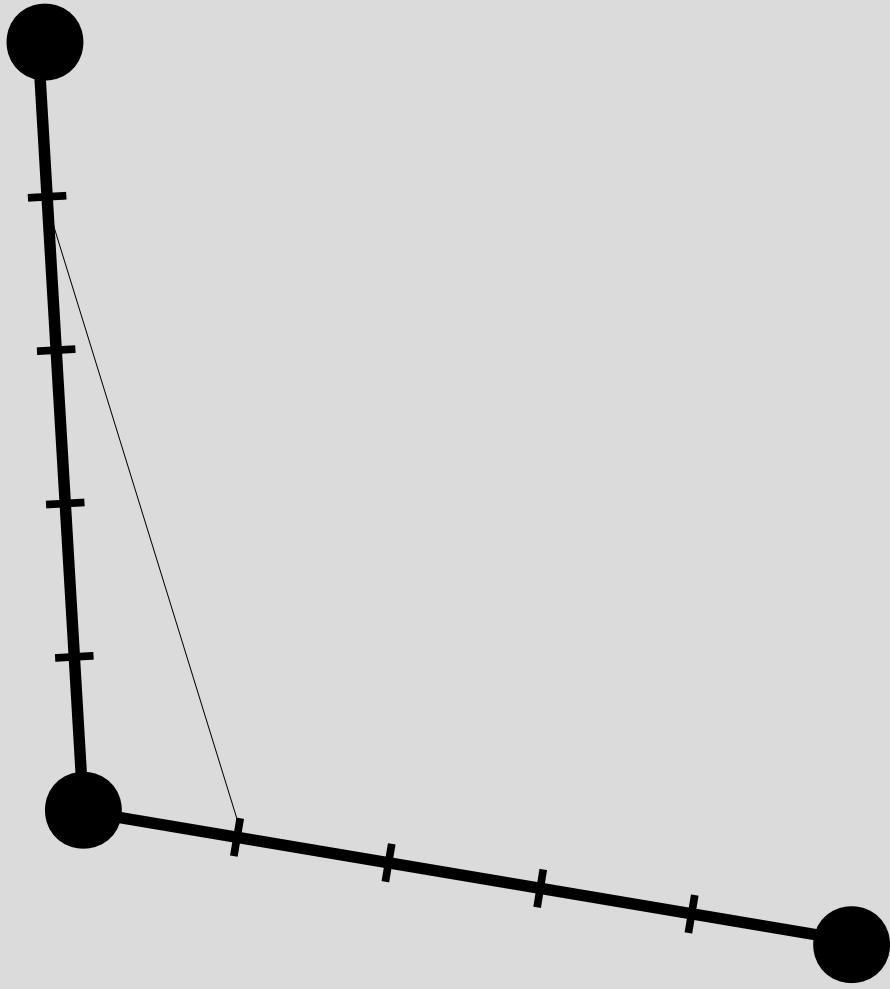
Curves



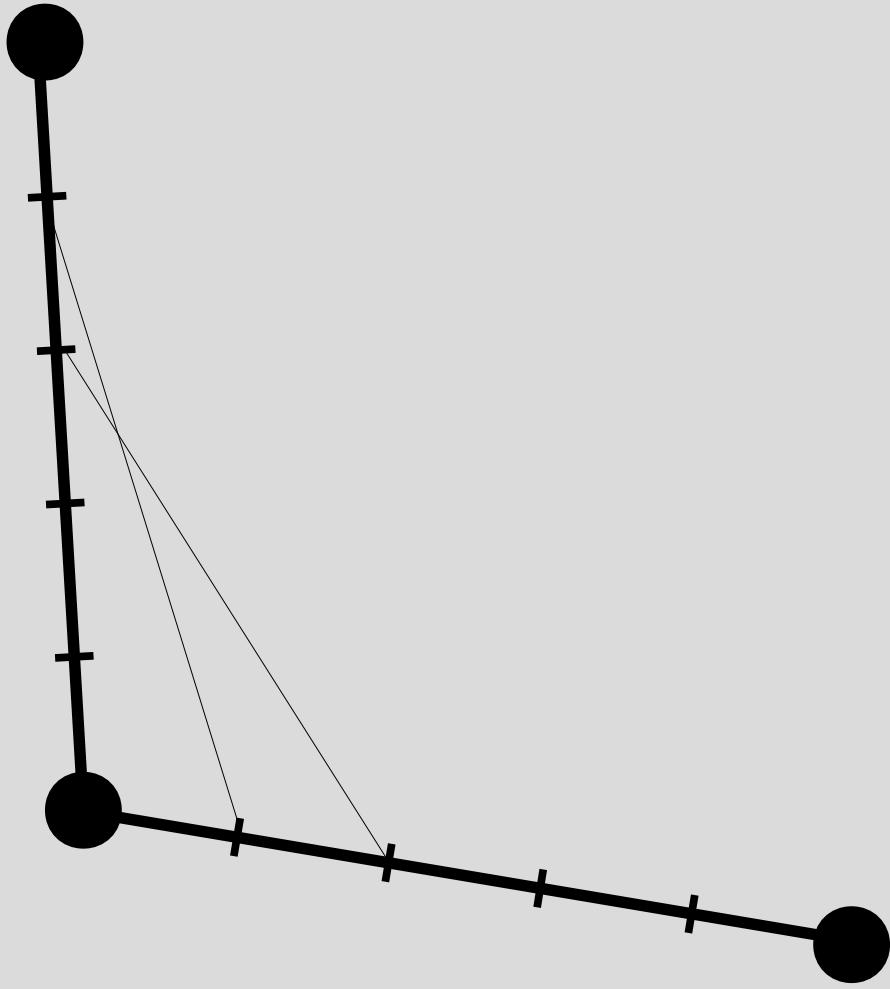
Curves



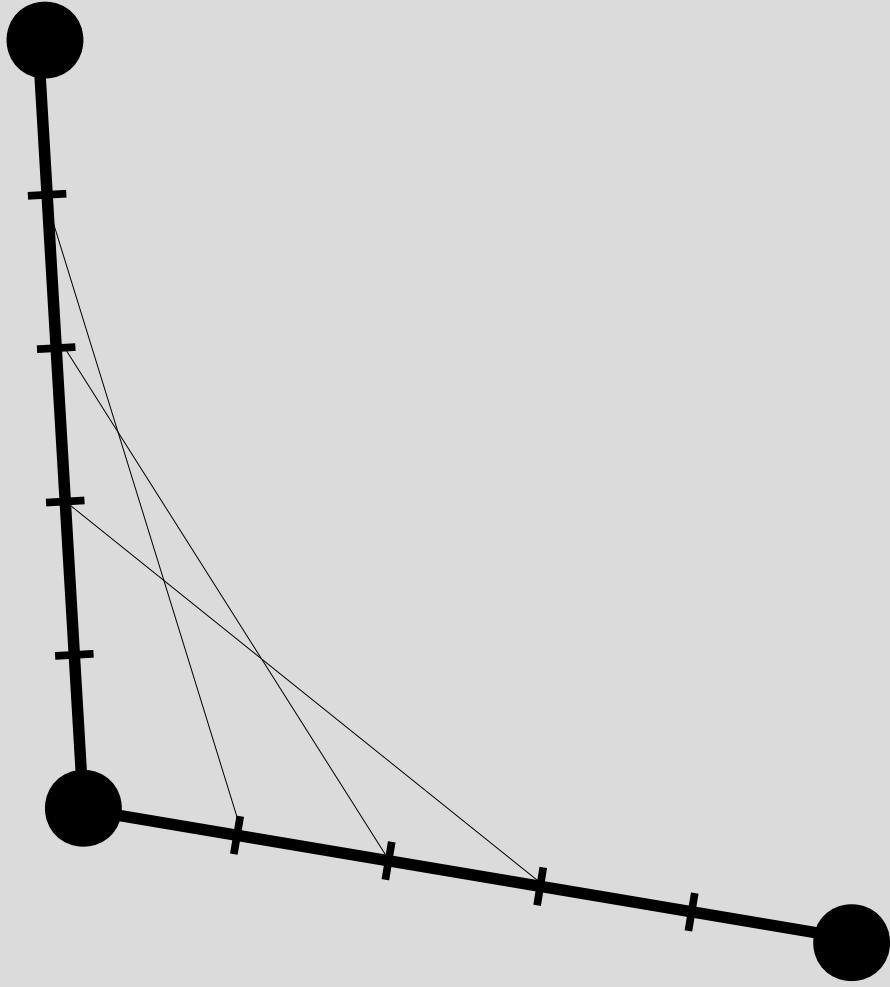
Curves



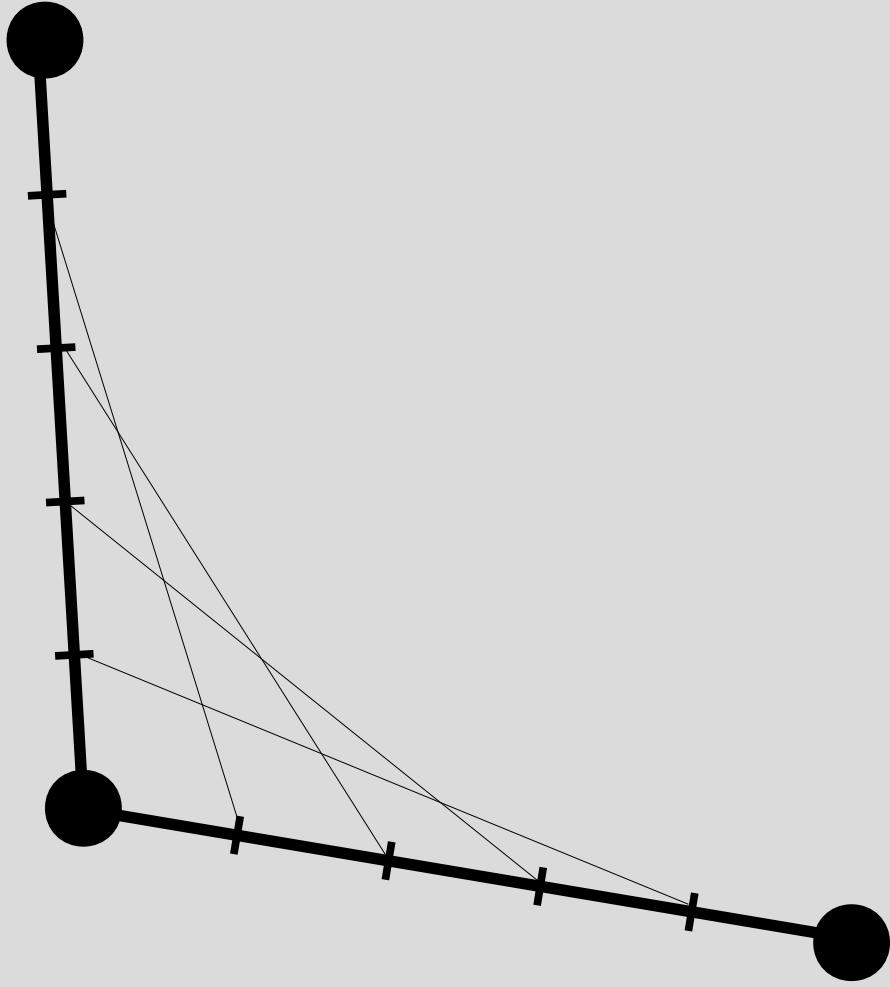
Curves



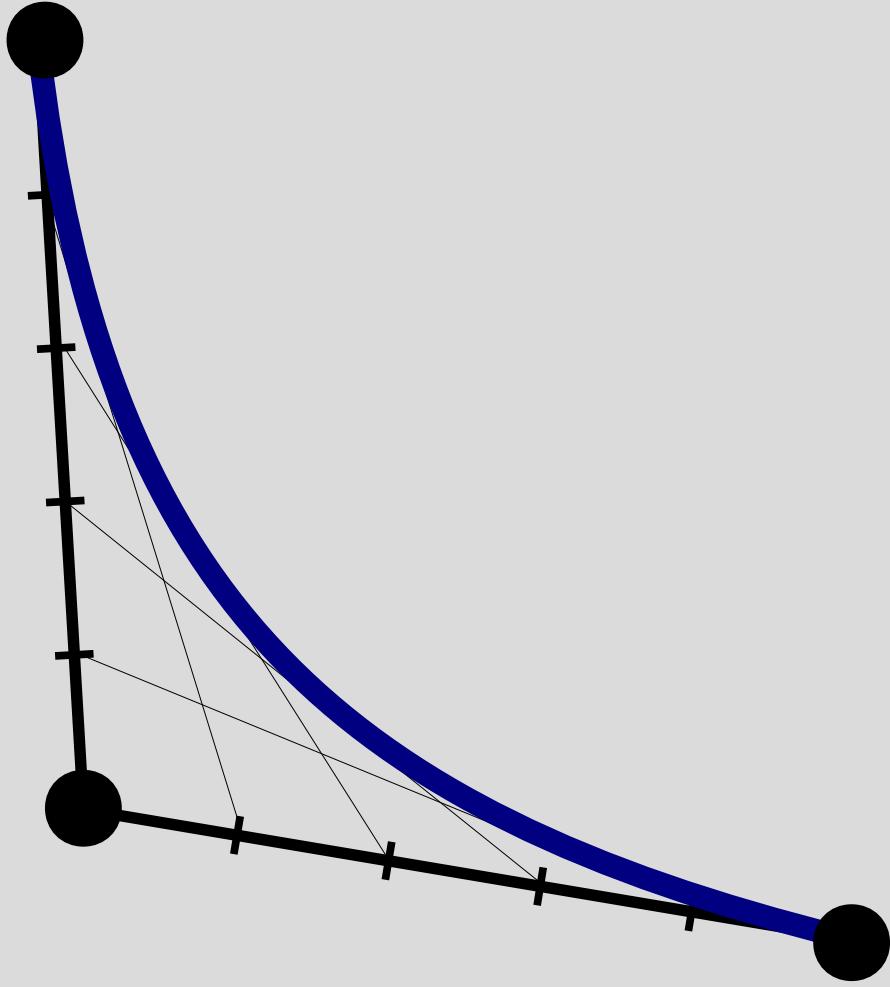
Curves



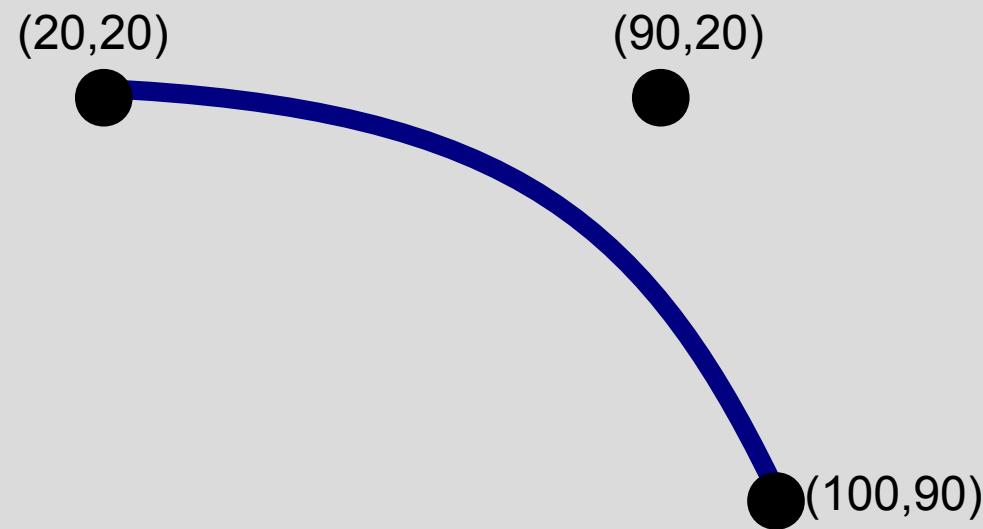
Curves



Curves



```
c.moveTo(20,20);  
c.quadraticCurveTo(90,20,100,90);  
c.stroke();
```



```
c.moveTo(20,20);  
c.quadraticCurveTo(90,20,100,90);  
c.stroke();
```

(20,20)



(90,20)



●(100,90)

```
c.moveTo(20,20);  
c.quadraticCurveTo(90,20,100,90);  
c.stroke();
```

(20,20)



(90,20)



(100,90)



```
c.moveTo(20,20);  
c.quadraticCurveTo(90,20,100,90);  
c.stroke();
```

(20,20)



(90,20)



(100,90)





```
c.moveTo(20,20);  
c.quadraticCurveTo(90,20,100,90);  
c.stroke();
```

(20,20)



(90,20)



(100,90)



c.moveTo(20,20);
c.quadraticCurveTo(90,20,100,90);
c.stroke();

(20,20)

(90,20)

(100,90)

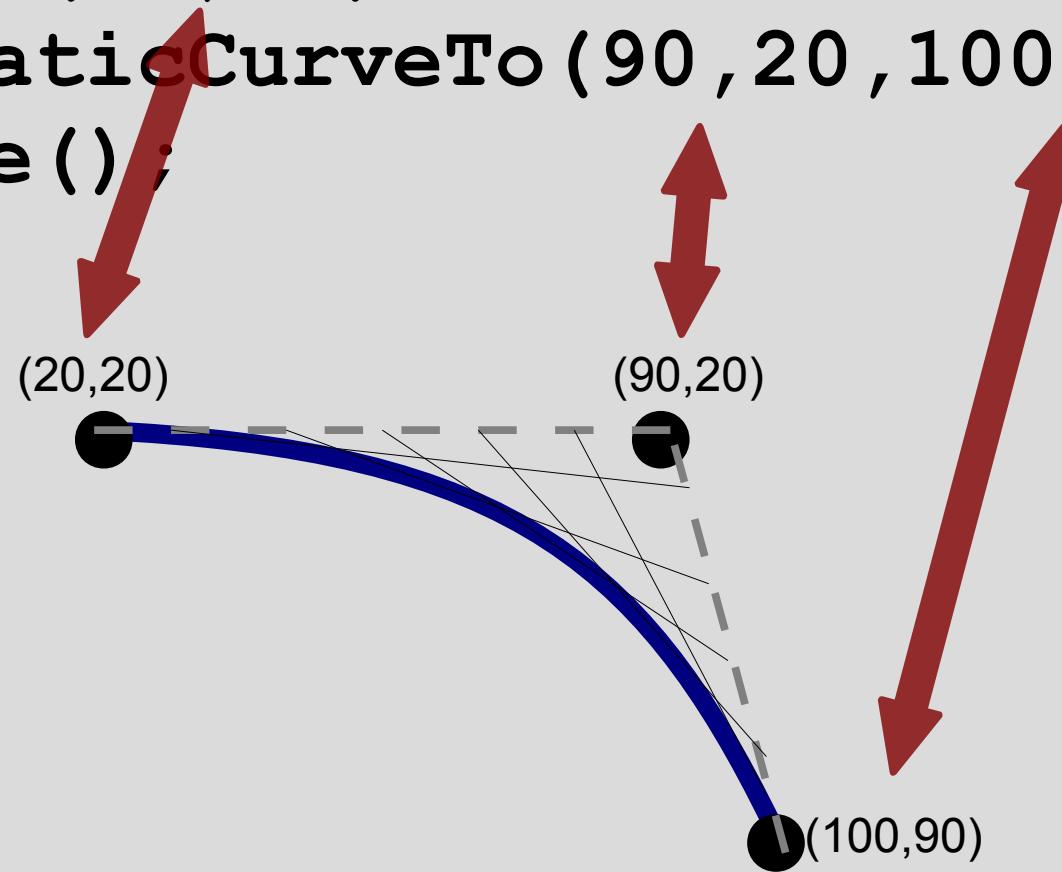
c.moveTo(20,20);
c.quadraticCurveTo(90,20,100,90);
c.stroke();

(20,20)

(90,20)

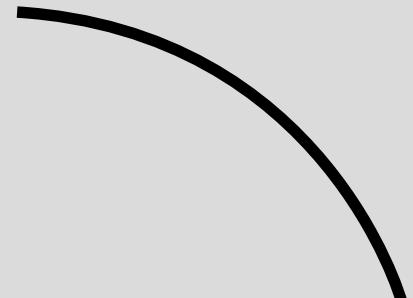
(100,90)

c.moveTo(20,20);
c.quadraticCurveTo(90,20,100,90);
c.stroke();

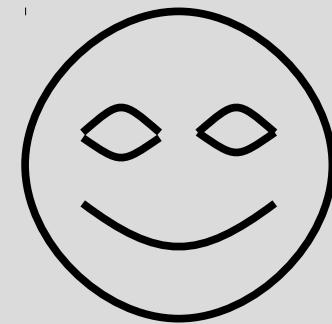
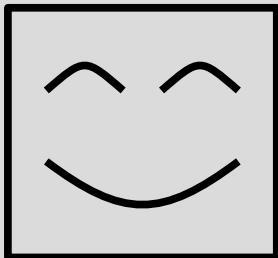
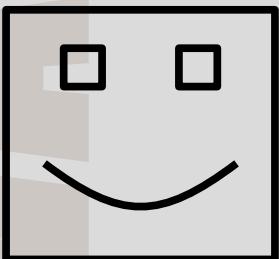


Drawing a Curve

```
c.moveTo(20,20);  
c.quadraticCurveTo(90,20,100,90);  
c.stroke();
```



Ideas



F12

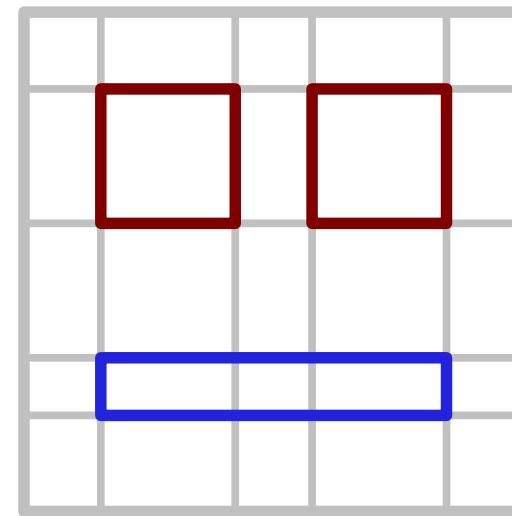
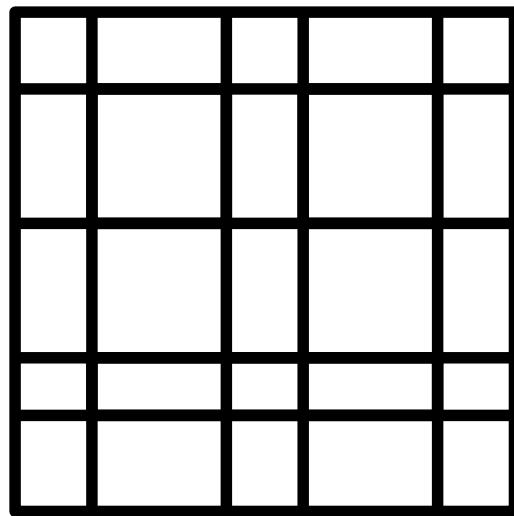


ctrl - shift ⌘ J



cmd ⌘ - option ⌘ alt - C

Colored Lines



Review

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.stroke();
```



Review

```
c.moveTo(20, 90);
```

```
c.lineTo(90, 90);
```

```
c.stroke();
```

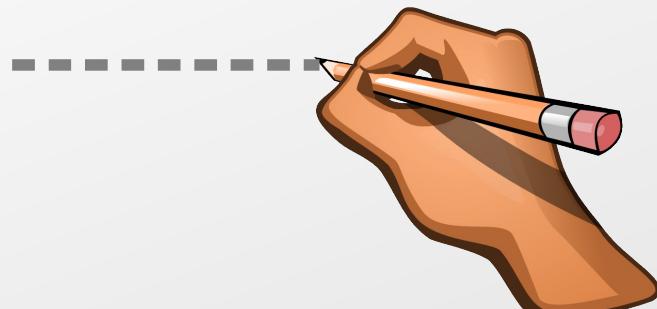


Review

```
c.moveTo(20, 90);
```

```
c.lineTo(90, 90);
```

```
c.stroke();
```



Review

```
c.moveTo(20, 90);
```

```
c.lineTo(90, 90);
```

```
c.stroke();
```



Colored Lines

```
c.moveTo(20, 90);
```

```
c.lineTo(90, 90);
```

```
c.strokeStyle = 'red';
```

```
c.stroke();
```



Colored Lines

```
c.moveTo(20, 90);
```

```
c.lineTo(90, 90);
```

```
c.strokeStyle = 'red';
```

```
c.stroke();
```



Colors

```
c.moveTo(20, 90);  
c.lineTo(90, 90);  
c.strokeStyle = 'red';  
c.stroke();
```

black

blue

brown

green

orange

purple

red

white

yellow

pink

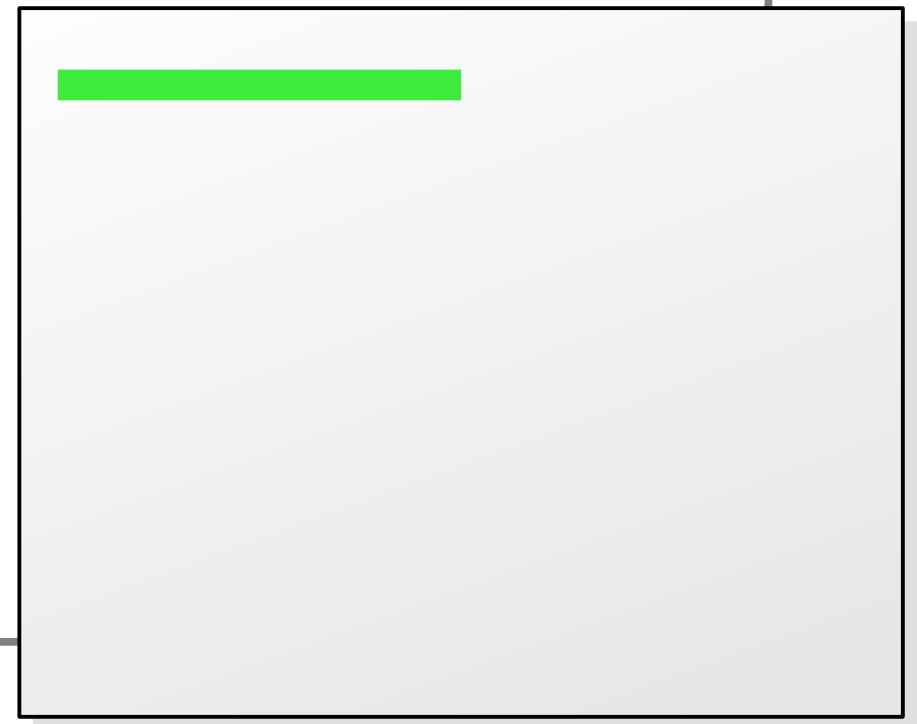
gray

Drawing Two Lines



Drawing Two Lines

```
c.moveTo(5, 5);  
c.lineTo(90, 5);  
c.strokeStyle='green';  
c.stroke();
```



Drawing Two Lines

```
c.moveTo(5, 5);  
c.lineTo(90, 5);  
c.strokeStyle='green';  
c.stroke();
```

```
c.moveTo(20, 20);  
c.lineTo(90, 20);  
c.strokeStyle='red';  
c.stroke();
```



Drawing Two Lines

```
c.moveTo(5, 5);  
c.lineTo(90, 5);  
c.strokeStyle='green';  
c.stroke();
```

```
c.moveTo(20, 20);  
c.lineTo(90, 20);  
c.strokeStyle='red';  
c.stroke();
```



Different Lines, Different Colors

```
c.moveTo(5,5);  
c.lineTo(90,5);  
c.strokeStyle='green';  
c.stroke();
```

```
c.beginPath();  
c.moveTo(20,20);  
c.lineTo(90,20);  
c.strokeStyle='red';  
c.stroke();
```



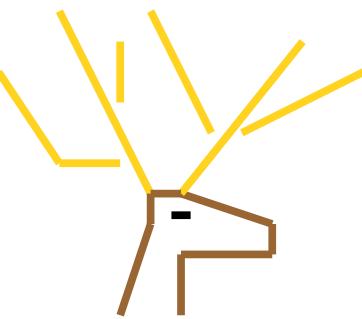
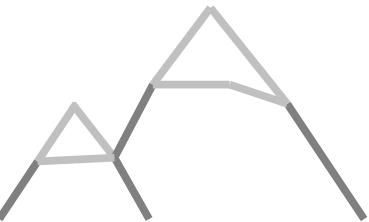
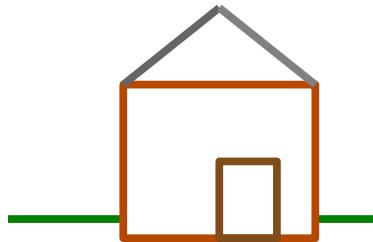
Colored Lines

```
c.beginPath();  
c.moveTo(20,20);  
c.lineTo(90,20);  
c.lineTo(90,90);  
c.strokeStyle='red';  
c.stroke();
```



black
blue
brown
green
orange
purple
red
white
yellow
pink
gray

Ideas



F12



ctrl - shift ⌘ J

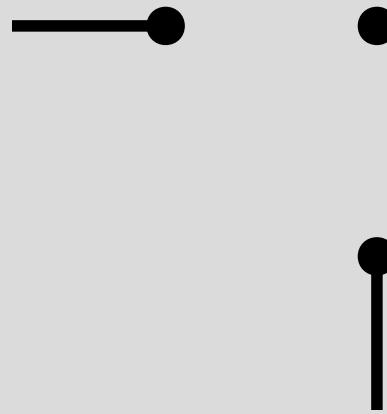


cmd ⌘ - option ⌘ alt - C

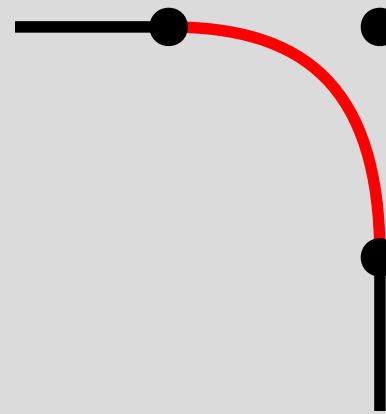
Crazy Curves



Crazy Curves



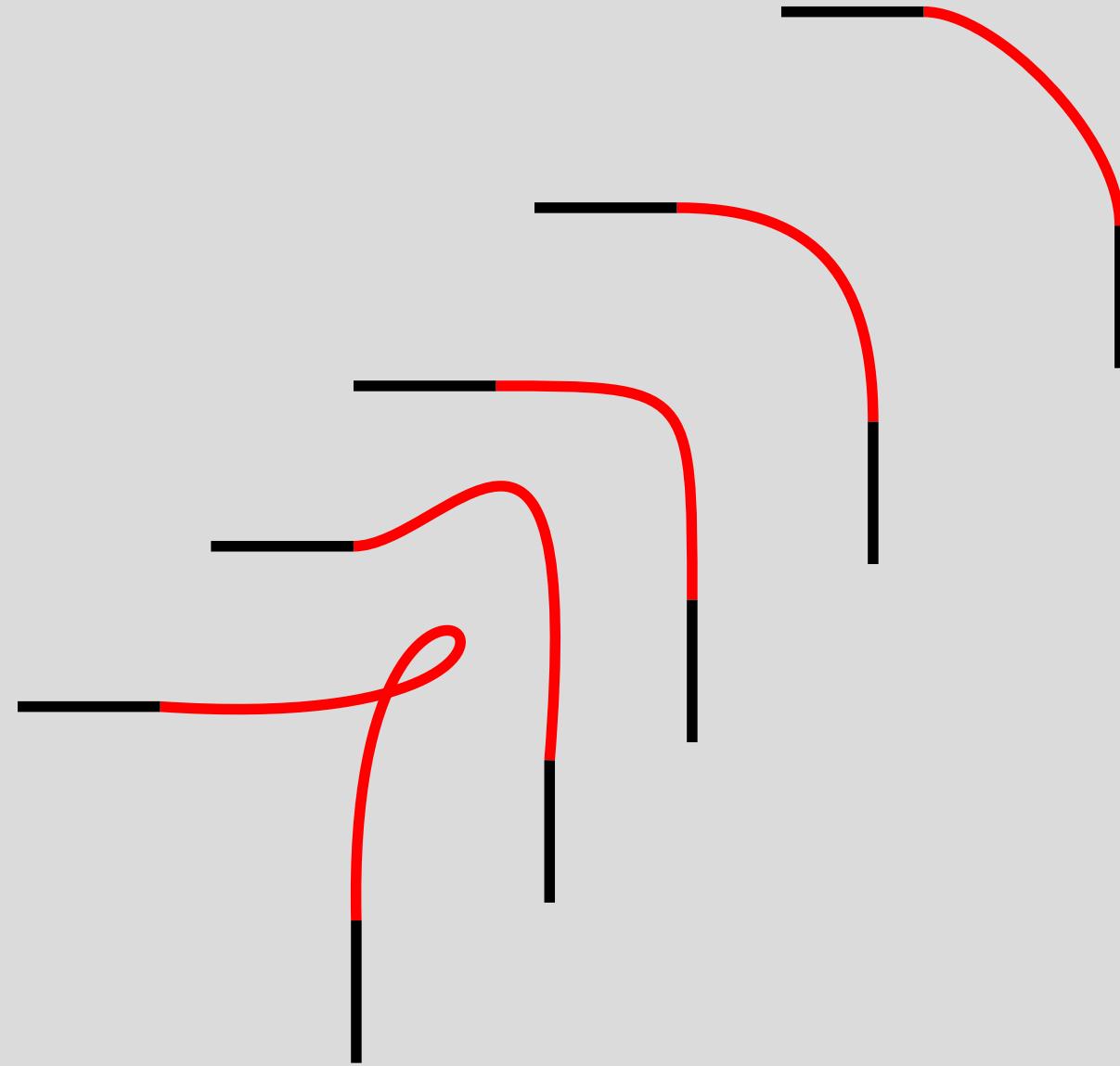
Crazy Curves



Crazy Curves

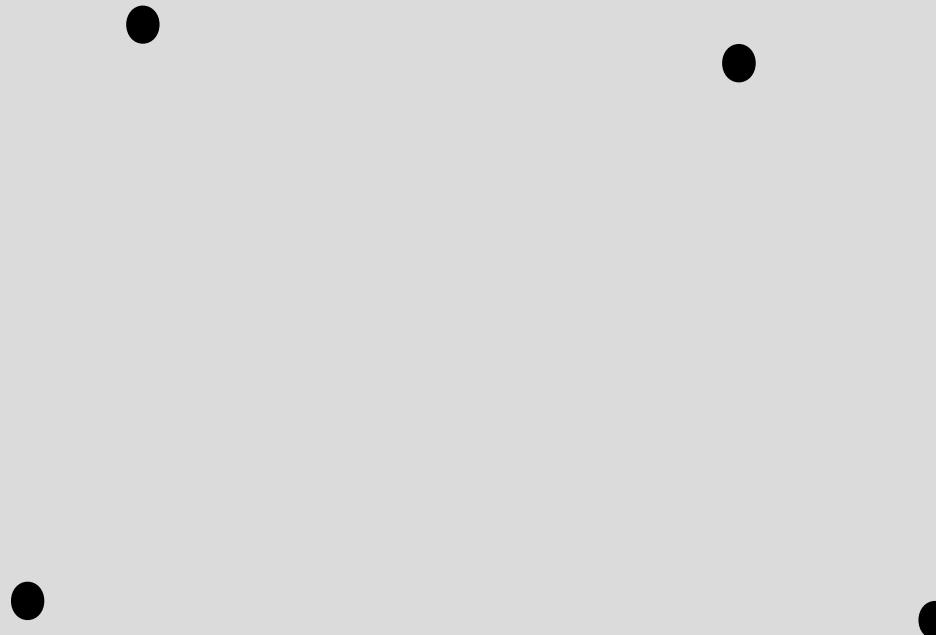


Crazy Curves



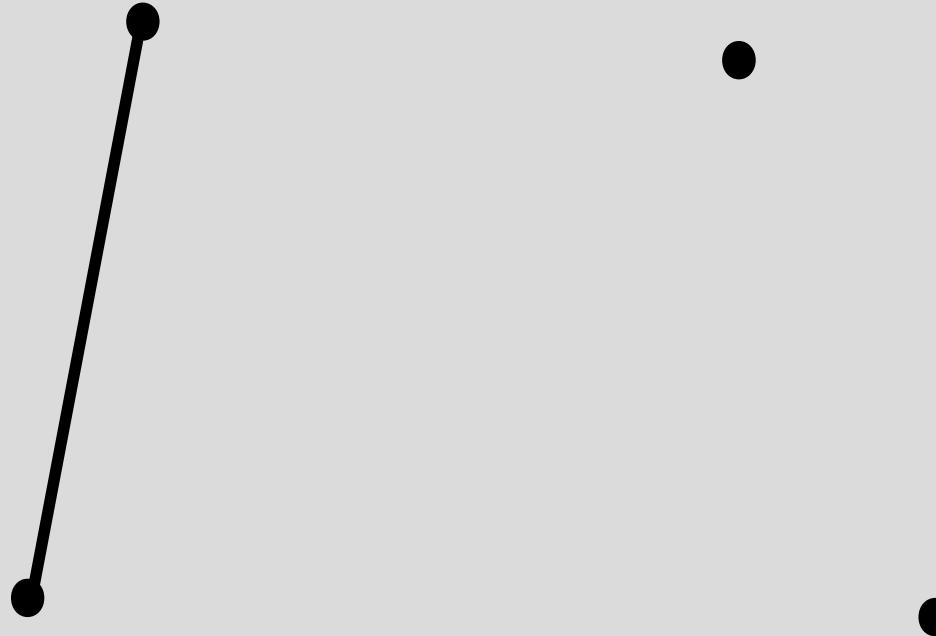
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



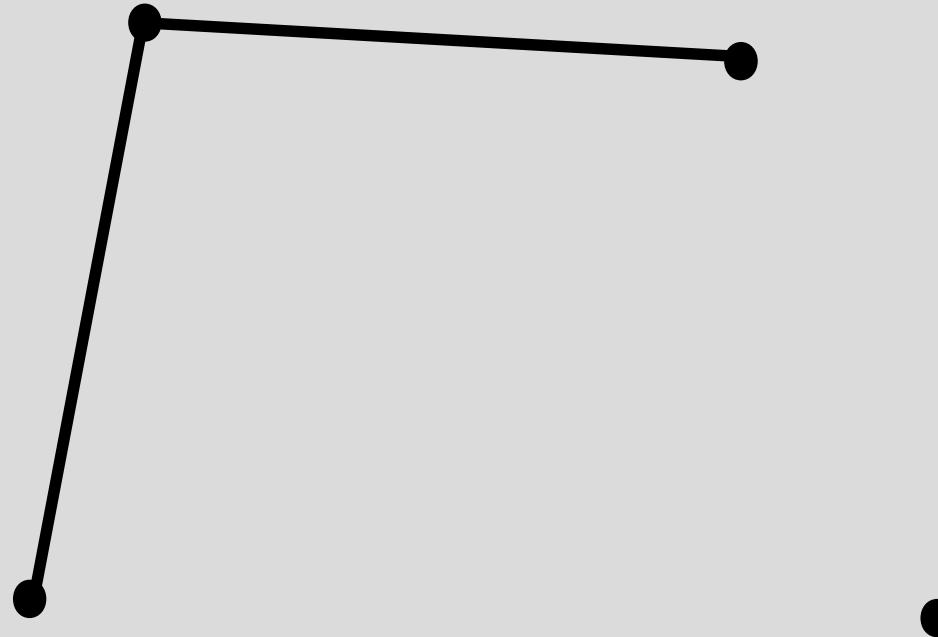
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



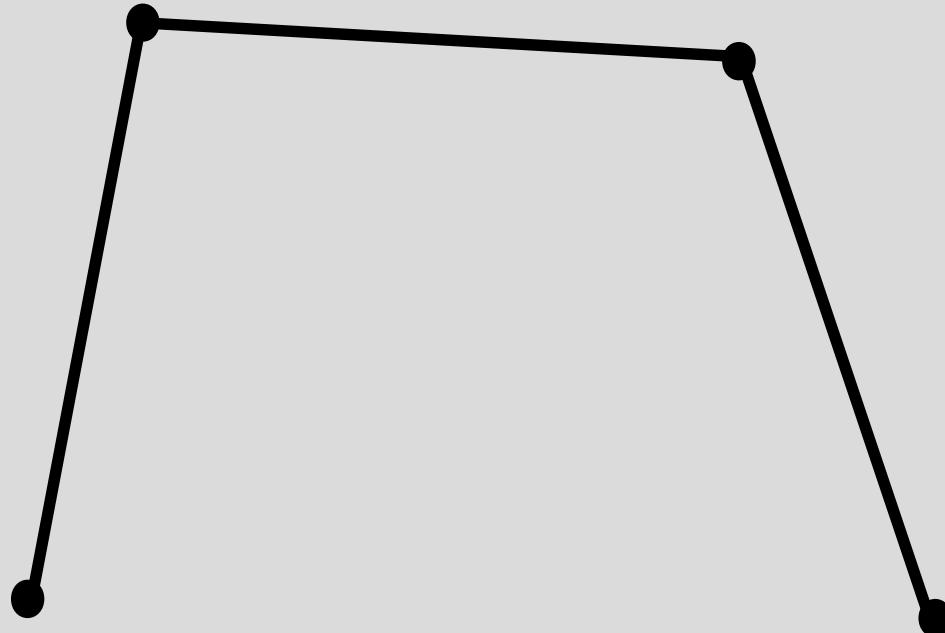
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



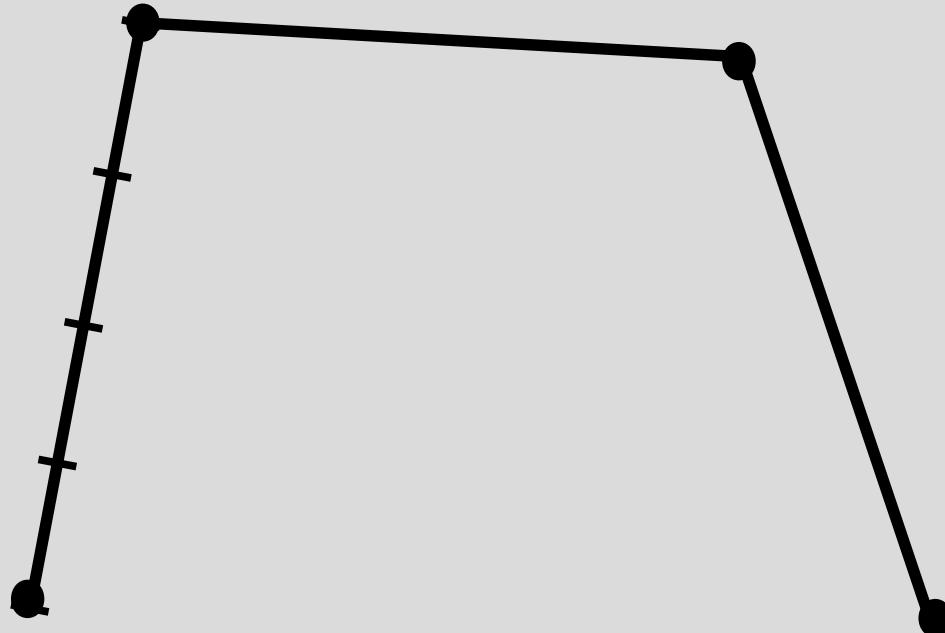
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



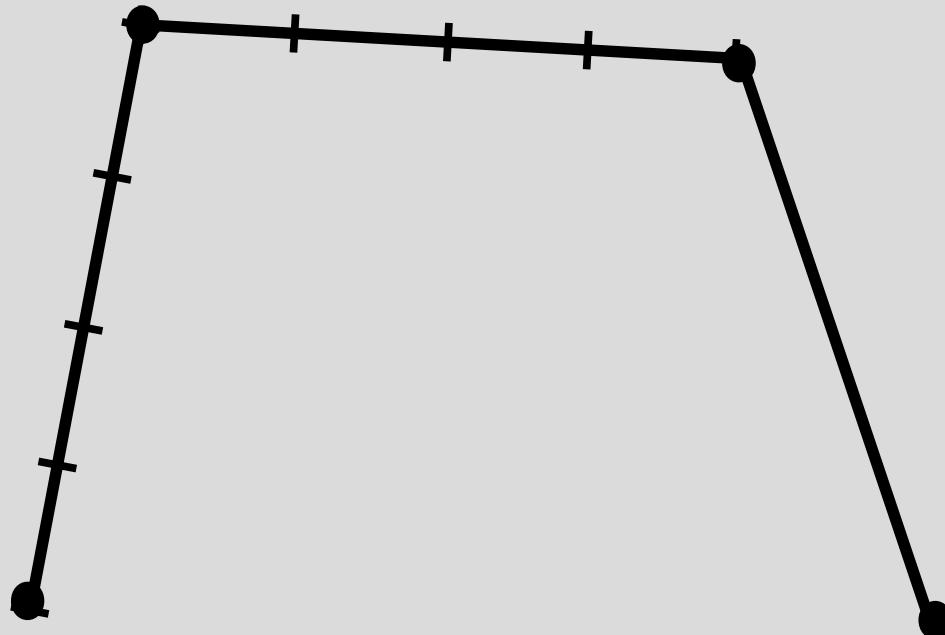
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



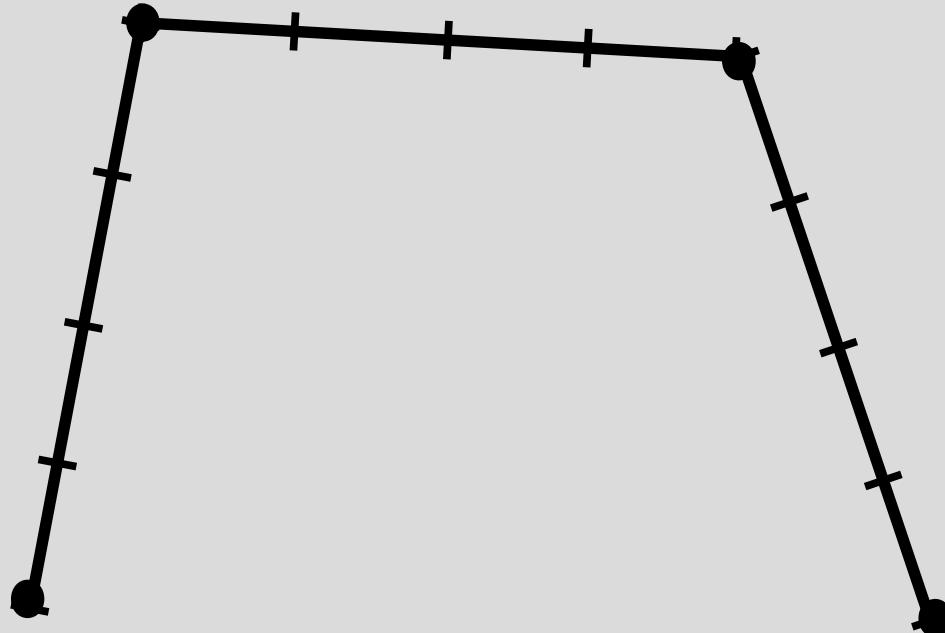
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



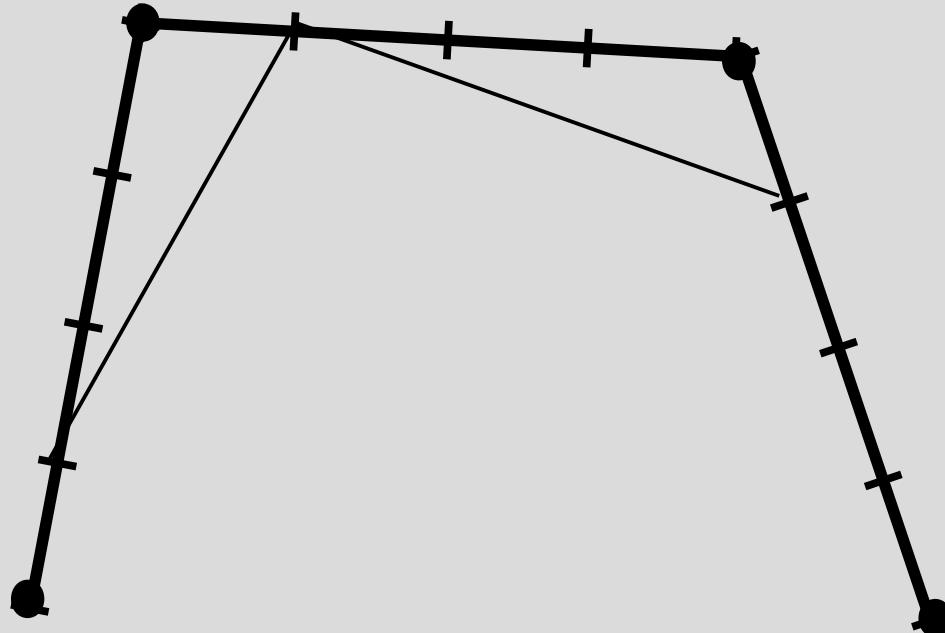
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



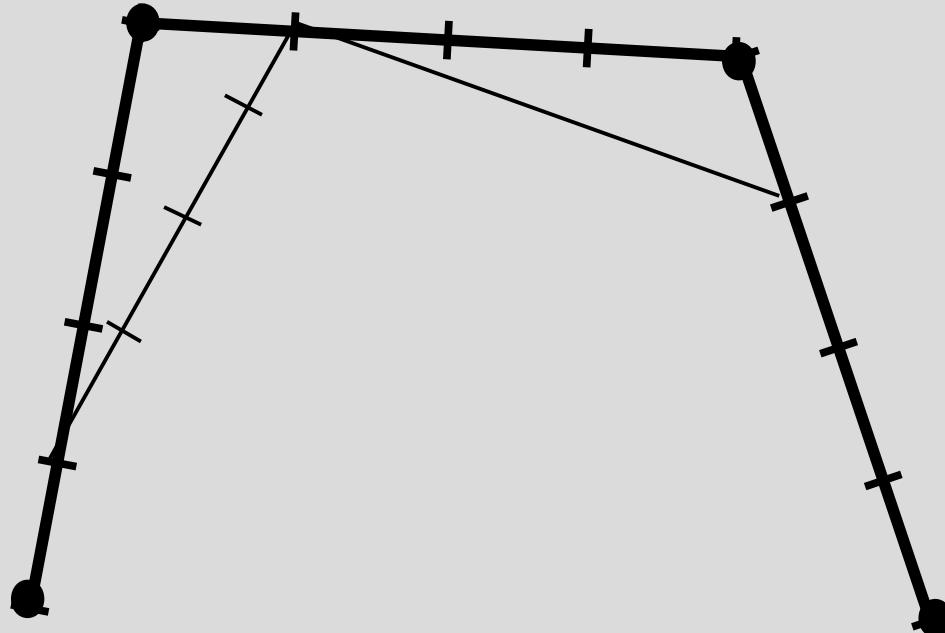
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



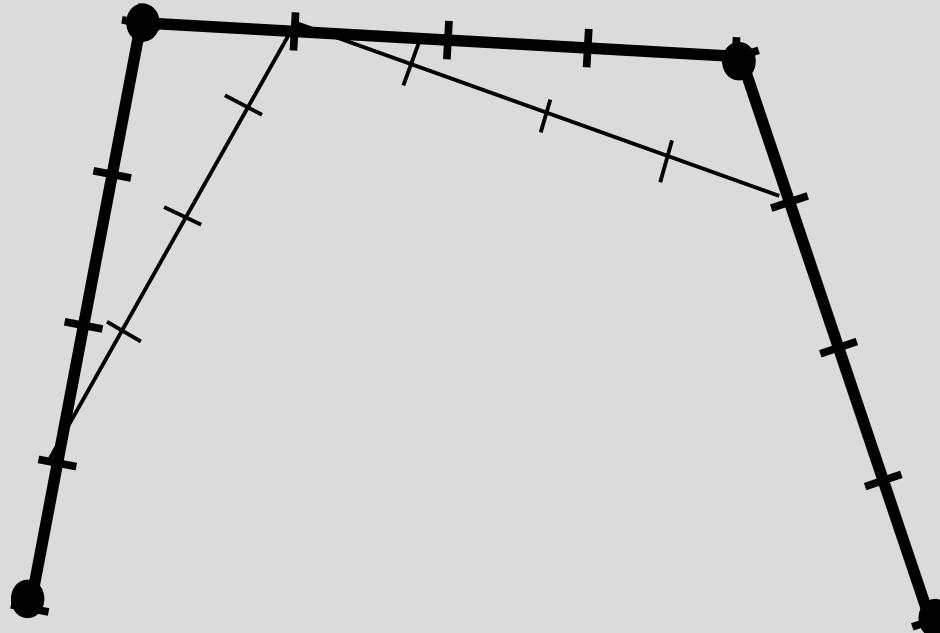
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



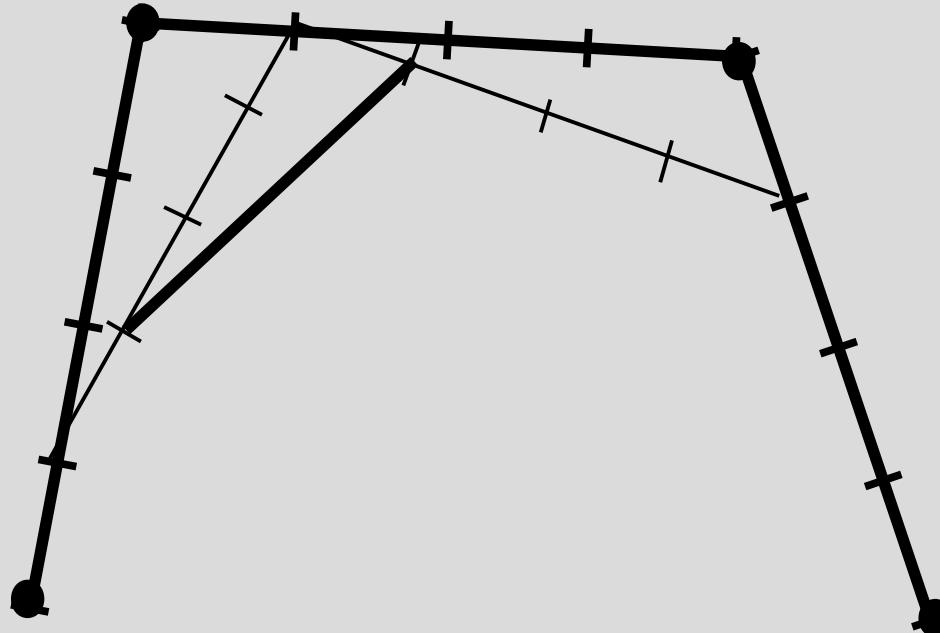
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



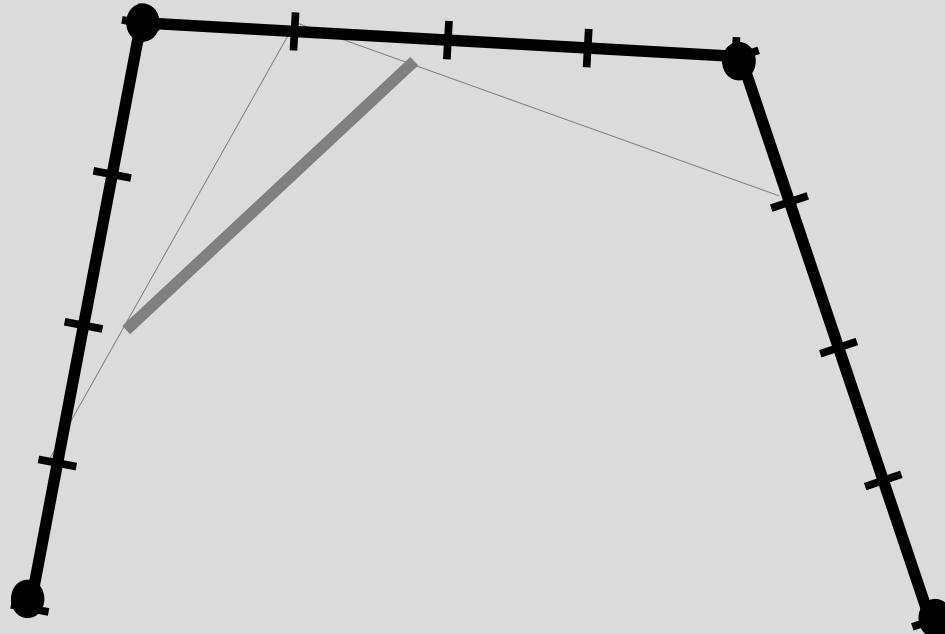
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



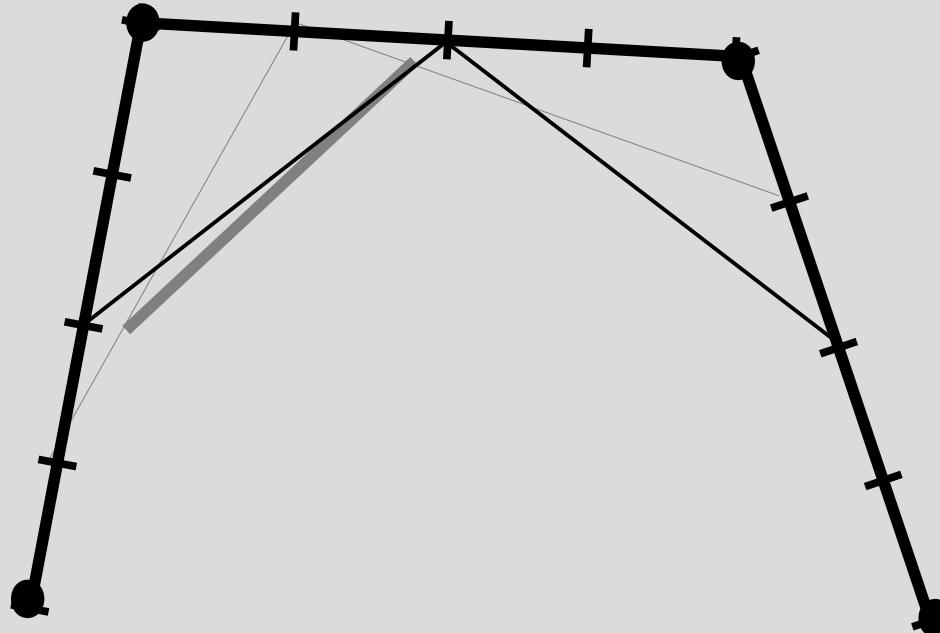
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



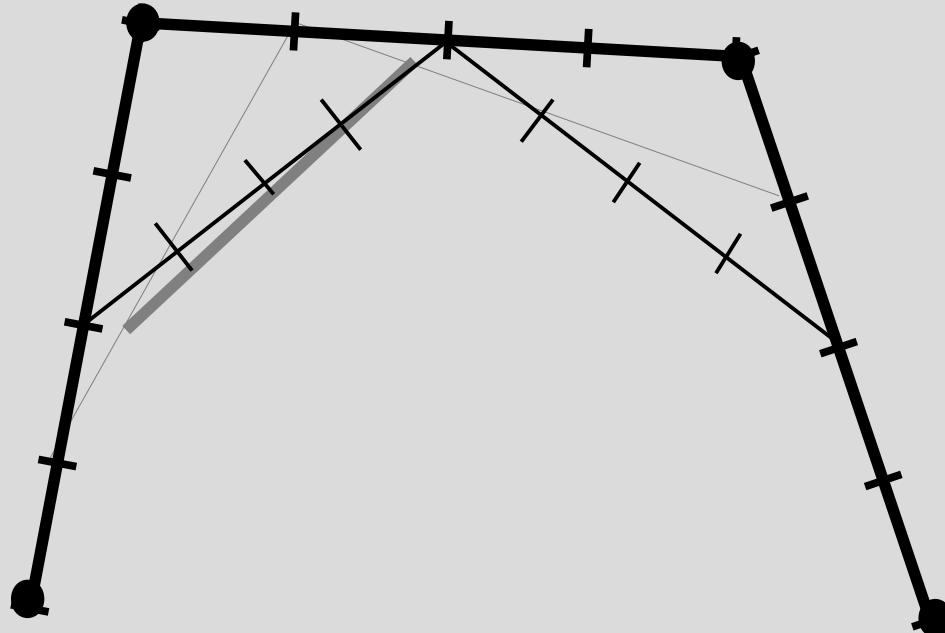
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



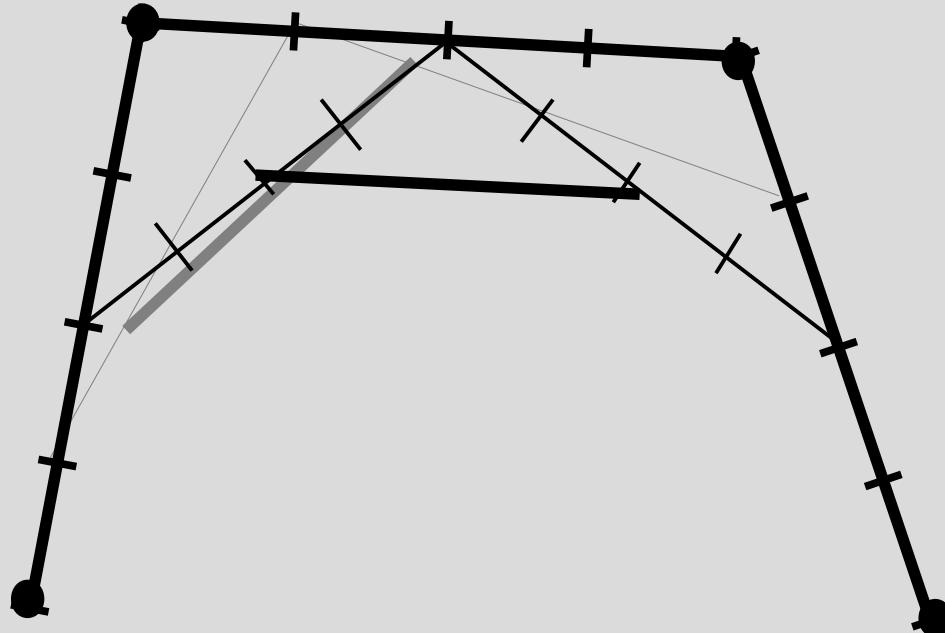
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



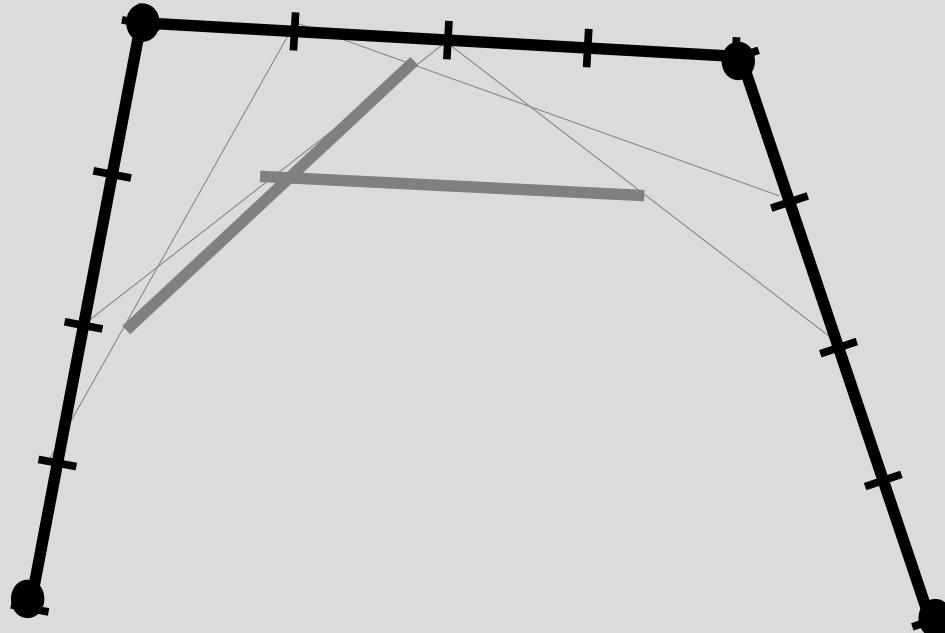
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



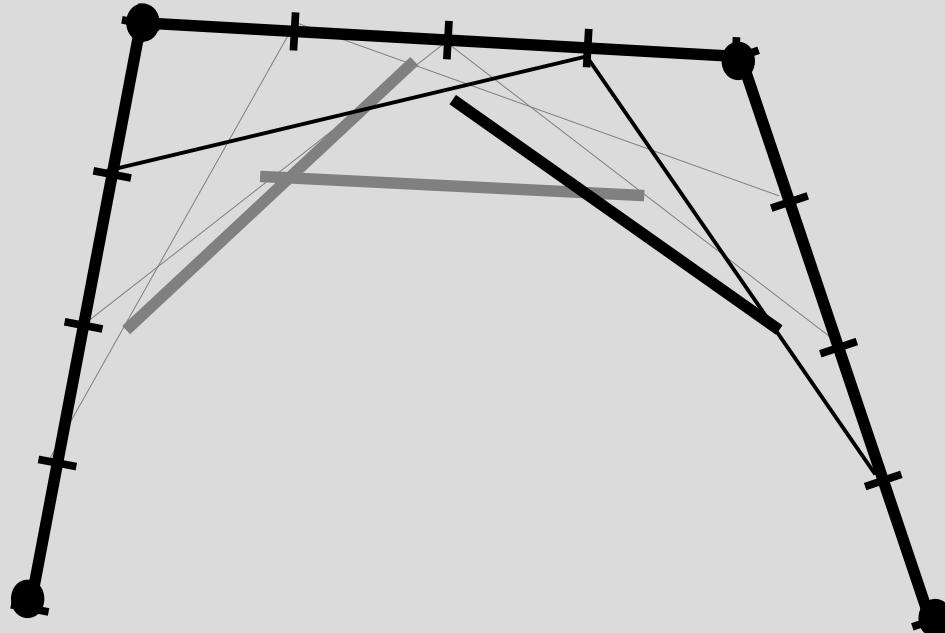
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



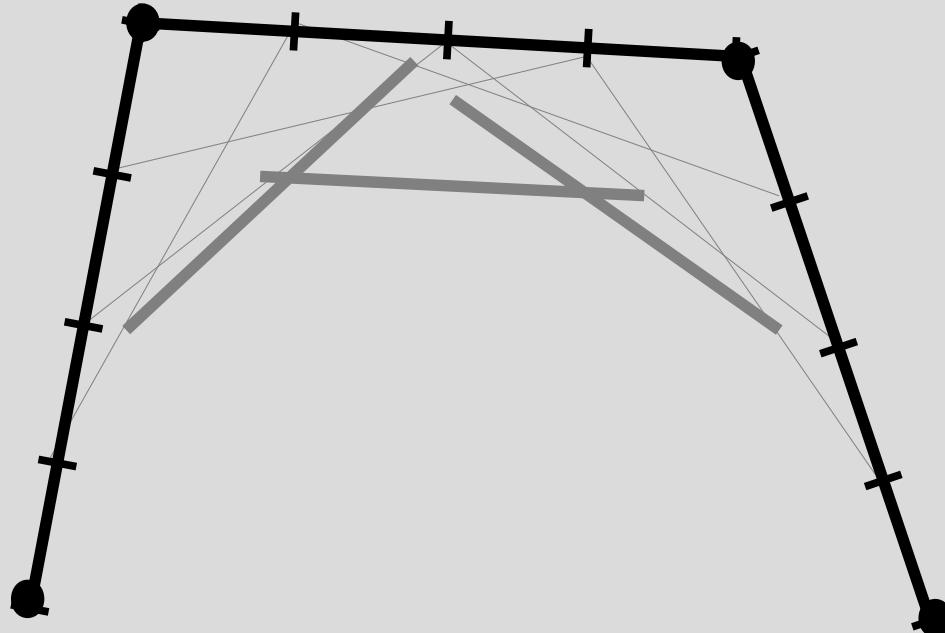
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



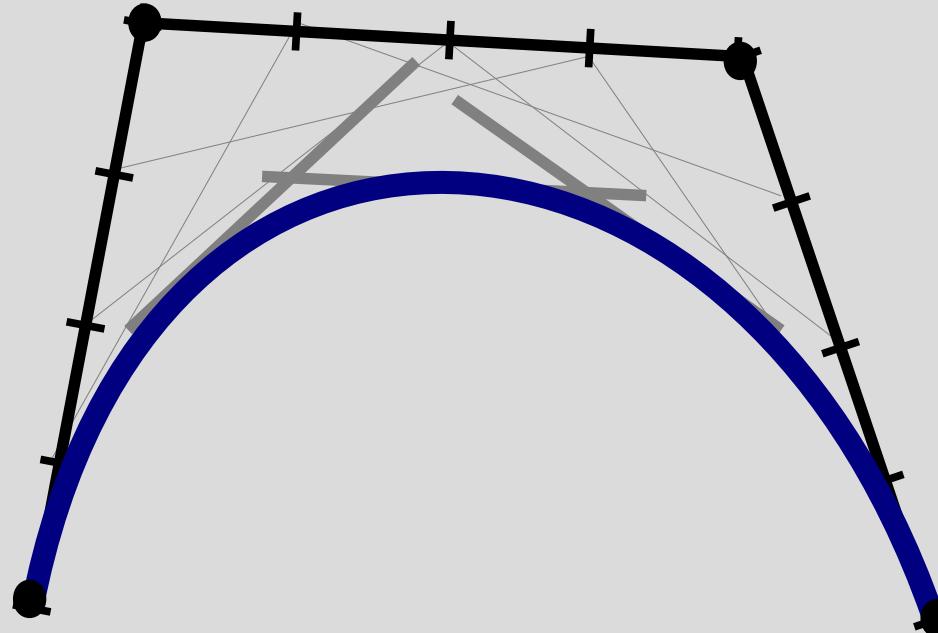
4 Point Bezier Curve

- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s

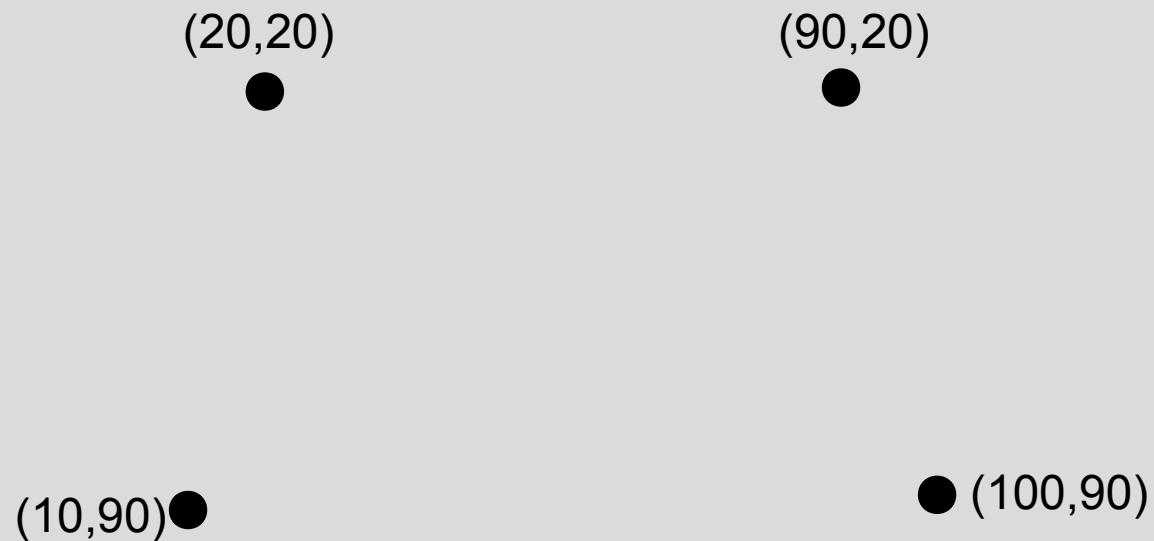


4 Point Bezier Curve

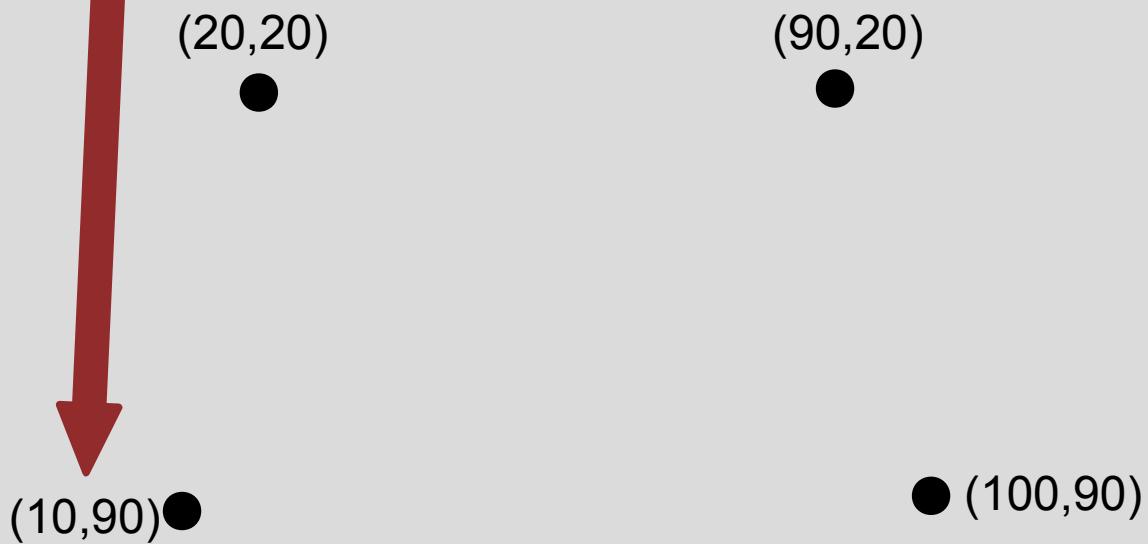
- Invented by French mathematicians/engineers around 1960
- Adobe used them in computer graphics in the 1980s



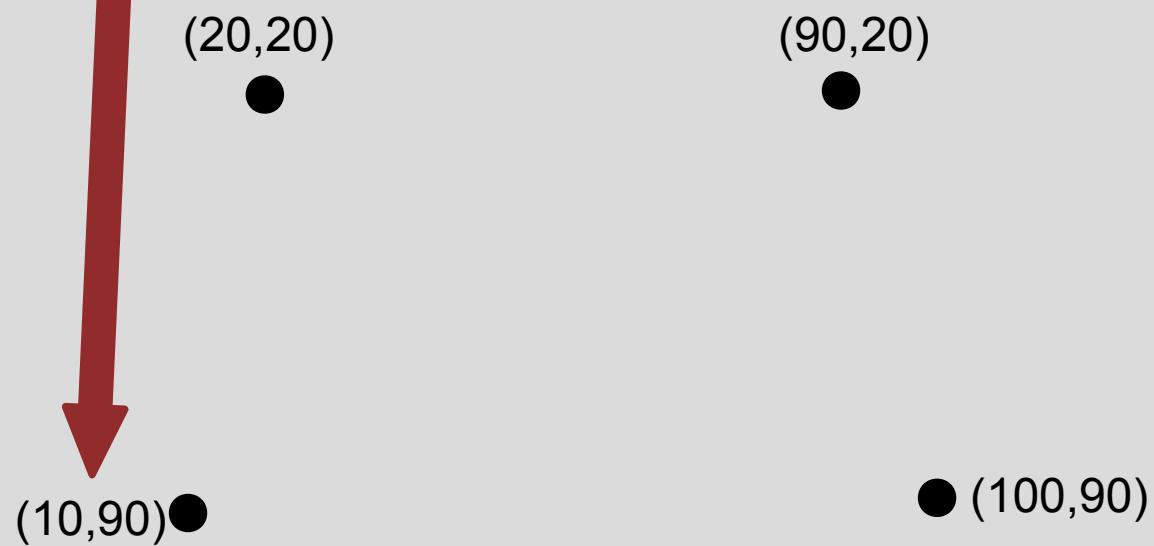
```
c.moveTo(10,90);  
c.bezierCurveTo(20,20,90,20,100,90);  
c.stroke();
```



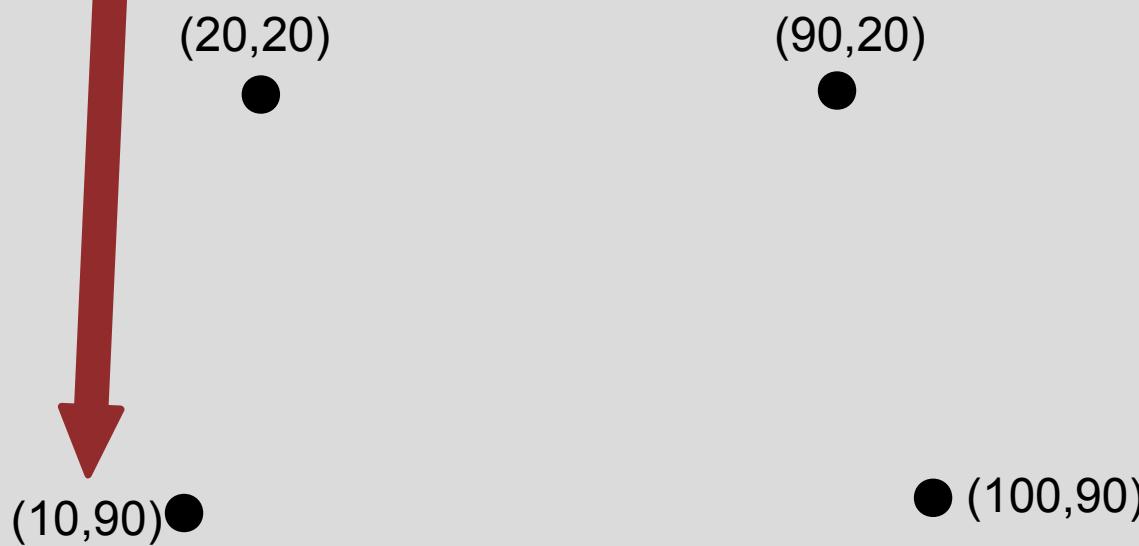
```
c.moveTo(10,90);  
c.bezierCurveTo(20,20,90,20,100,90);  
c.stroke();
```



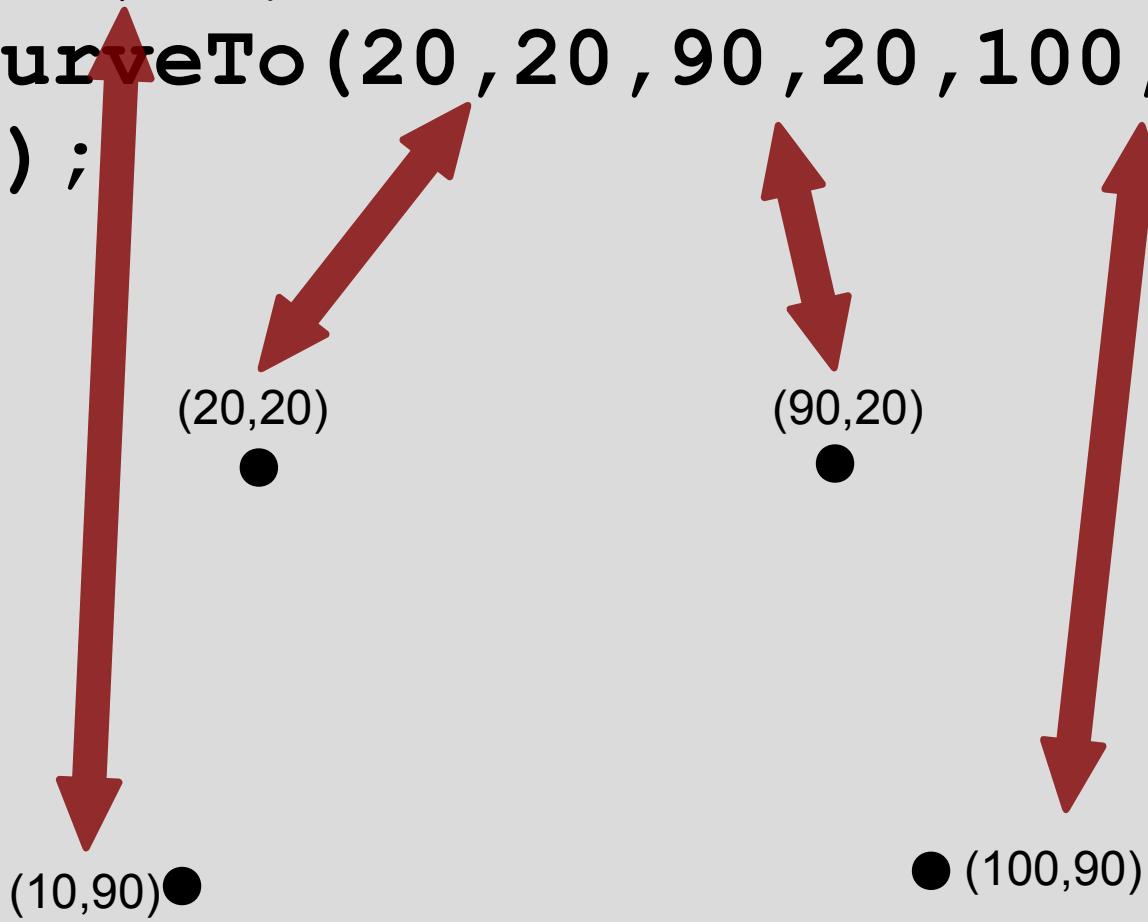
c.moveTo(10, 90);
c.bezierCurveTo(20, 20, 90, 20, 100, 90);
c.stroke();



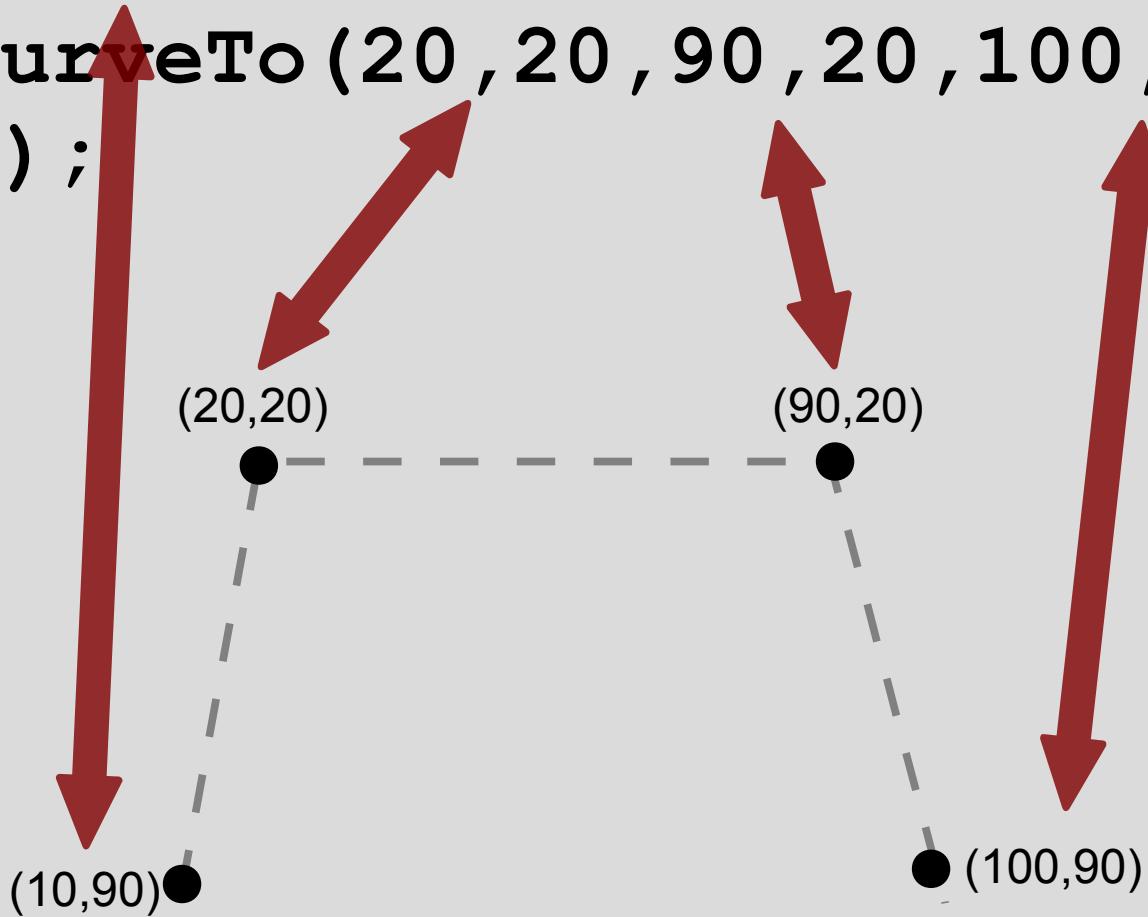
c.moveTo(10, 90);
c.bezierCurveTo(20, 20, 90, 20, 100, 90);
c.stroke();



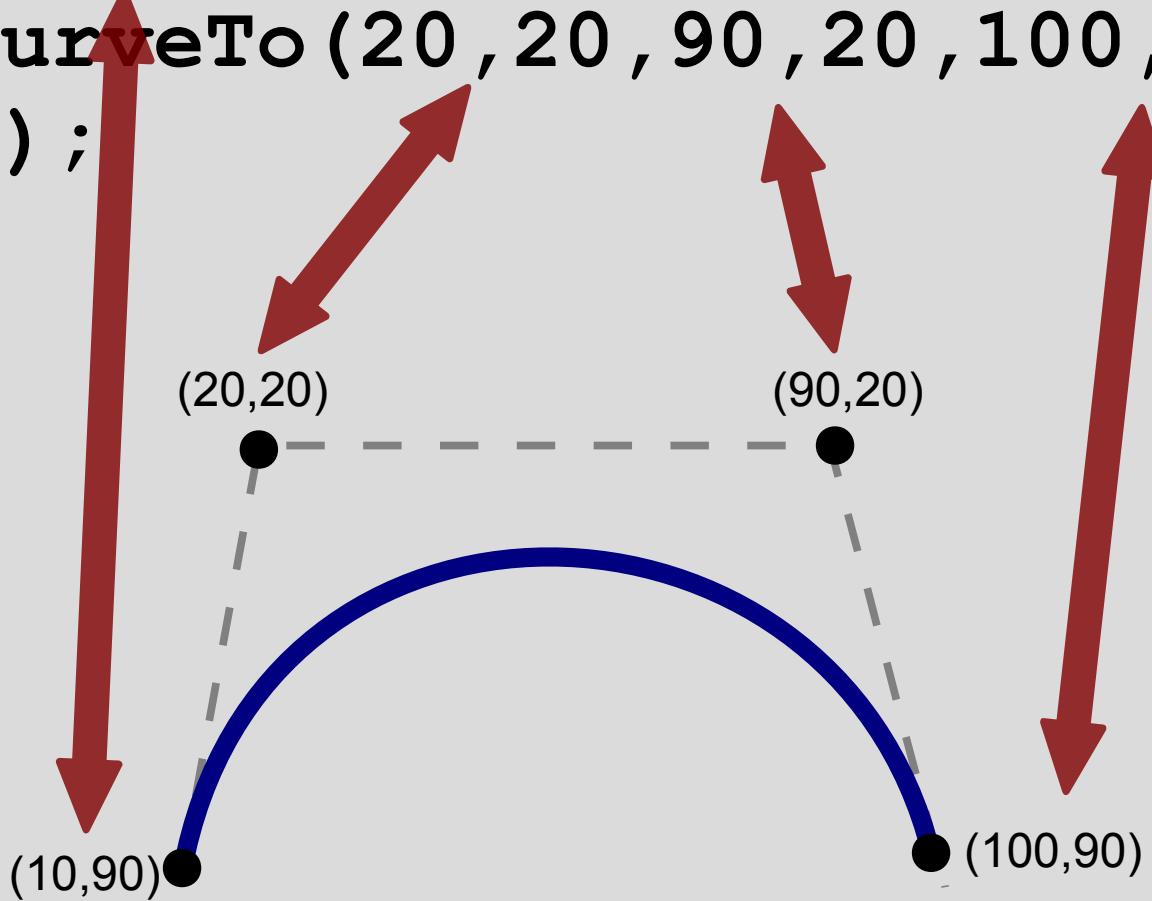
`c.moveTo(10, 90);
c.bezierCurveTo(20,20,90,20,100,90);
c.stroke();`



`c.moveTo(10, 90);
c.bezierCurveTo(20,20,90,20,100,90);
c.stroke();`

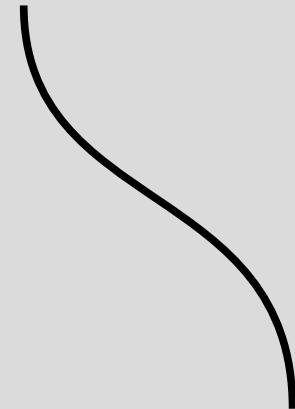


`c.moveTo(10, 90);
c.bezierCurveTo(20,20,90,20,100,90);
c.stroke();`

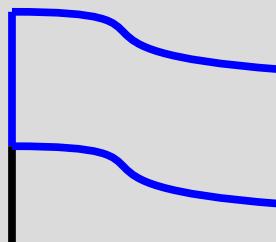
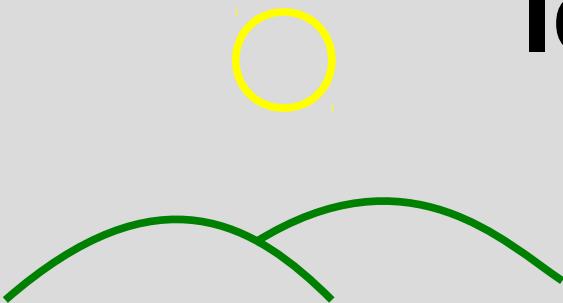


Bezier Curves

```
c.beginPath();  
c.moveTo(10,10);  
c.bezierCurveTo(10,50,90,50,90,90);  
c.stroke();
```



Ideas



F12

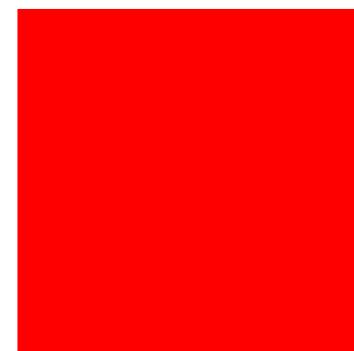
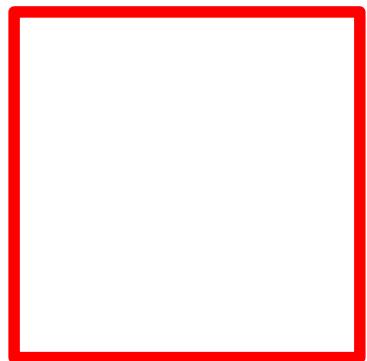


ctrl - shift ⌘ J



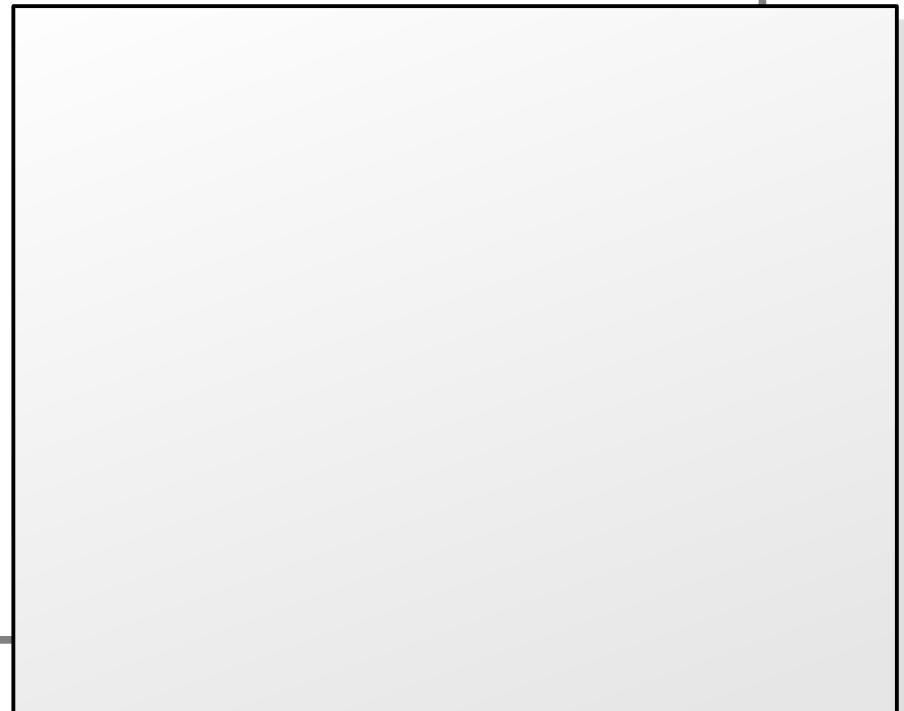
cmd ⌘ - option ⌘ alt - C

Filled Shapes



Drawing Shapes

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



Drawing Shapes

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



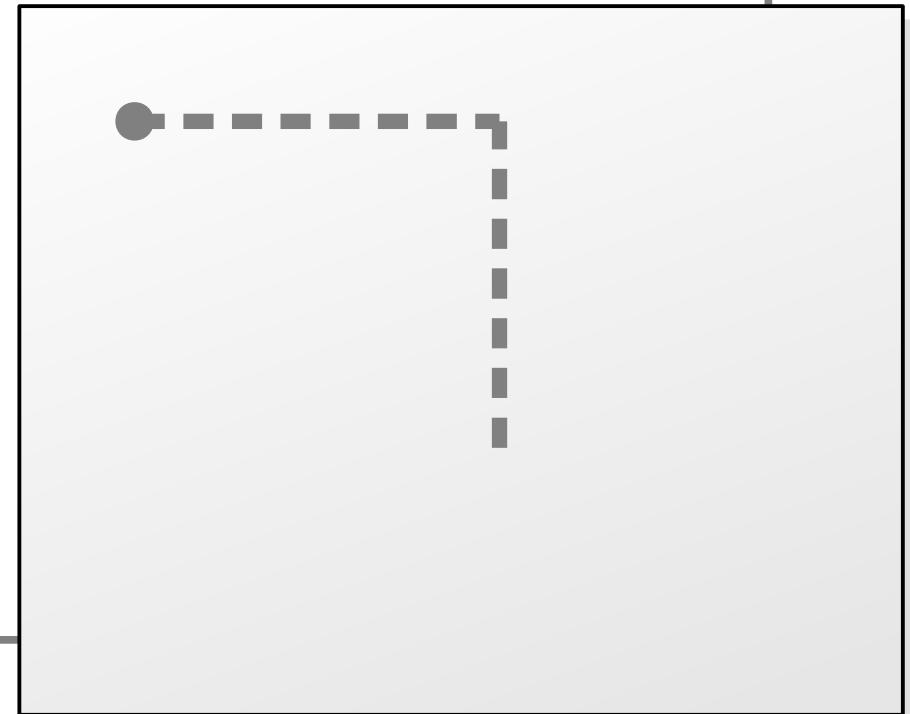
Drawing Shapes

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



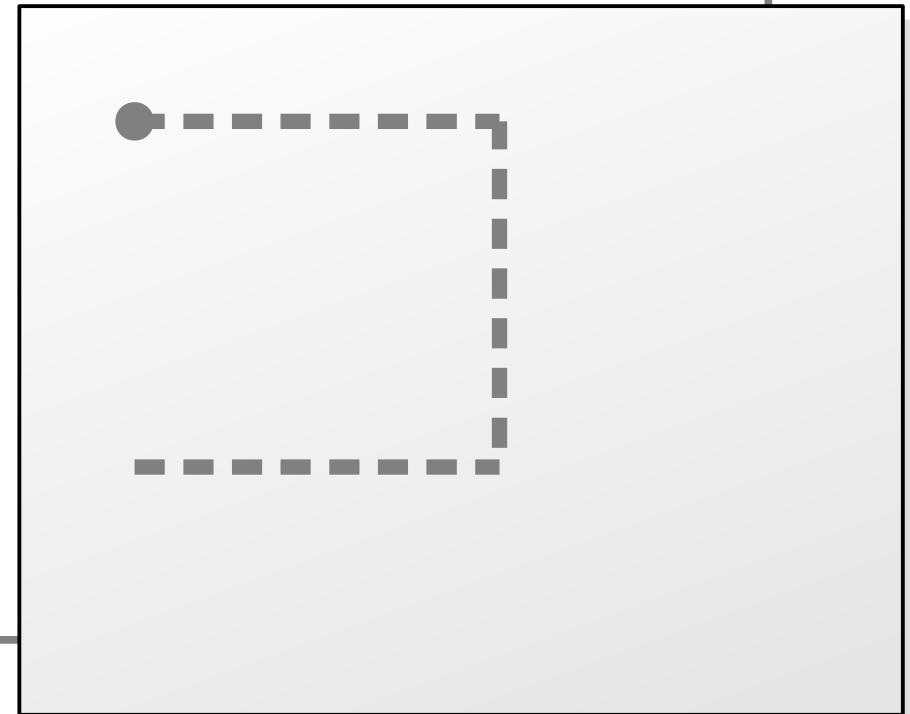
Drawing Shapes

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



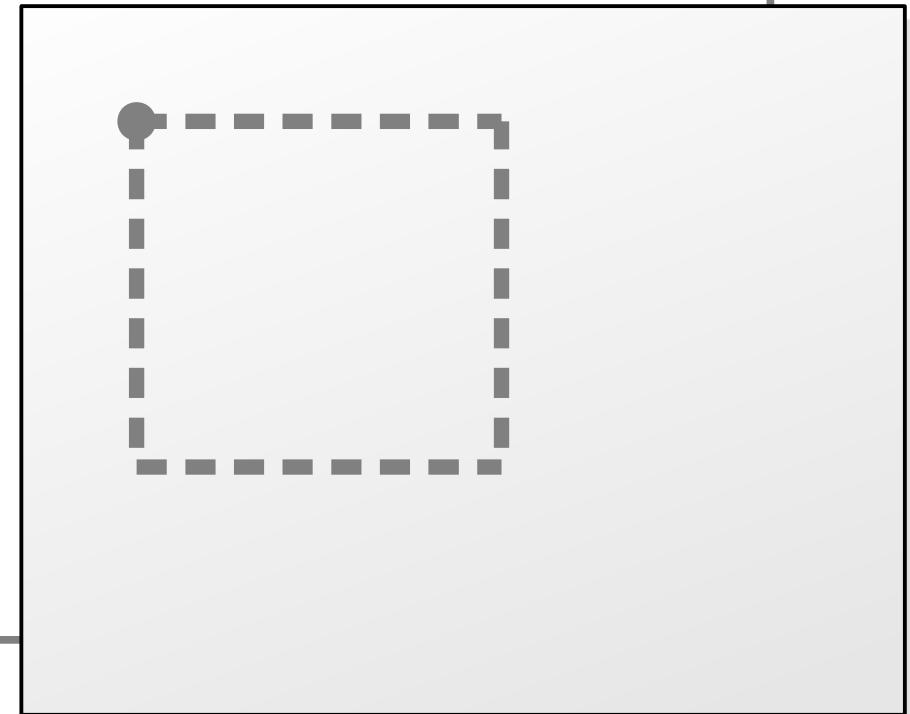
Drawing Shapes

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



Drawing Shapes

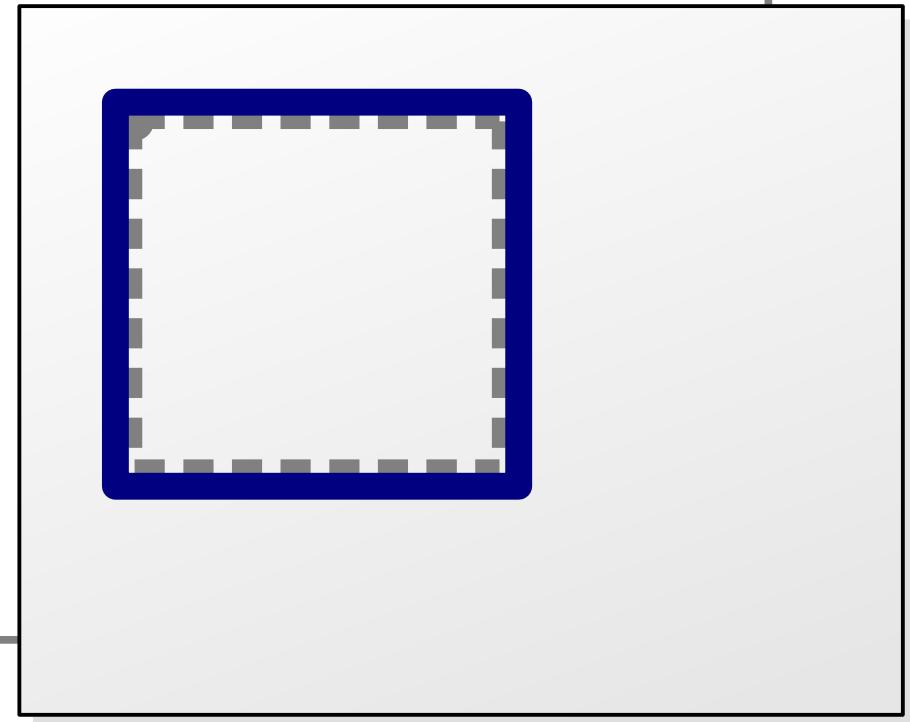
```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



Drawing Shapes

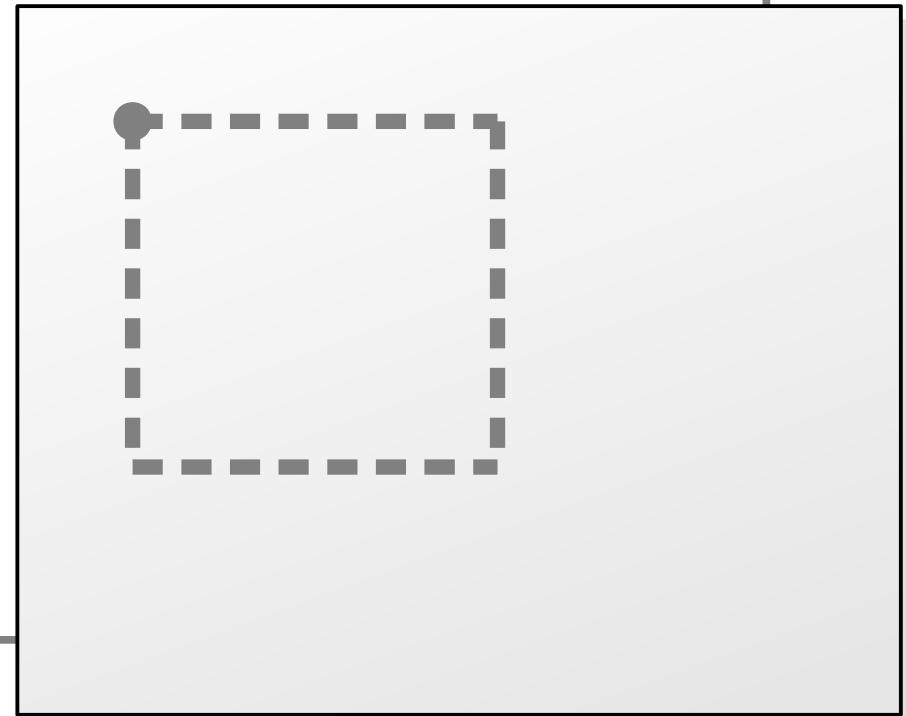
```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);
```

```
c.stroke();
```



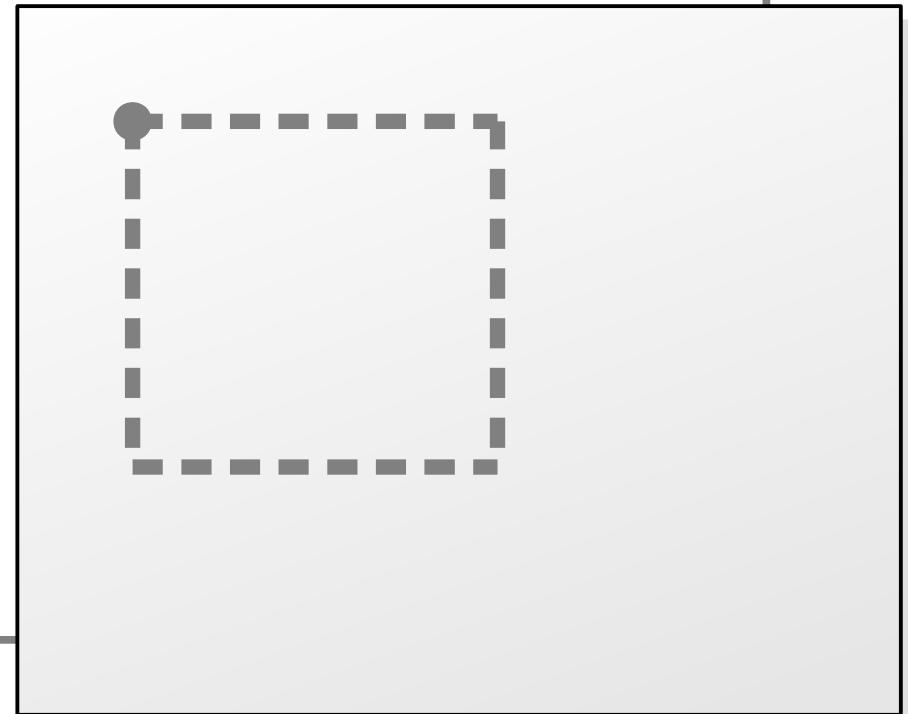
Fills

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();
```



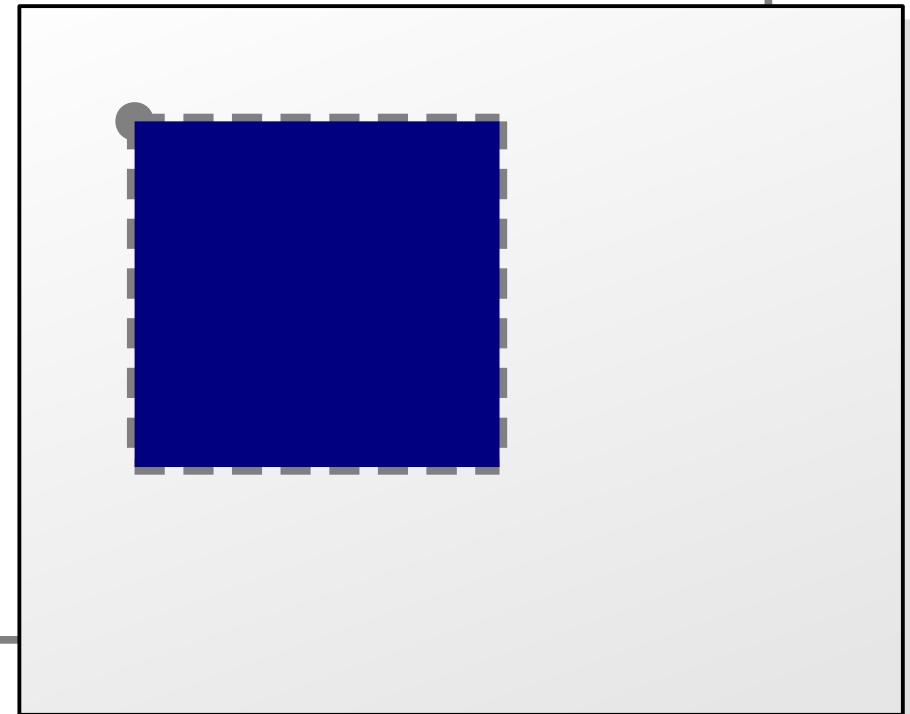
Fills

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();  
c.fill();
```



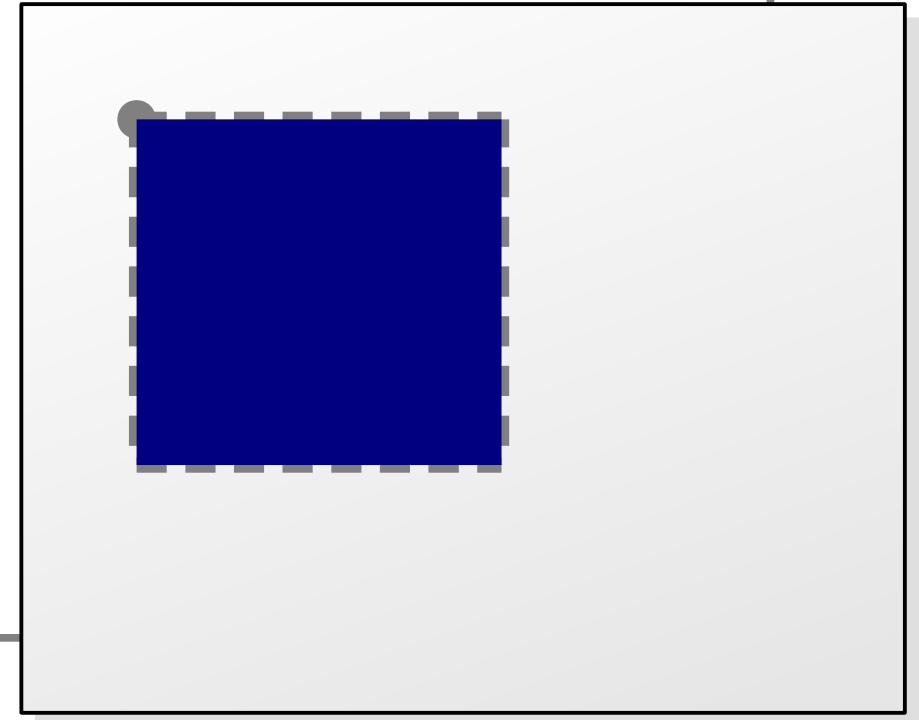
Fills

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.stroke();  
c.fill();
```



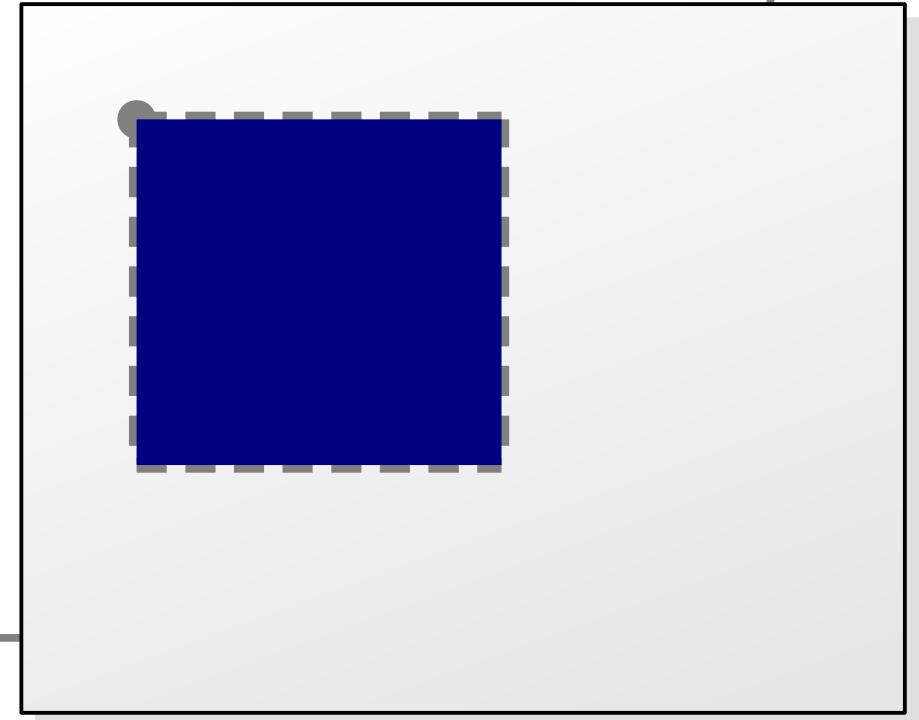
Colored Fills

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.fill();
```



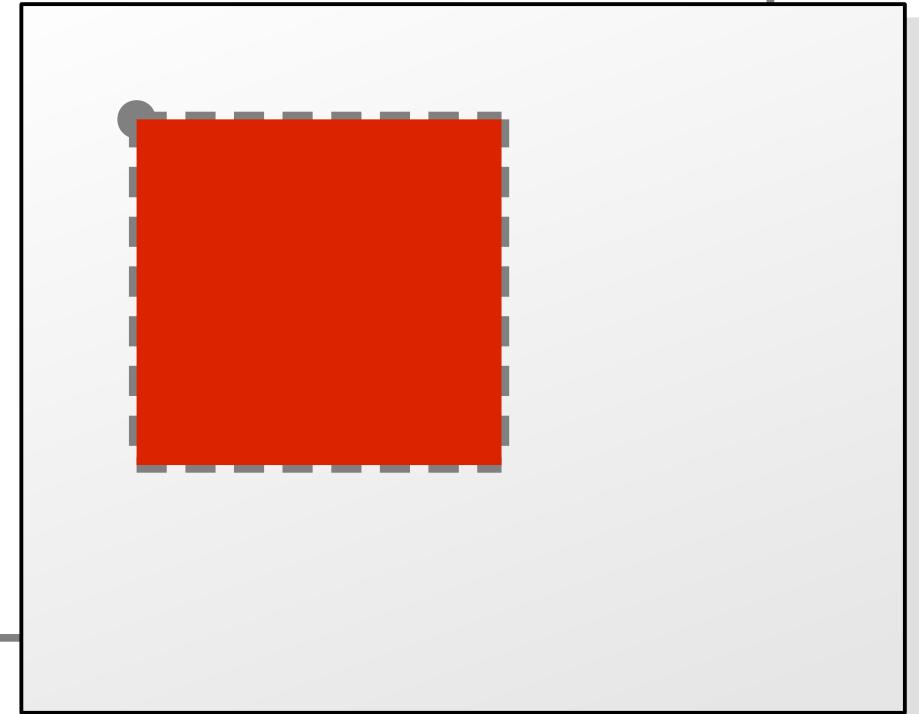
Colored Fills

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.fillStyle = 'red';  
c.fill();
```



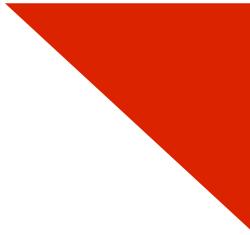
Colored Fills

```
c.beginPath();  
c.moveTo(5,5);  
c.lineTo(90,5);  
c.lineTo(90,90);  
c.lineTo(5,90);  
c.lineTo(5,5);  
  
c.fillStyle = 'red';  
c.fill();
```



Filled Shapes

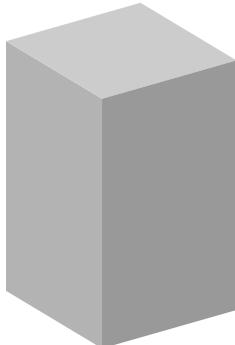
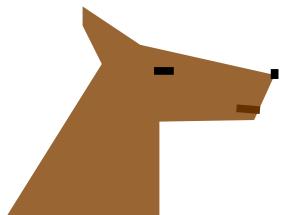
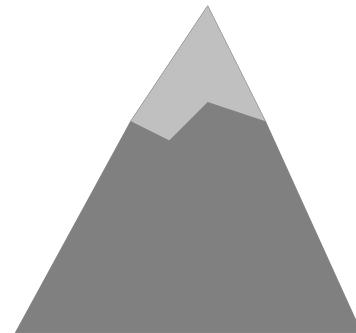
```
c.beginPath();  
c.moveTo(20,20);  
c.lineTo(90,20);  
c.lineTo(90,90);  
c.fillStyle='red';  
c.fill();
```



black
blue
brown
green
orange
purple
red

white
yellow
pink
gray

Ideas



F12



ctrl - shift ⇧ J



cmd⌘ - option⌥ alt - C

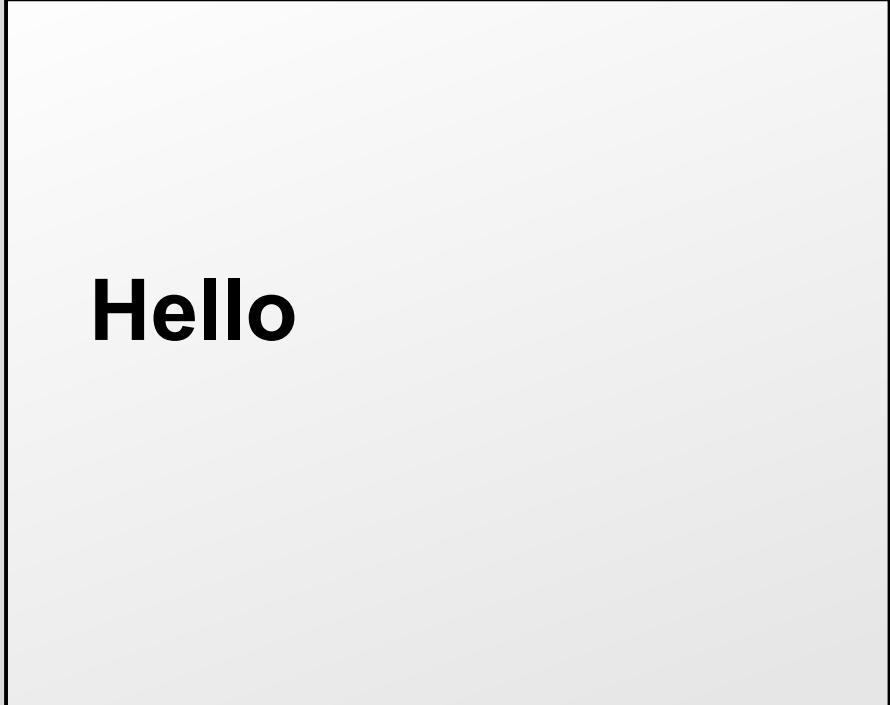
Text

Will you go to the
dance with me?



Writing Things

```
c.fillText('Hello', 20, 100);
```



Hello

Writing Things

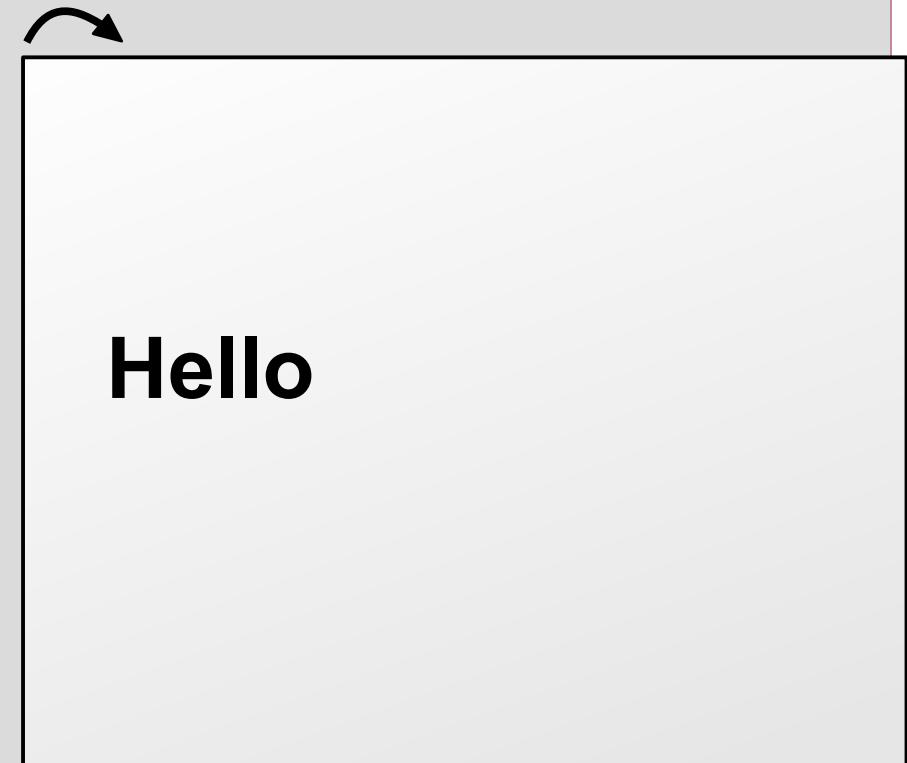
```
c.fillText('Hello', 20, 100);
```



Hello

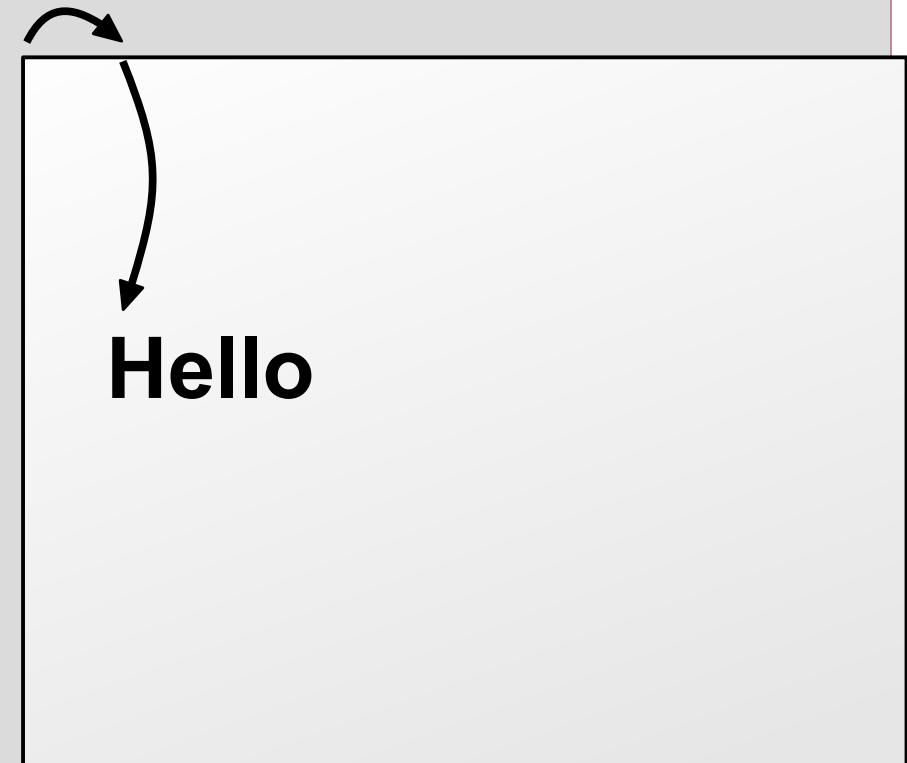
Writing Things

```
c.fillText('Hello', 20, 100);
```



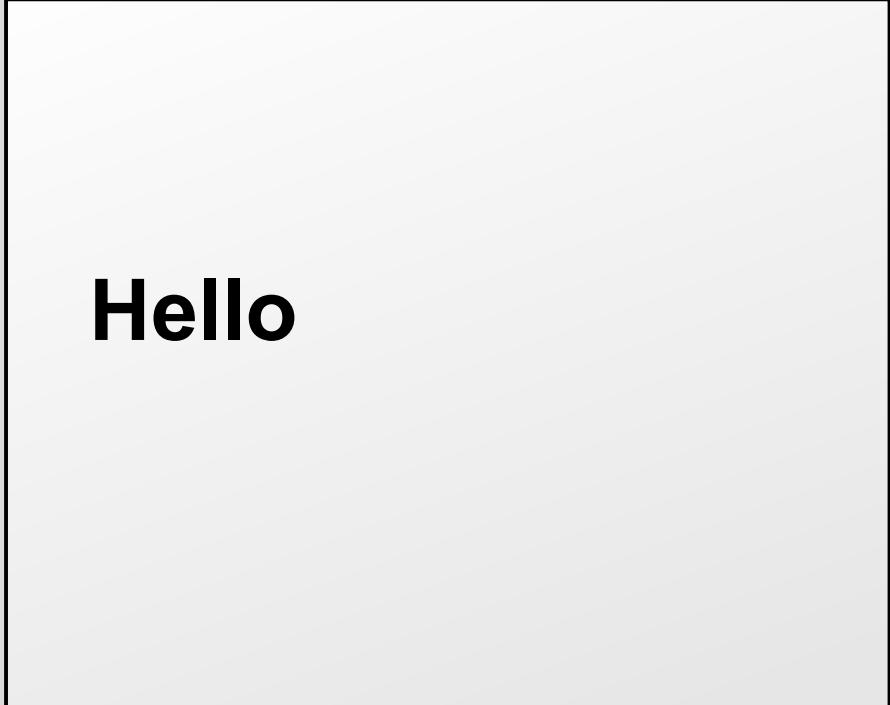
Writing Things

```
c.fillText('Hello', 20, 100);
```



Writing Things

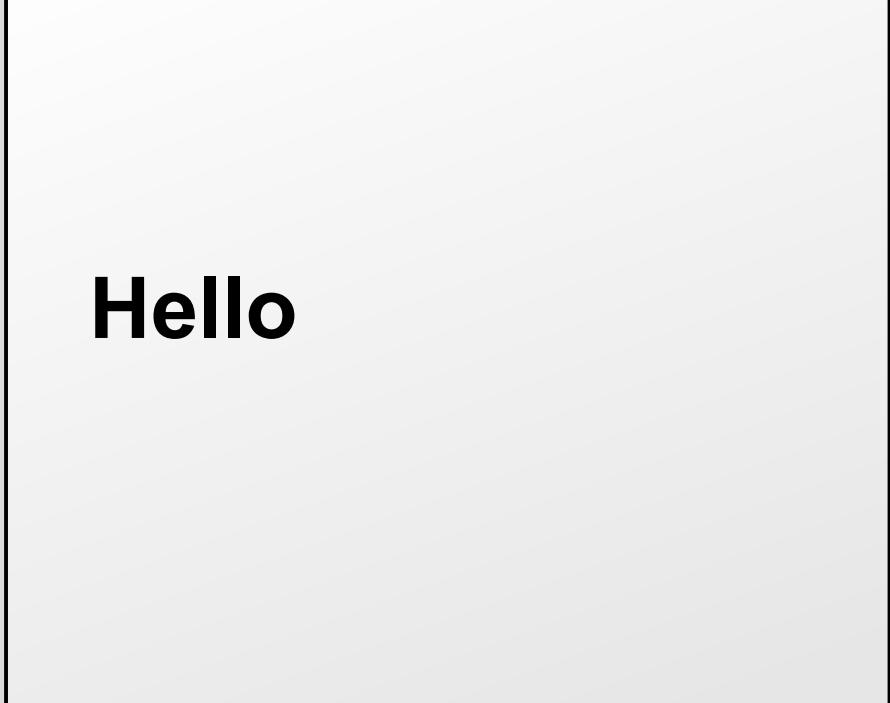
```
c.font = '20px';  
c.fillText('Hello', 20, 100);
```



Hello

Writing Things

```
c.font = '20px';
c.fillText('Hello', 20, 100);
```



Hello

Writing Things

```
c.font = '20px';  
c.fillText('Hello', 20, 100);
```



Hello

Writing Things

```
c.font = '20px serif';
c.fillText('Hello', 20, 100);
```



Hello

Writing Things

```
c.font = '20px serif';
c.fillText('Hello', 20, 100);
```



Hello

Text

```
c.fillStyle='blue' ;  
c.font = '20px sans-serif' ;  
c.fillText('Hello', 20, 100) ;
```

Hello

Ideas

Red

Moon



F12

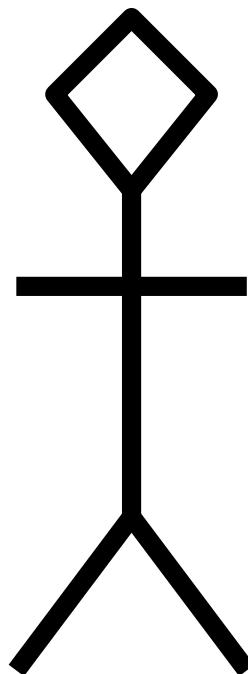


ctrl - shift ⌘ J



cmd ⌘ - option ⌘ alt - C

Drawing is Hard



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Changing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Changing Images

```
a = new Image();  
a.src = 'http://oocli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



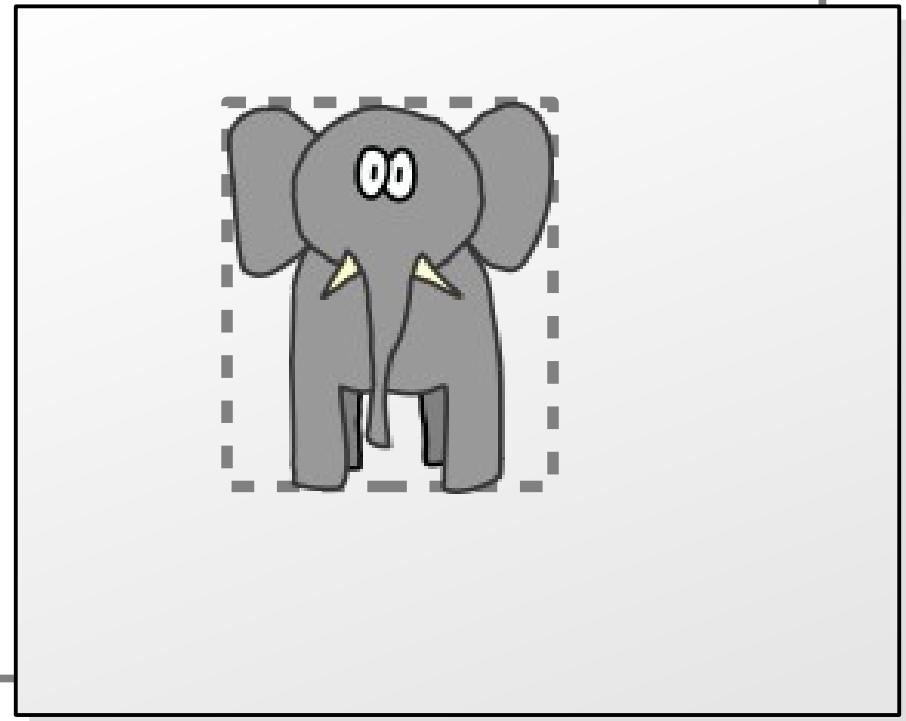
Changing Images

```
a = new Image(); http://o.ooli.ca/ele.png  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



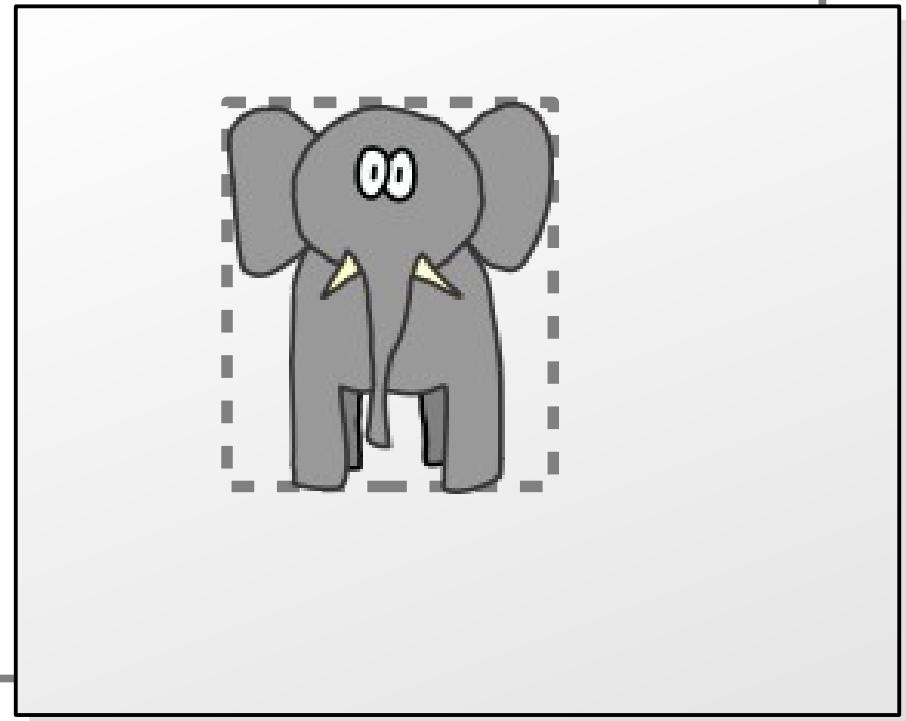
Changing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



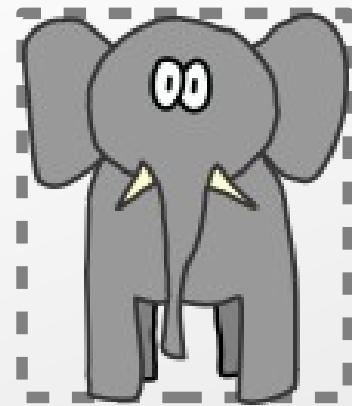
Placing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



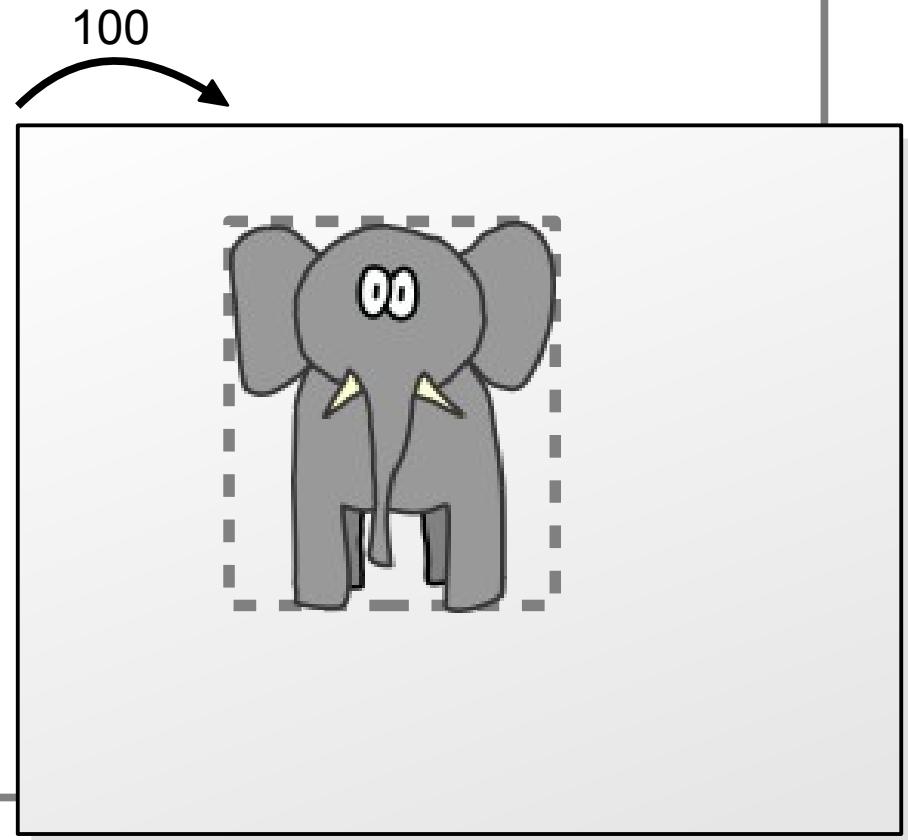
Placing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



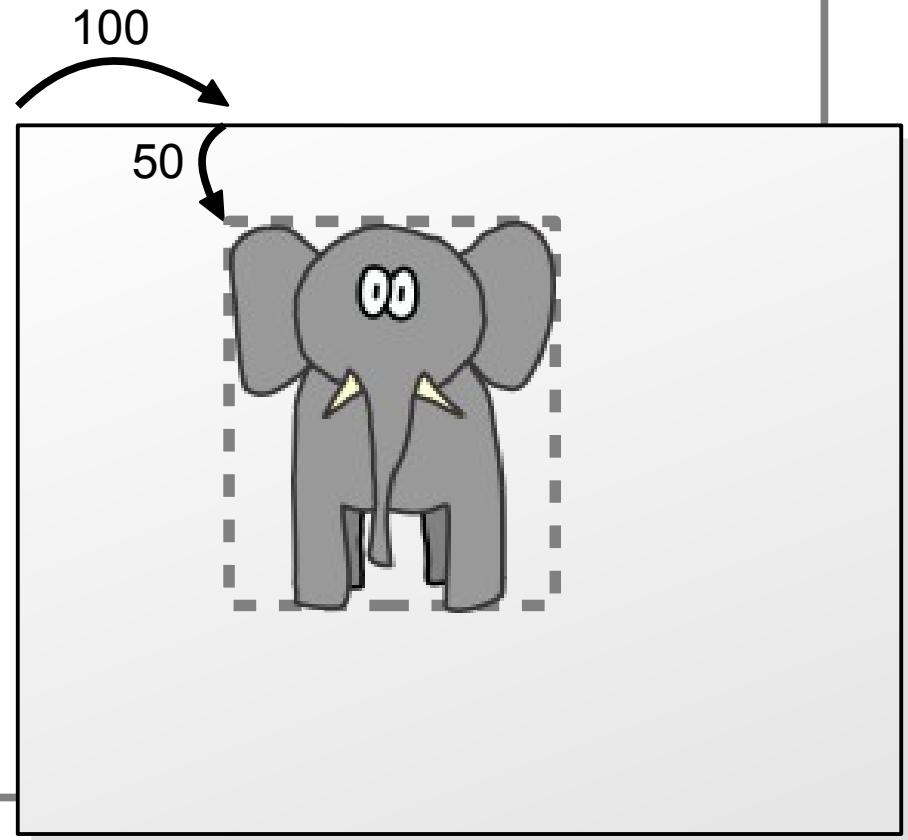
Placing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a, 100, 50);  
  
});
```



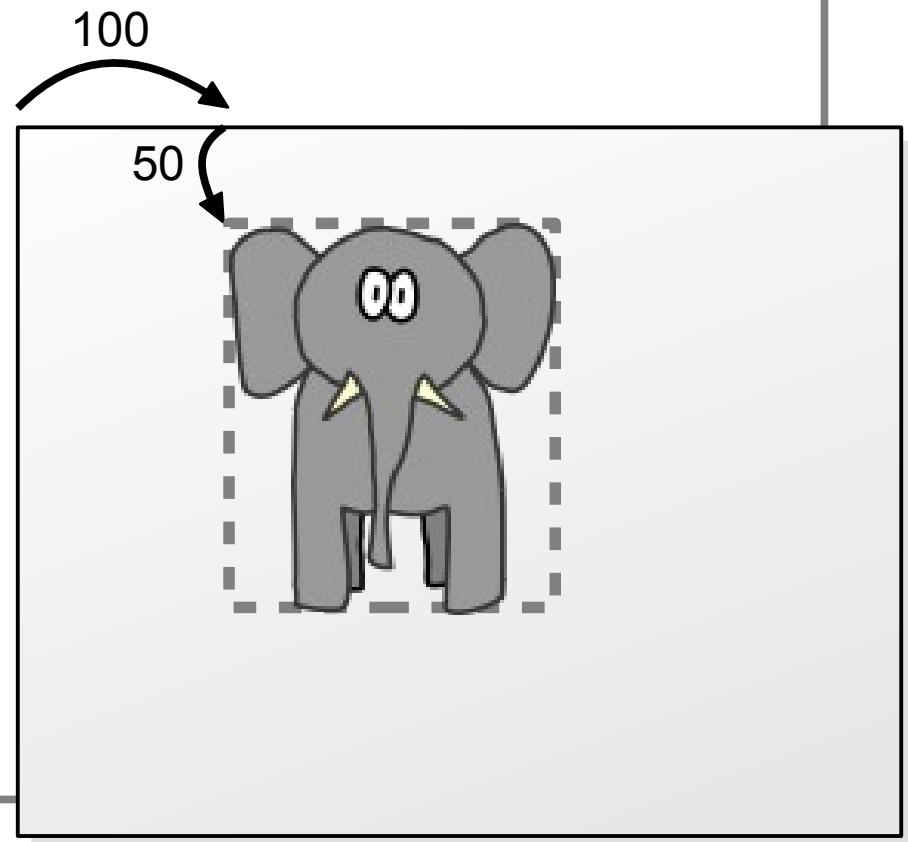
Placing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a, 100, 50);  
  
});
```



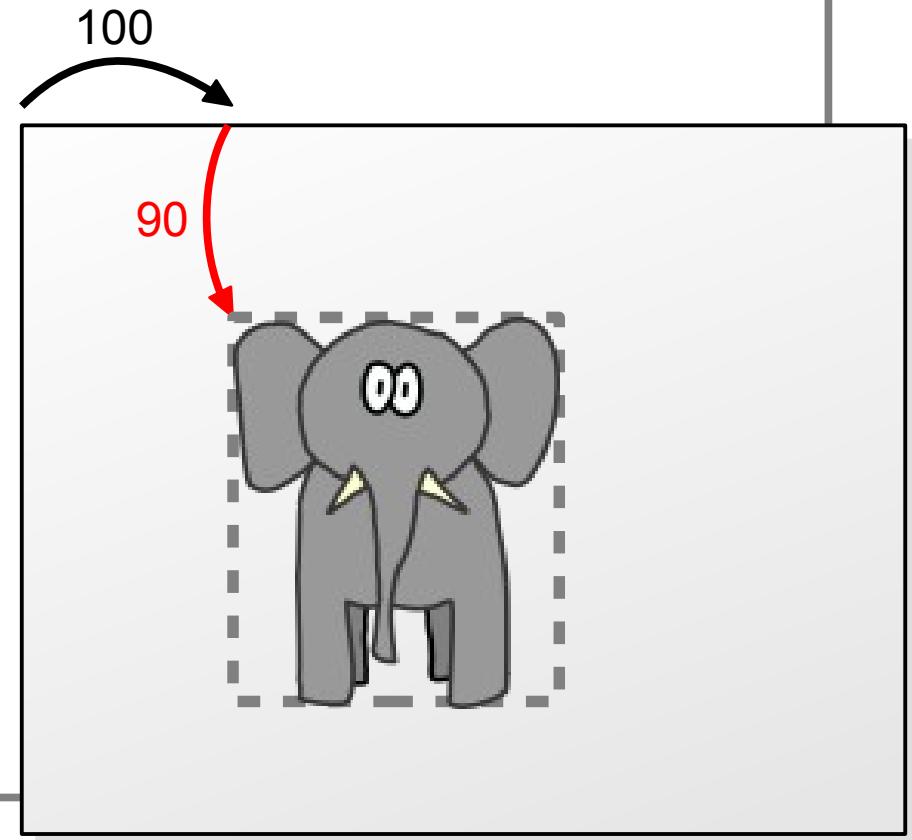
Placing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a, 100, 90);  
  
});
```



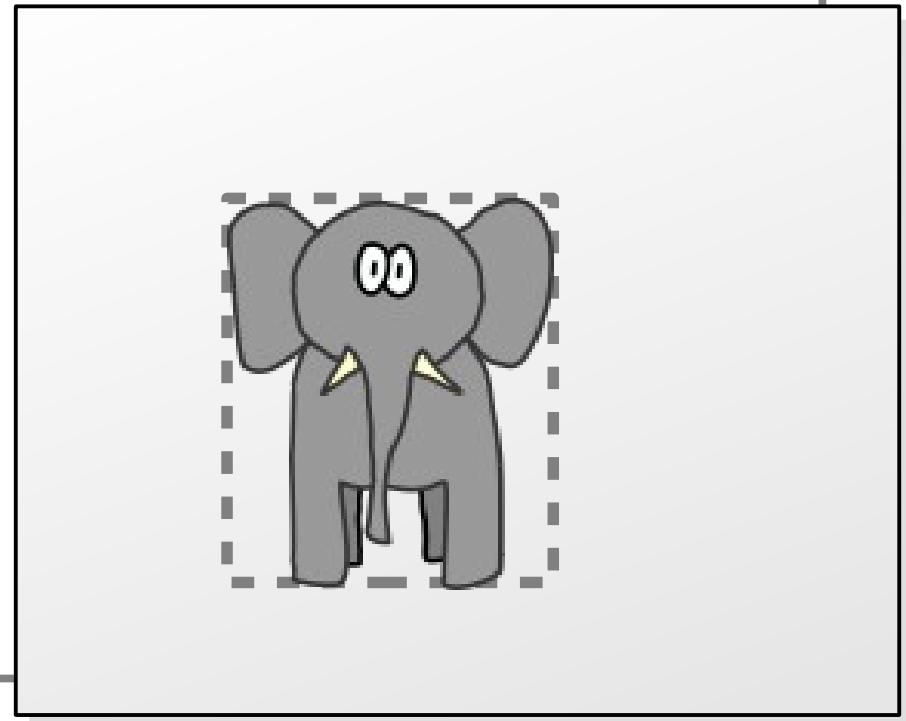
Placing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a, 100, 90);  
  
});
```



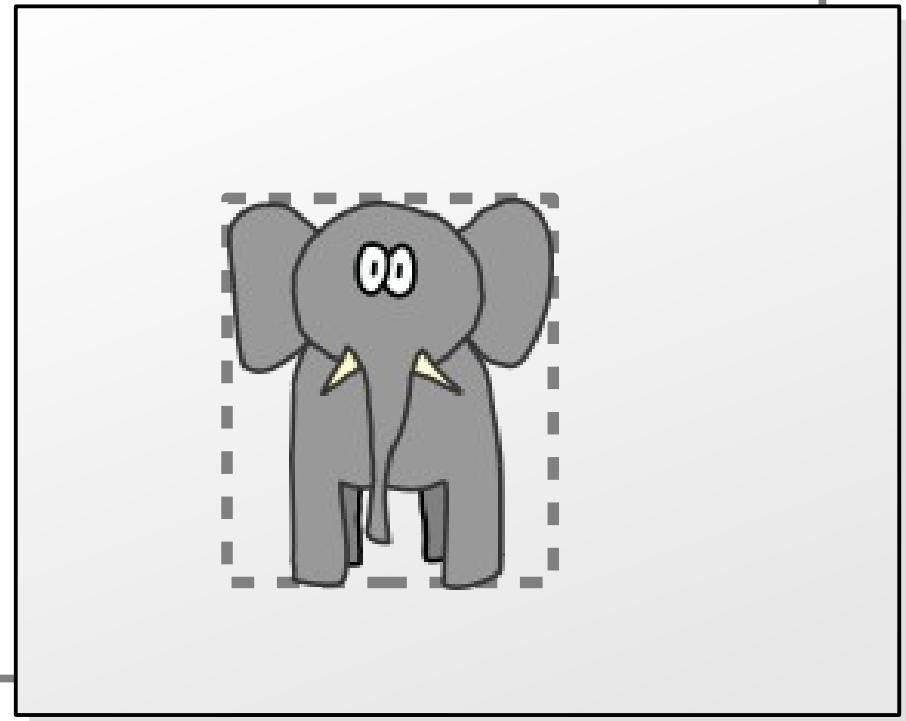
Two Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a,100,90);  
  
});
```



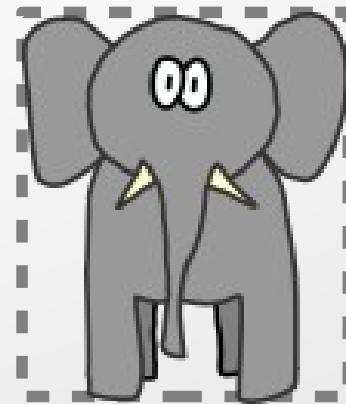
Two Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a,100,90);  
  
});
```



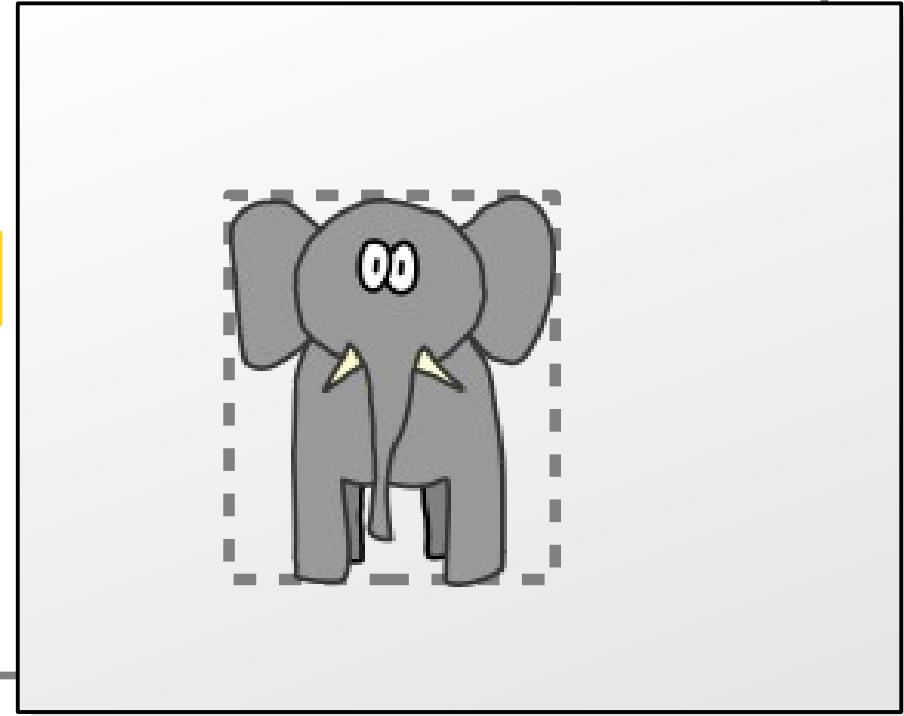
Two Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
b = new Image();  
b.src = 'http://o.ooli.ca/mona.jpg';  
wait(function() {  
  
    c.drawImage(a,100,90);  
  
});
```



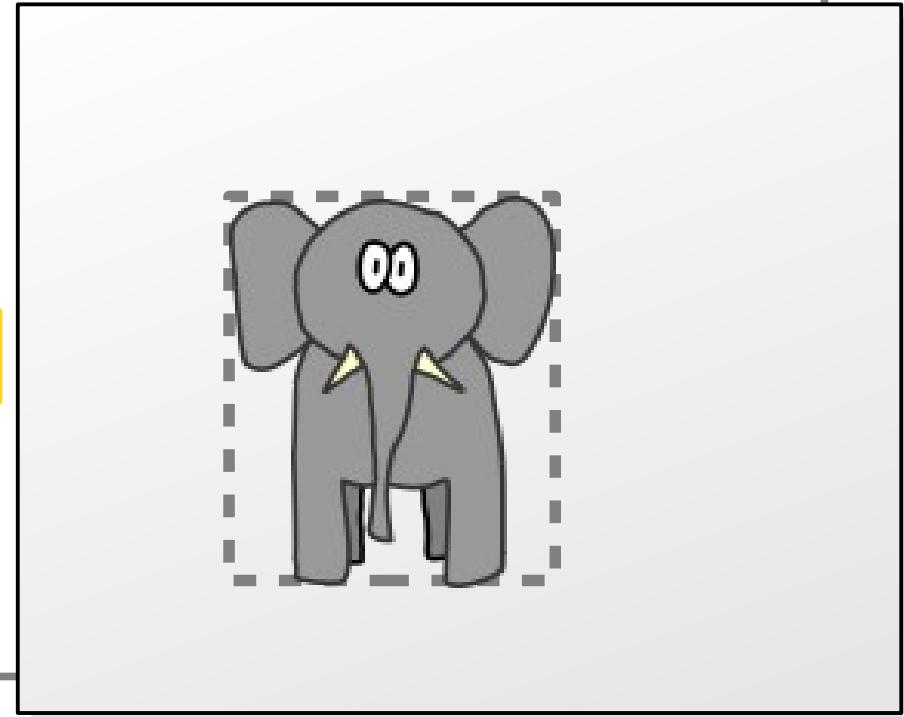
Two Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
b = new Image();  
b.src = 'http://o.ooli.ca/mona.jpg';  
wait(function() {  
  
    c.drawImage(a,100,90);  
  
});
```



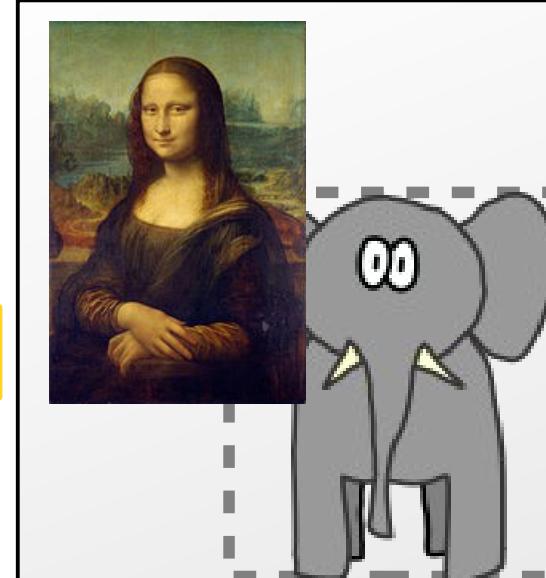
Two Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
b = new Image();  
b.src = 'http://o.ooli.ca/mona.jpg';  
wait(function() {  
  
    c.drawImage(a,100,90);  
    c.drawImage(b,10,10);  
  
});
```



Two Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
b = new Image();  
b.src = 'http://o.ooli.ca/mona.jpg';  
wait(function() {  
  
    c.drawImage(a,100,90);  
    c.drawImage(b,10,10);  
  
});
```



Click on Run If It Gets Stuck

The screenshot shows the JS Bin editor interface. The top navigation bar includes tabs for JS Bin, Add library, Share, HTML (selected), CSS, JavaScript, Console, and Output. The HTML tab displays the following code:

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
    canvas =
document.getElementById('c
anvas');
    c =
canvas.getCon
text();
    c.beginPath();
    c.arc(100, 50, 50, 0, 2 * Math.PI);
    c.fill();
    c.stroke();
</script>
```

The JavaScript tab contains the following code:

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {
    c.drawImage(a,100,50);
});
```

The Output panel features a "Run with JS" button, which is highlighted with a large black mouse cursor icon pointing at it. Below the button is the text "Auto-run".

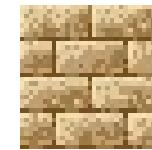
Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

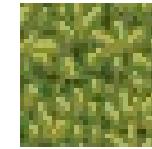
Program



stone.png

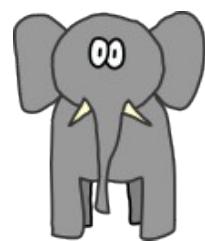


brick.png

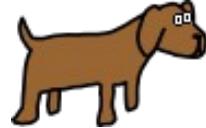


grass.png

http://o.ooli.ca/



ele.png



dog.png



person.png



car_top.png



mona.jpg



tree.png



leaves.png



F12



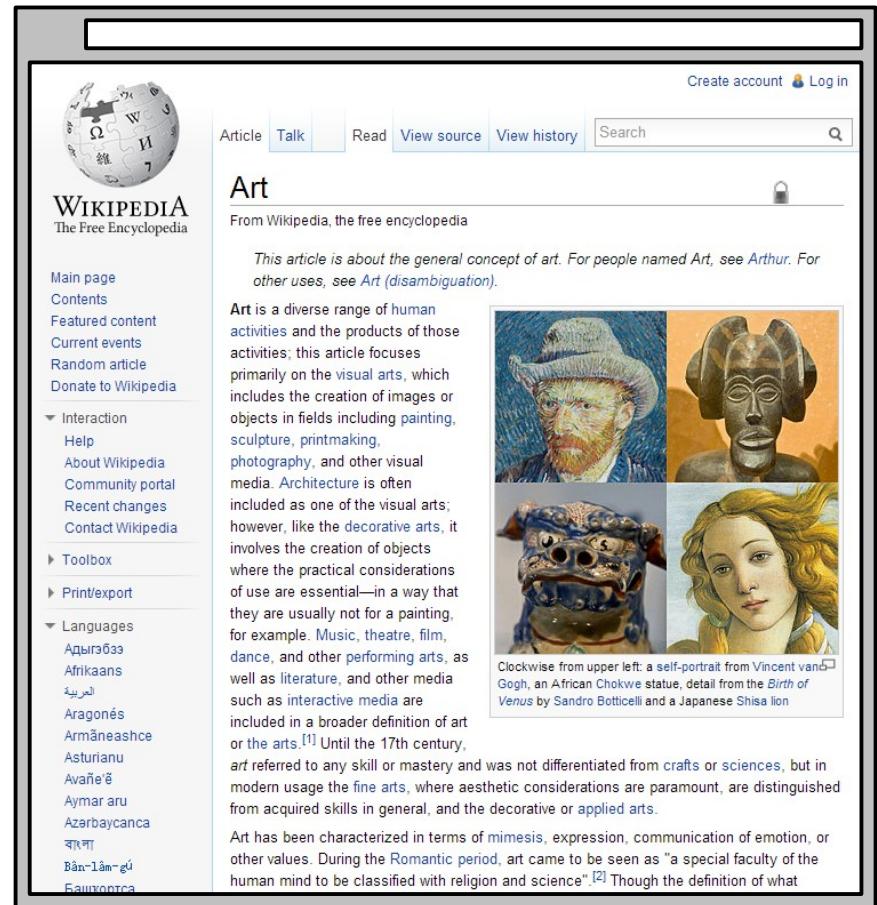
ctrl - shift ⌘ J



cmd ⌘ - option ⌘ alt - C

Where to Get Images

- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it
- Or upload your own images!



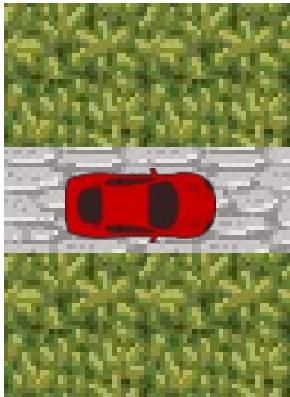
```

a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {
    c.drawImage(a,100,50);
}) ;

```

Ideas



- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it

<http://o.ooli.ca/ele.png>
<http://o.ooli.ca/dog.png>
<http://o.ooli.ca/person.png>
http://o.ooli.ca/car_top.png
<http://o.ooli.ca/mona.jpg>
<http://o.ooli.ca/tree.png>
<http://o.ooli.ca/leaves.png>
<http://o.ooli.ca/stone.png>
<http://o.ooli.ca/brick.png>
<http://o.ooli.ca/grass.png>



F12



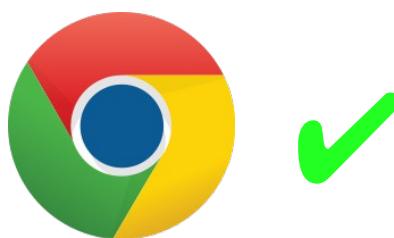
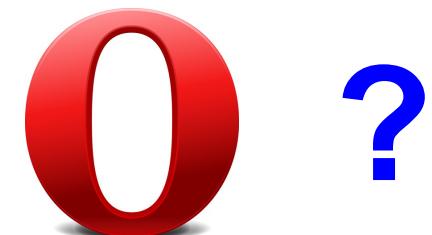
ctrl - shift ⌘ J



cmd ⌘ - option ⌘ - alt - C

Animation Using HTML5 Canvas

- Go to <http://o.ooli.ca/canvasjsbin>
- *Presentation copy http://*



Overview

- Main Topics

- Images



- Basic Animation



- Keyboard Control

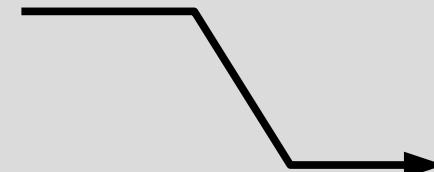


- Optional

- Affine Transforms



- Advanced Animation



jsbin

<http://o.olli.ca/canvasjsbin>

The screenshot shows the jsbin interface with the following components:

- Top Bar:** Includes tabs for JS Bin, Add library, Share, HTML (selected), CSS, JavaScript, Console, and Output.
- HTML Pane:** Contains the following code:

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
    canvas =
document.getElementById('canvas');
    c =
canvas.getContext('2d');
```
- JavaScript Pane:** Empty.
- Output Pane:** Contains a Run with JS button and an Auto-run JS checkbox (unchecked).

jsbin

<http://o.ooli.ca/canvasjsbin>

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500"></canvas>
<script>
    canvas = document.getElementById('canvas');
    c = canvas.getContext('2d');
    c.clear = function() {this.clearRect(0,0,500,500);}
    function wait(fn) {window.setTimeout(fn, 250); }
    function repeat(fn) {
        if (window.requestAnimationFrame) {
            var advance = function() {fn(); requestAnimationFrame(advance);}
            requestAnimationFrame(advance);
        } else window.setInterval(fn, 50);
    }
    var dx = 0, dy = 0, mousex = 0, mousey=0, mouseclicks = 0;
    document.onkeydown = function(e) {
        var key = e.keyCode;
        if (key == 37) dx=-1; else if (key == 38) dy=-1; else if (key == 39) dx=1; else if (key == 40) dy=1; else return true;
        return false;
    };
    document.onkeyup = function(e) {
        var key = e.keyCode; if (key == 37 || key == 39) dx=0; else if (key == 38 || key == 40) dy=0;else return true;
        return false;
    };
    canvas.onmousemove = function(e) {
        var rect = canvas.getBoundingClientRect(); mousex = e.clientX - rect.left; mousey = e.clientY - rect.top;
    };
    canvas.onmousedown = function(e) {mouseclicks++;}
</script>
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {

c.drawImage(a,100,50);

});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```

Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Changing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Changing Images

```
a = new Image();  
a.src = 'http://oocli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



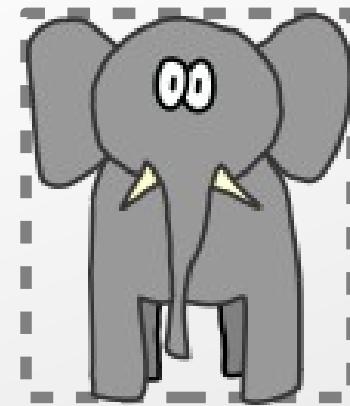
Changing Images

```
a = new Image(); http://o.ooli.ca/ele.png  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



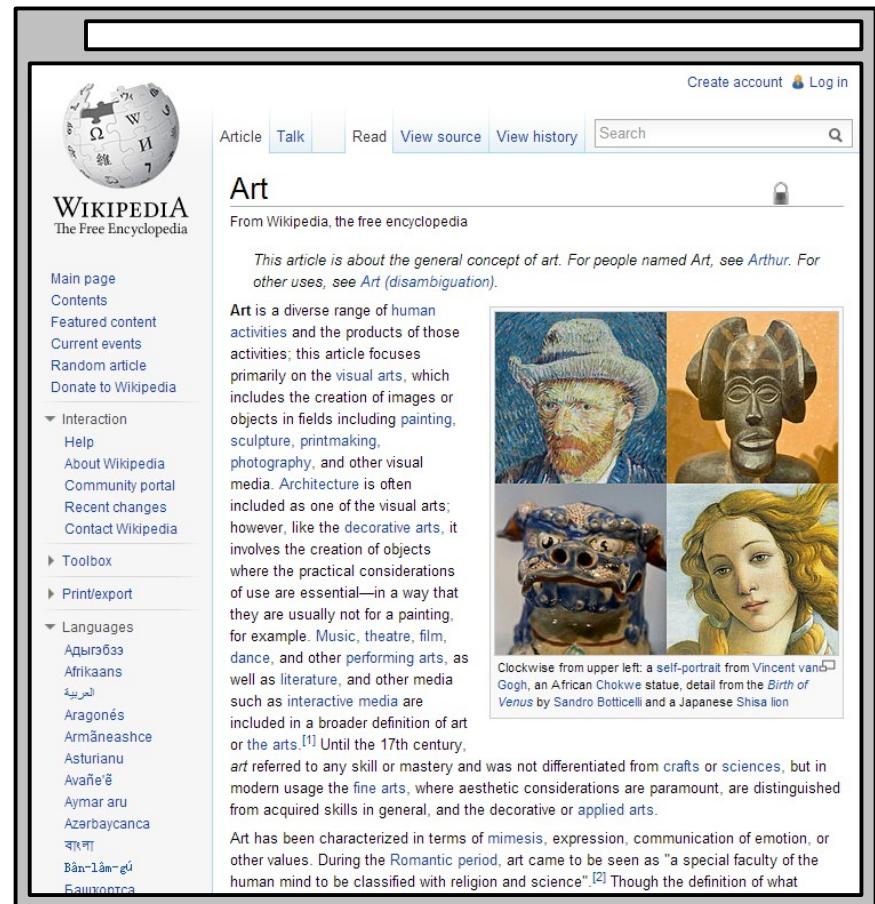
Changing Images

```
a = new Image();  
a.src = 'http://o.ooli.ca/ele.png';  
  
wait(function() {  
  
    c.drawImage(a,100,50);  
  
});
```



Where to Get Images

- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it
- Or upload your own images!



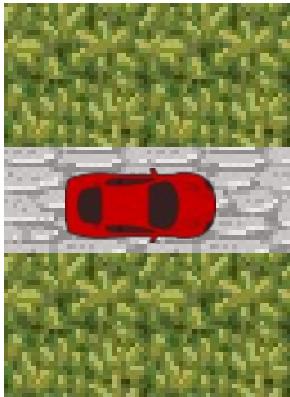
```

a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {
    c.drawImage(a,100,50);
}) ;

```

Ideas



- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it

<http://o.ooli.ca/ele.png>
<http://o.ooli.ca/dog.png>
<http://o.ooli.ca/person.png>
http://o.ooli.ca/car_top.png
<http://o.ooli.ca/mona.jpg>
<http://o.ooli.ca/tree.png>
<http://o.ooli.ca/leaves.png>
<http://o.ooli.ca/stone.png>
<http://o.ooli.ca/brick.png>
<http://o.ooli.ca/grass.png>



F12



ctrl - shift ⌘ J



cmd ⌘ - option ⌘ - alt - C

Affine Transformations

- What are they?
 - Graphics effects for distorting images
 - Mostly useful for 3d animation
 - Due to useful mathematical properties

Affine Transformation Example

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {

c.drawImage(a,10,10);

});
```



Affine Transformation Example

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {
    c.scale(3, 1);
    c.drawImage(a,10,10);

});
```

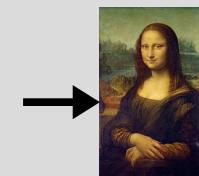


Four Distortions

scale



translate



rotate



shear (*not available in canvas*)

Scale

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

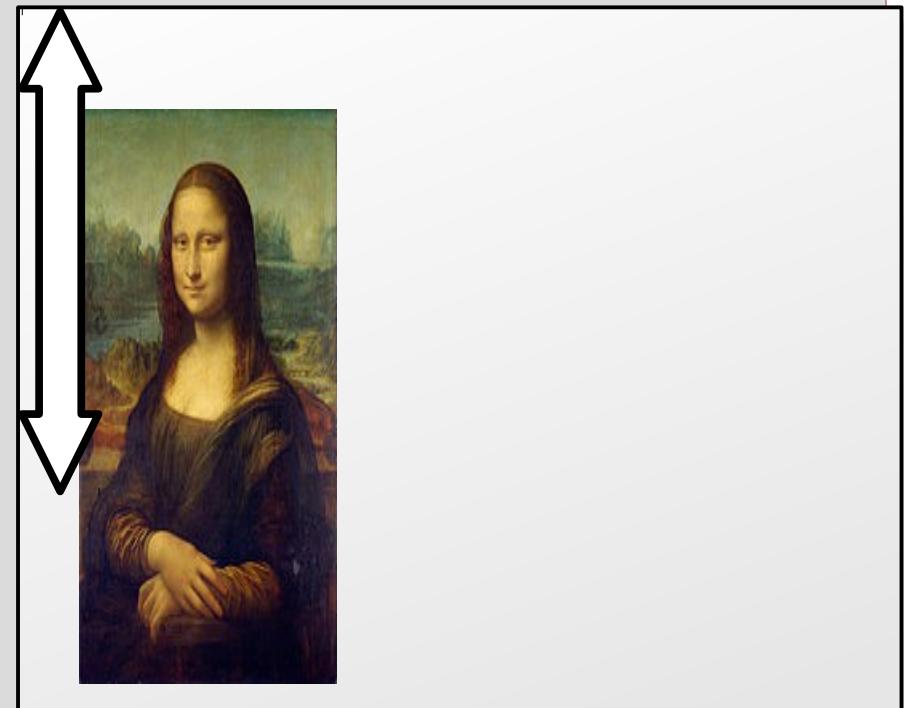
wait(function() {
    c.scale(1, 1);
    c.drawImage(a,10,10);

});
```



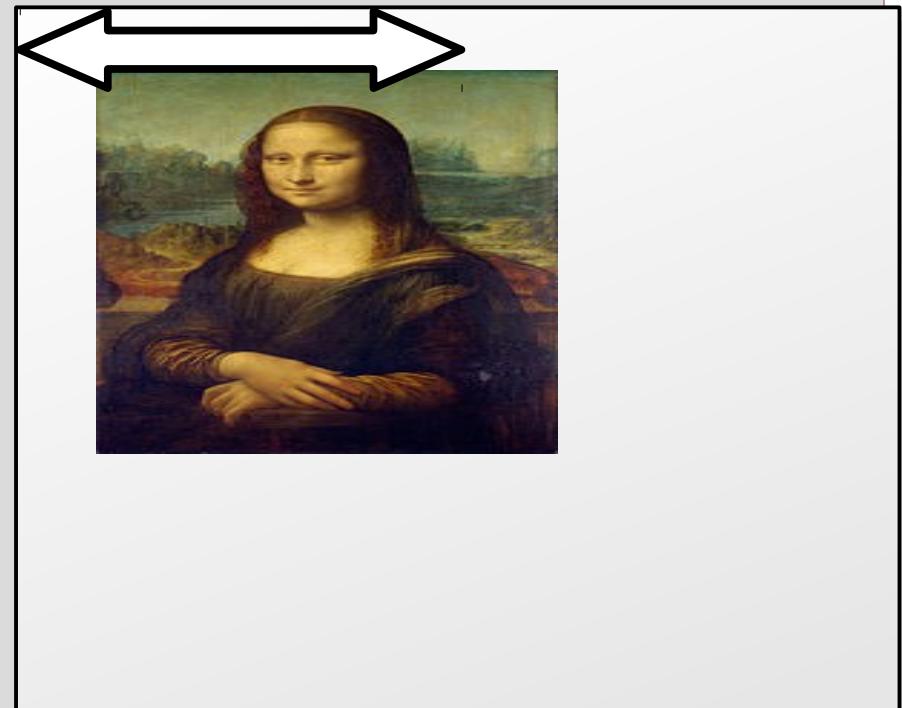
Scale

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.scale(1, 2);  
    c.drawImage(a,10,10);  
  
});
```



Scale

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.scale(2, 1);  
    c.drawImage(a,10,10);  
  
});;
```



Scale

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.scale(3, 1);  
    c.drawImage(a,10,10);  
  
});;
```



Scale

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {

    c.scale(0.5, 1);
    c.drawImage(a,10,10);

});
```

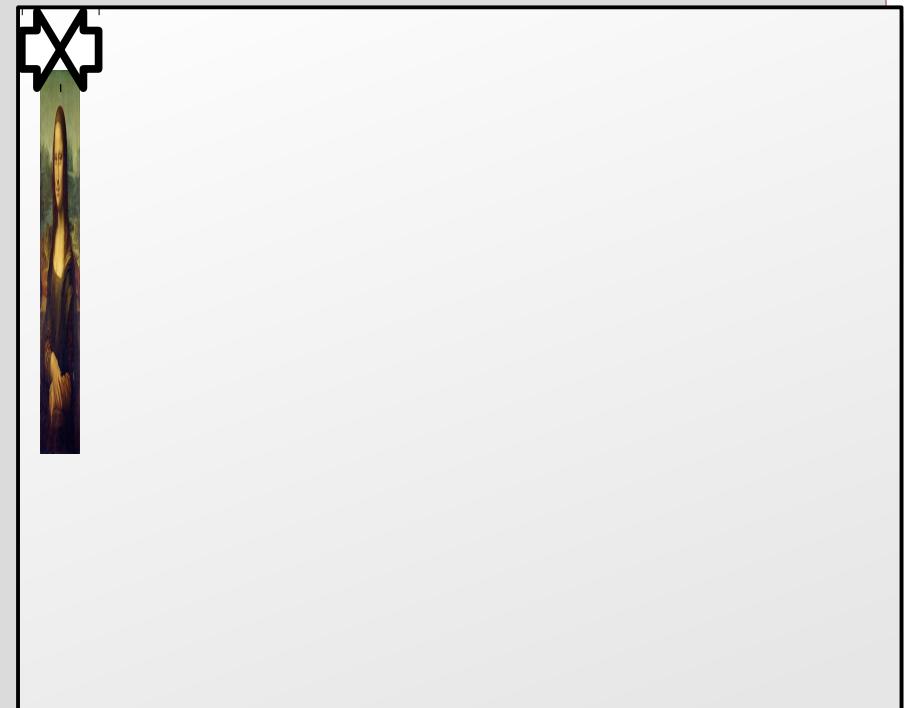


Scale

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {
    c.scale(0.1, 1);
    c.drawImage(a,10,10);

});
```



Scale

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {

    c.scale(-1, 1);
    c.drawImage(a,10,10);

});
```



Scale

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {

    c.scale(-1, 1);
    c.drawImage(a, 100, 10);

});
```



Translate

```
a = new Image();
a.src = 'http://o.ooli.ca/mona.jpg';

wait(function() {

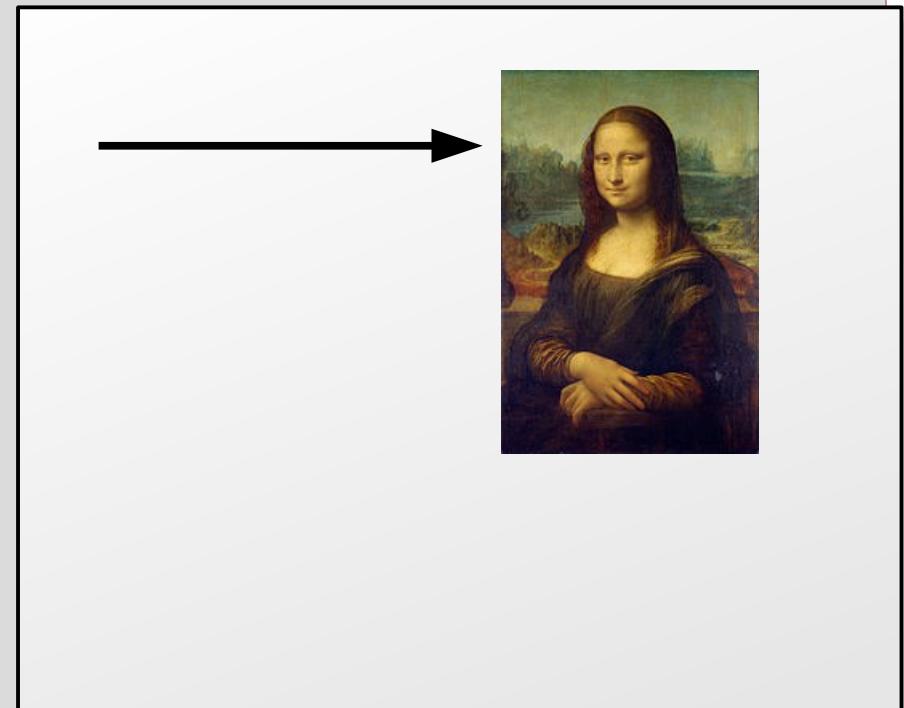
    c.translate(0, 0);
    c.drawImage(a,10,10);

});
```



Translate

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.translate(300, 0);  
    c.drawImage(a,10,10);  
  
});;
```



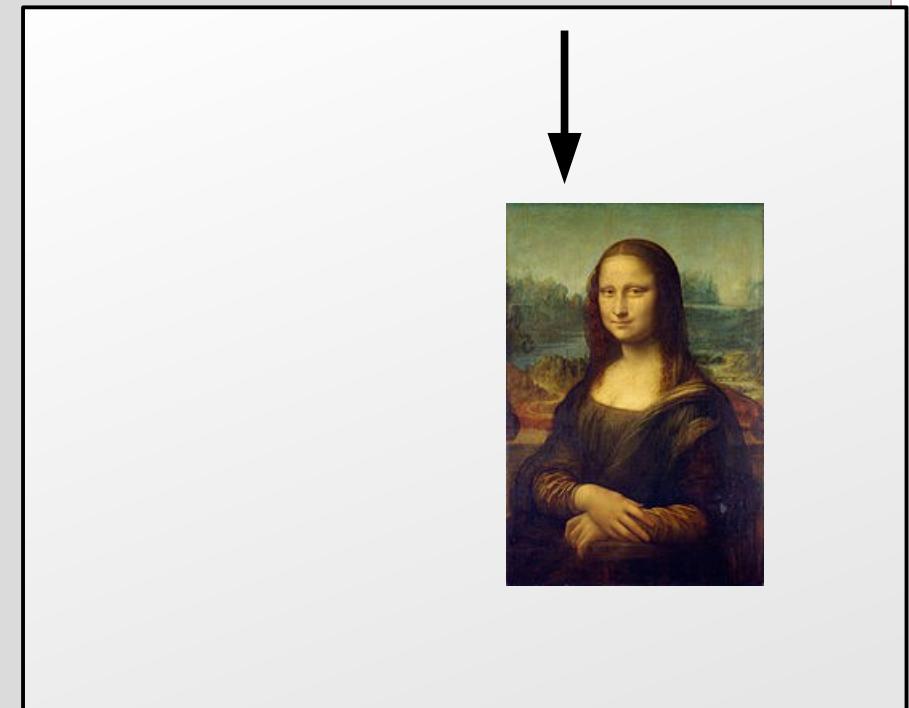
Translate

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';
```

```
wait(function() {
```

```
c.translate(300, 50);  
c.drawImage(a,10,10);
```

```
});
```



Rotate

```
a = new Image();  
a.src = 'http://o.ooli.ca/mona.jpg';  
  
wait(function() {  
  
    c.rotate(30 * Math.PI / 180);  
    c.drawImage(a,10,10);  
  
});
```



Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```

- More than one transformation?
 - What happens?

Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```

- Do the steps backwards!

Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```



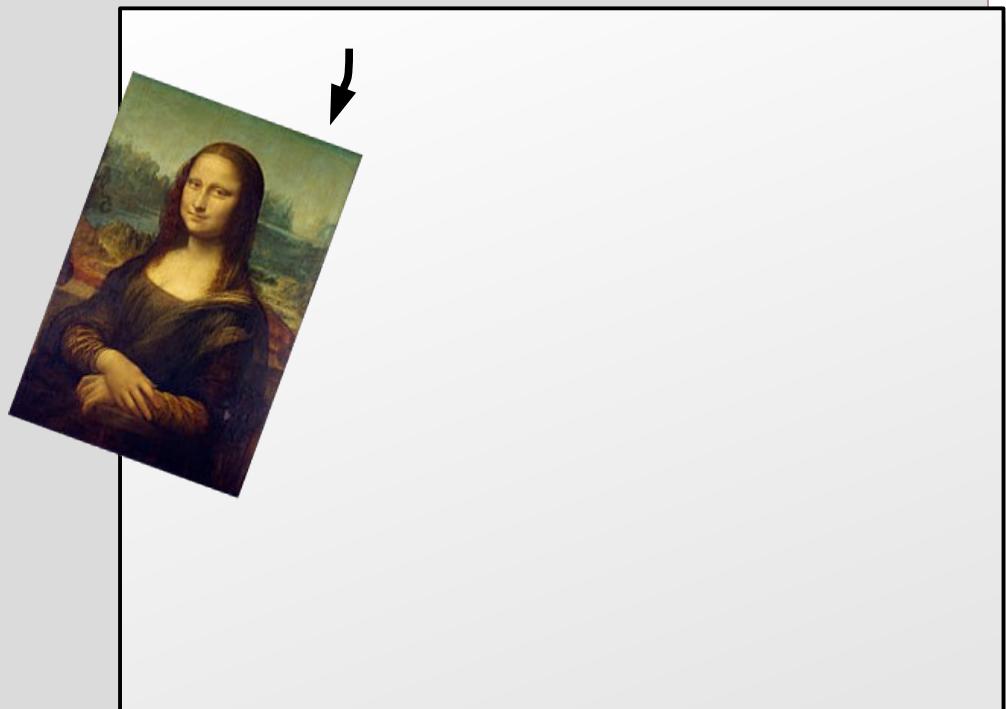
Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```



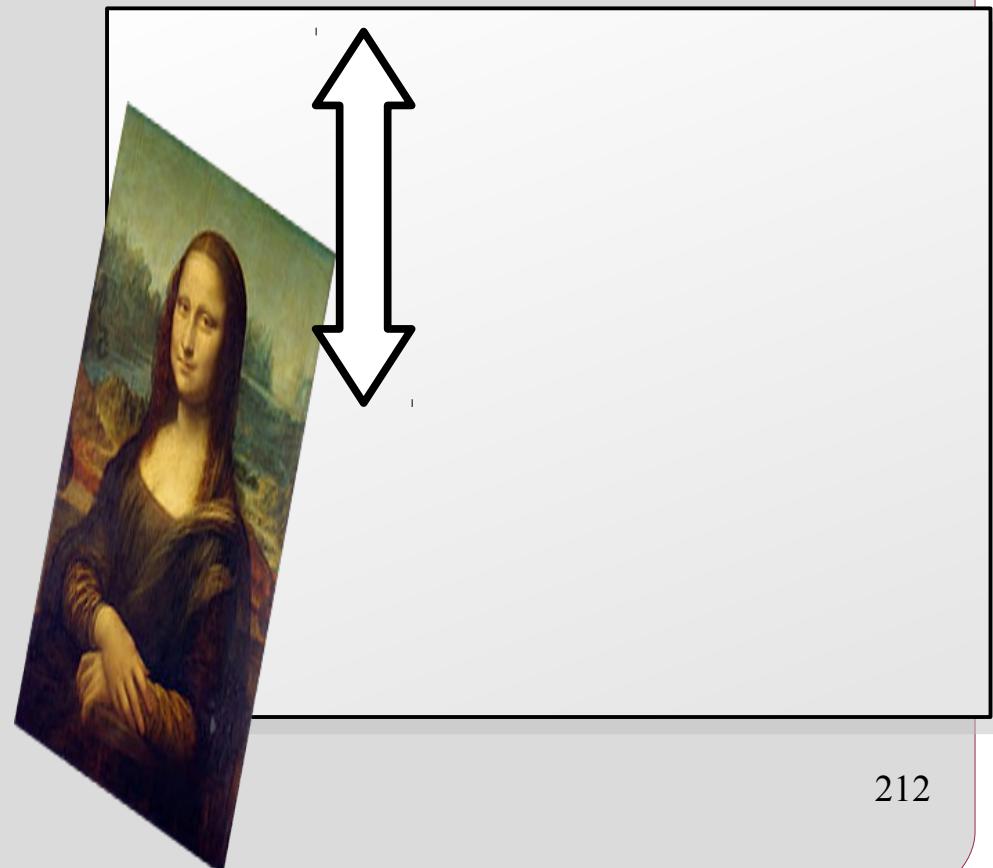
Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```



Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```



Combining Affine Transforms

```
c.translate(100, 0);  
c.scale(1, 2);  
c.rotate(20 * Math.PI / 180);  
c.translate(-5, 0);  
c.drawImage(a,10,10);
```



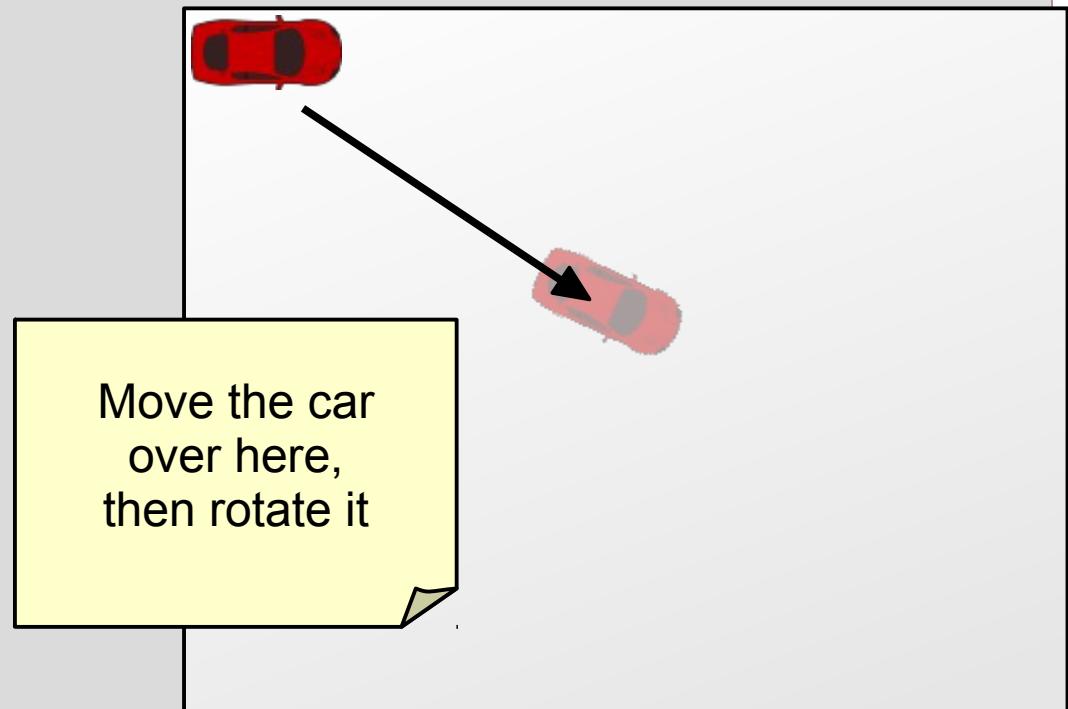
Overhead Car

```
a = new Image();  
a.src = 'http://o.ooli.ca/car_top.png';  
  
wait(function() {  
  
    c.drawImage(a, 0, 0);  
  
});
```



Overhead Car

```
a = new Image();  
a.src = 'http://o.ooli.ca/car_top.png';  
  
wait(function() {  
  
    c.drawImage(a, 0, 0);  
  
});
```



Overhead Car

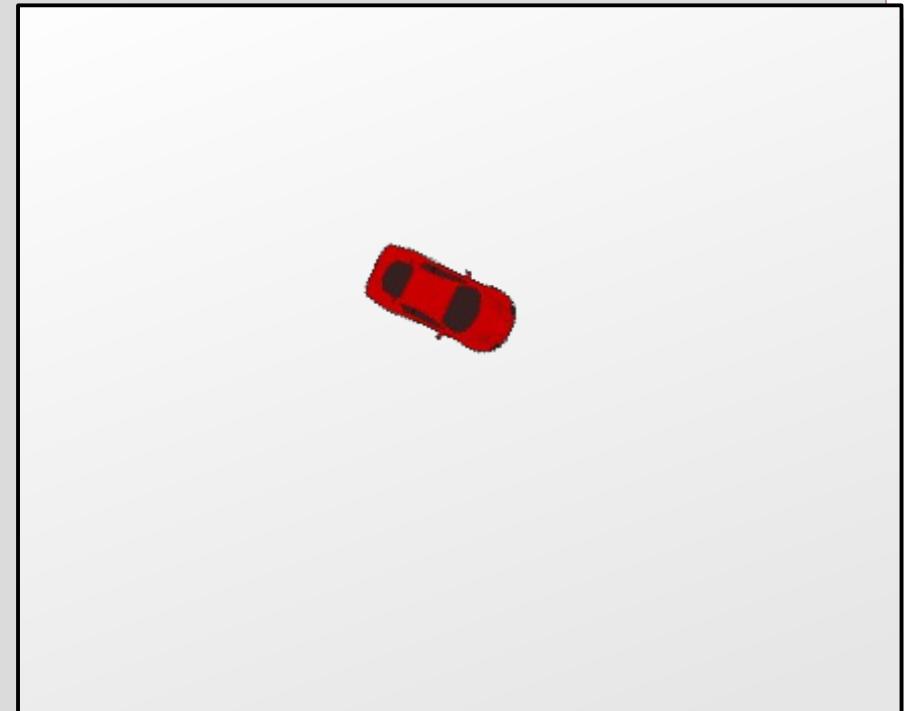
```
a = new Image();
a.src = 'http://o.ooli.ca/car_top.png';

wait(function() {

c.translate(200, 200);
c.rotate(30 * Math.PI / 180);
c.translate(-37, -19);
c.drawImage(a, 0, 0);

// Reset
c.setTransform(1,0,0,1,0,0);

});
```



Overhead Car

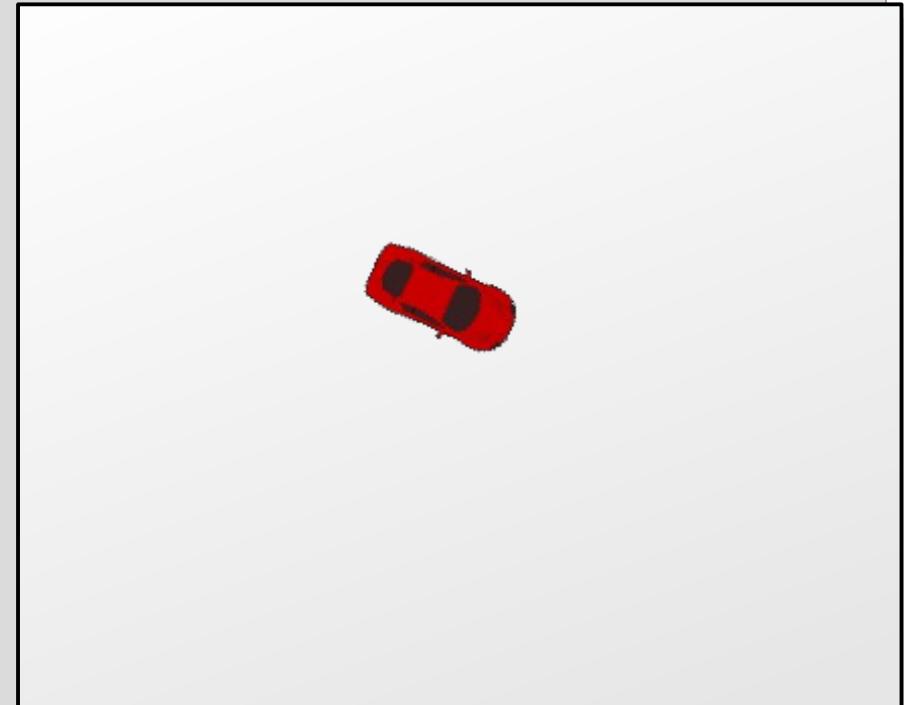
```
a = new Image();
a.src = 'http://o.ooli.ca/car_top.png';

wait(function() {

    c.translate(200, 200);
    c.rotate(30 * Math.PI / 180);
    c.translate(-37, -19);
    c.drawImage(a, 0, 0);

    // Reset
    c.setTransform(1,0,0,1,0,0);

});
```



Overhead Car

```
c.translate(200, 200);  
c.rotate(30 * Math.PI / 180);  
c.translate(-37, -19);  
c.drawImage(a, 0, 0);
```



Overhead Car

```
c.translate(200, 200);  
c.rotate(30 * Math.PI / 180);  
c.translate(-37, -19);  
c.drawImage(a, 0, 0);
```



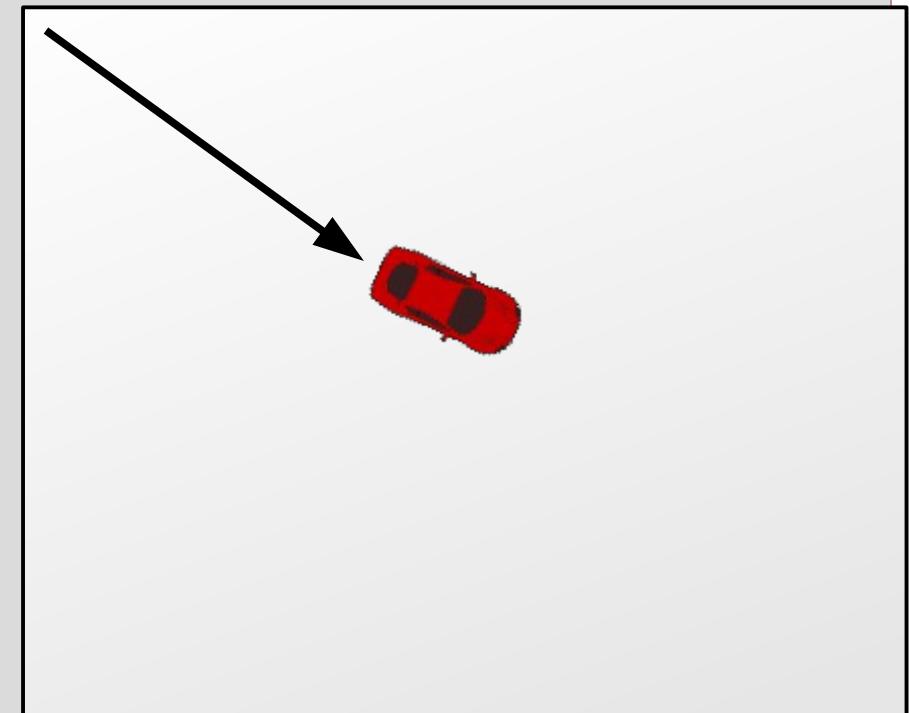
Overhead Car

```
c.translate(200, 200);  
c.rotate(30 * Math.PI / 180);  
c.translate(-37, -19);  
c.drawImage(a, 0, 0);
```



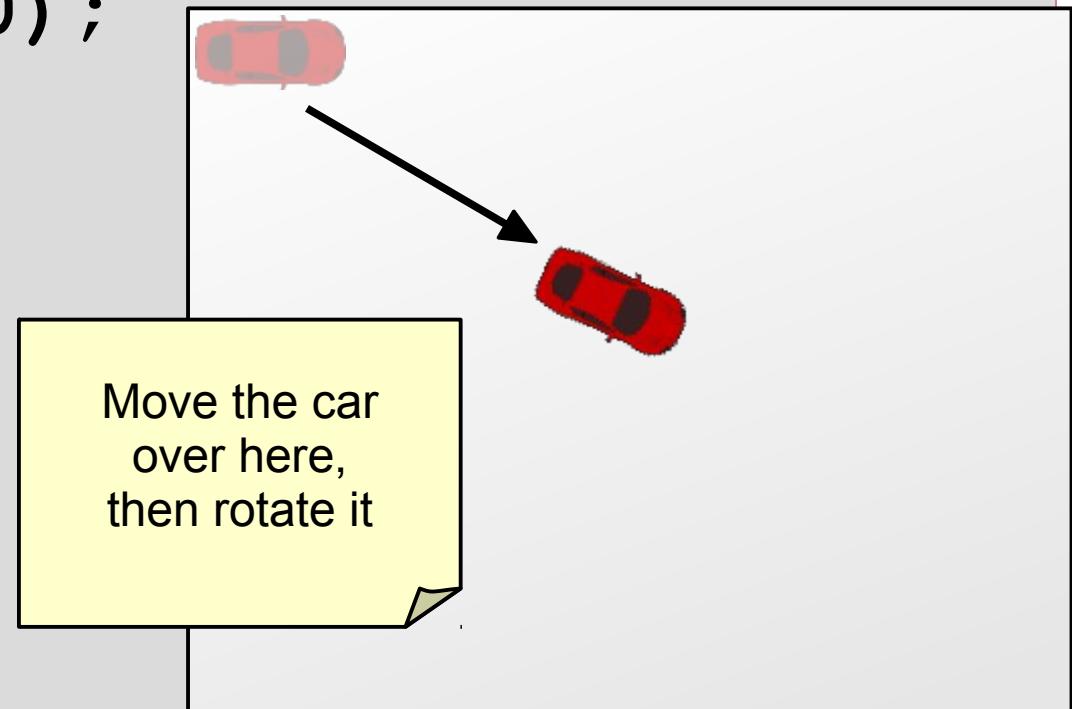
Overhead Car

```
c.translate(200, 200);  
c.rotate(30 * Math.PI / 180);  
c.translate(-37, -19);  
c.drawImage(a, 0, 0);
```



Overhead Car

```
c.translate(200, 200);  
c.rotate(30 * Math.PI / 180);  
c.translate(-37, -19);  
c.drawImage(a, 0, 0);
```



```

a = new Image();
a.src = 'http://o.ooli.ca/car_top.png';

wait(function() {

c.translate(200, 200);
c.rotate(30 * Math.PI / 180);
c.translate(-37, -19);
c.scale(1, 1);
c.drawImage(a, 0, 0);

// Reset
c.setTransform(1,0,0,1,0,0);

});

```

- Stretch an image
- Mirror or flip an image
- Rotate an image its lower-right point

- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it

[http://o.ooli.ca/ ...
!\[\]\(702b0678a2544b22c6e8cc49ed601dc4_img.jpg\)
\[dog.png\]\(http://o.ooli.ca/dog.png\)
\[person.png\]\(http://o.ooli.ca/person.png\)
\[car_top.png\]\(http://o.ooli.ca/car_top.png\)
\[mona.jpg\]\(http://o.ooli.ca/mona.jpg\)
\[tree.png\]\(http://o.ooli.ca/tree.png\)
\[leaves.png\]\(http://o.ooli.ca/leaves.png\)
\[stone.png\]\(http://o.ooli.ca/stone.png\)
\[brick.png\]\(http://o.ooli.ca/brick.png\)
\[grass.png\]\(http://o.ooli.ca/grass.png\)](http://o.ooli.ca/ele.png)



F12



ctrl - shift ⌘ J



cmd⌘ - option⌥ - alt - C

Animation: Moving Things



Animation: Moving Things



Images Review

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
wait(function() {  
  
    c.drawImage(a,50,50);  
  
});
```



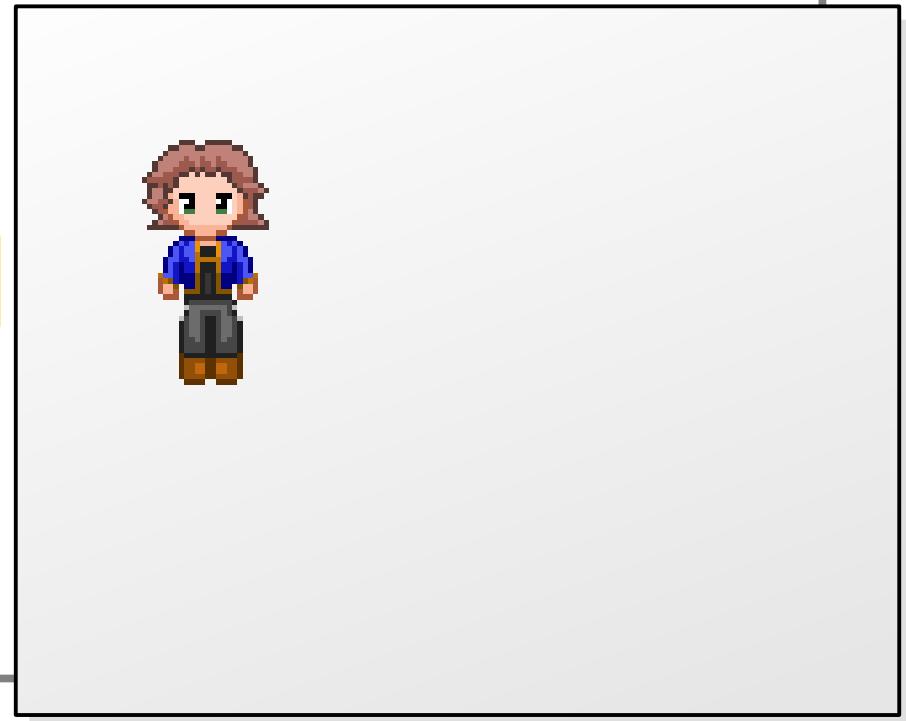
Images Review

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
wait(function() {  
  
    c.drawImage(a, 50, 50);  
  
});
```



Images Review

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
wait(function() {  
  
    c.drawImage(a,50,50);  
  
});
```



Animation

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
wait(function() {  
  
    c.drawImage(a,50,50);  
  
});
```



Animation

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
wait(function() {  
c.drawImage(a,50,50);  
});
```



Animation

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
repeat(function() {  
    c.drawImage(a,50,50);  
});
```



Animation

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
repeat(function() {  
    c.drawImage(a,50,50);  
  
});
```



Animation: Variables

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
repeat(function() {  
    c.drawImage(a,50,50);  
});
```



Animation: Variables

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
  
repeat(function() {  
    c.drawImage(a, 50, 50);  
});
```



Animation: Variables

```
a = new Image();  
a.src = 'http://o.ooli.ca/person.png';  
x = 50;  
repeat(function() {  
  
    c.drawImage(a, x, 50);  
  
}) ;
```



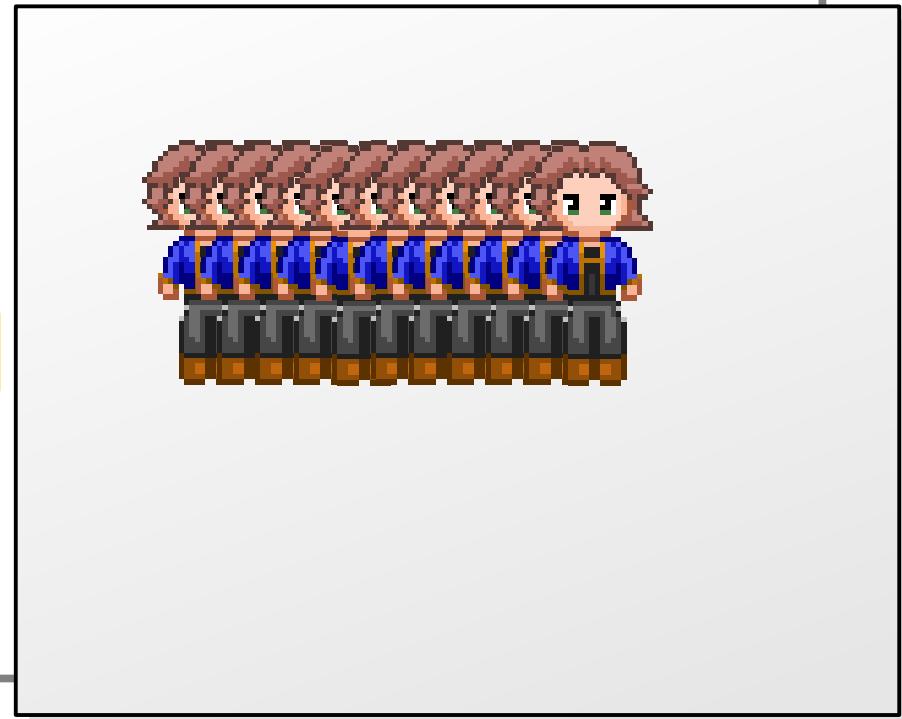
Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```

Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```

Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```

Animation: Changing Things

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



```

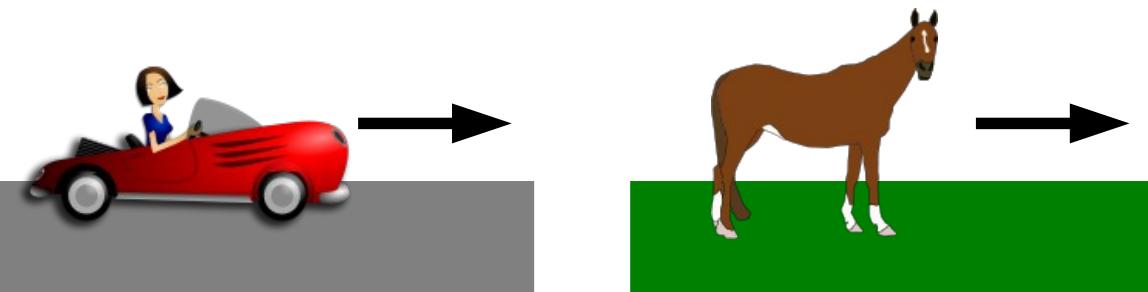
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
}) ;

```

- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it

[http://o.ooli.ca/ ...](http://o.ooli.ca/)
 ele.png
 dog.png
 person.png
 car_top.png
 mona.jpg
 tree.png
 leaves.png
 stone.png
 brick.png
 grass.png

Ideas



F12



ctrl - shift ⌘ J



cmd⌘ - option⌥ - alt - C

Advanced Animation

- So far

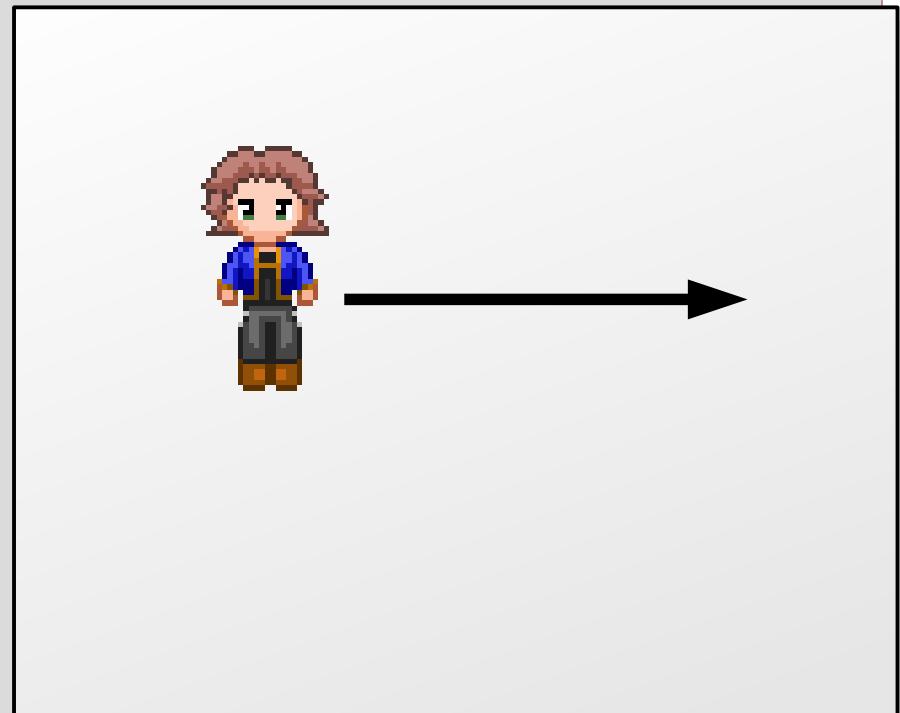
- More flexibility



Time

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
y = 50;

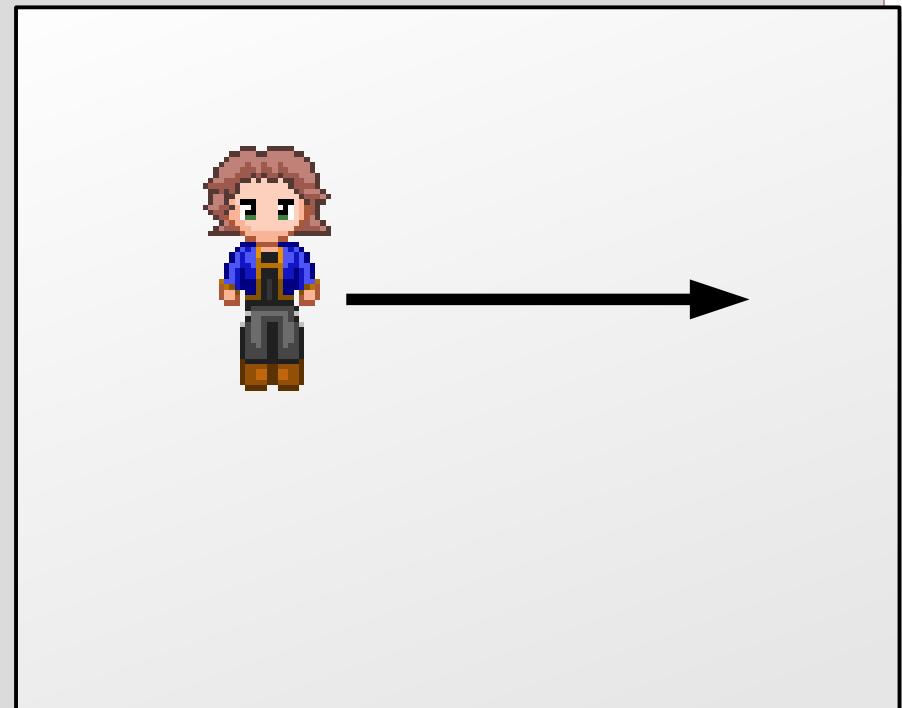
repeat(function() {
    c.clear();
    c.drawImage(a, x, y);
    x = x + 1;
}) ;
```



Time

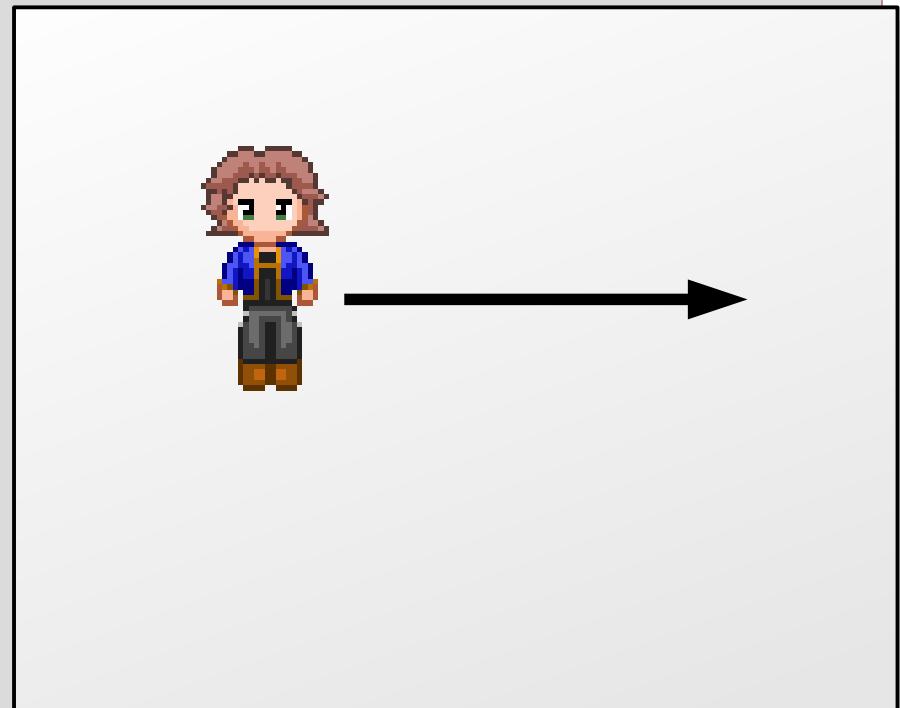
```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
y = 50;

repeat(function() {
    c.clear();
    c.drawImage(a, x, y);
    x = x + 1;
}) ;
```



Time

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
y = 50;
time = 1;
repeat(function() {
    c.clear();
    c.drawImage(a, x, y);
    x = x + 1;
}) ;
```

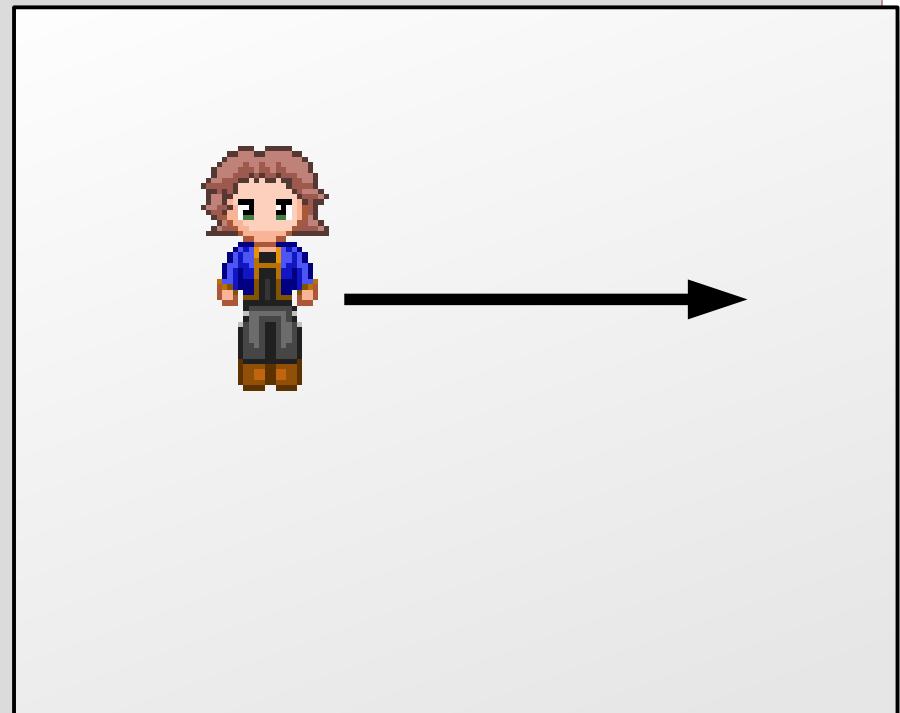


Time

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
y = 50;
time = 1;
repeat(function() {

    c.clear();
    c.drawImage(a, x, y);
    time = time + 1;
    x = x + 1;

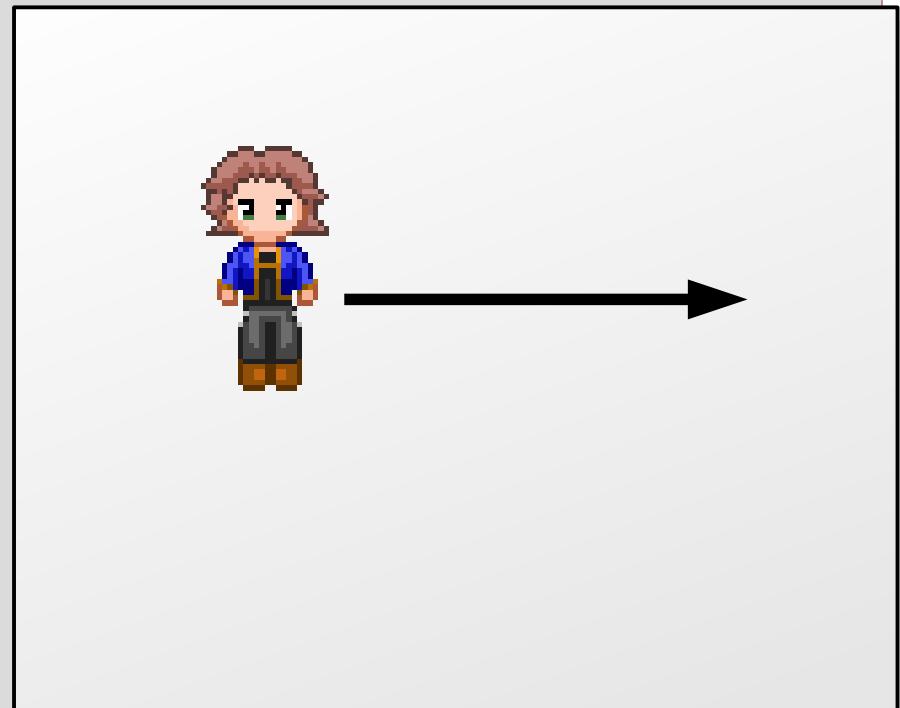
});
```



What Time Is It?

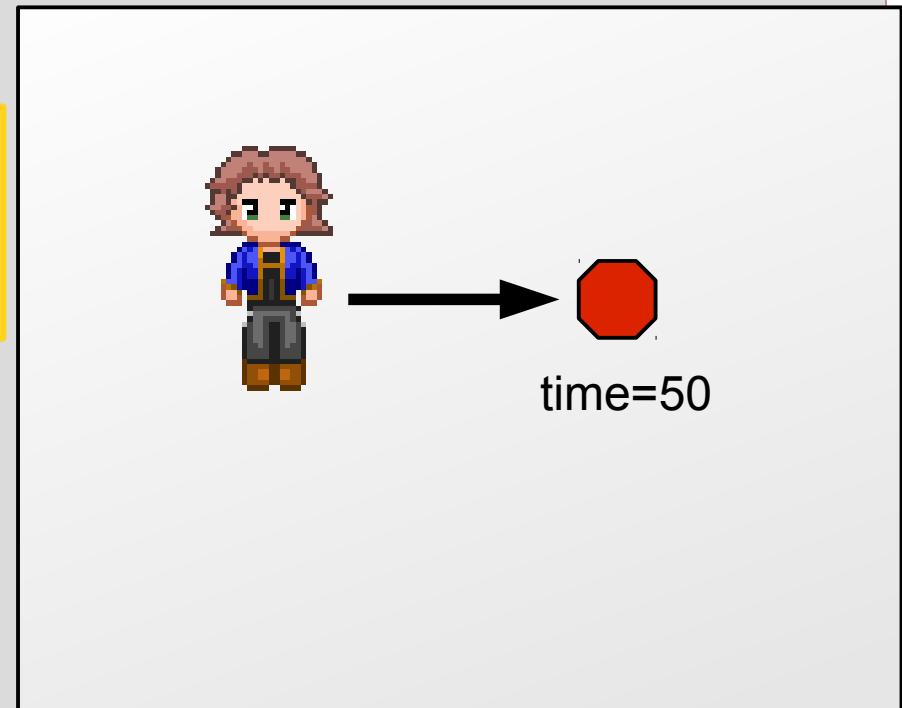
```
...  
repeat(function() {  
  
    c.clear();  
    c.drawImage(a, x, y);  
    time = time + 1;  
    x = x + 1;  
});
```

Move right



What Time Is It?

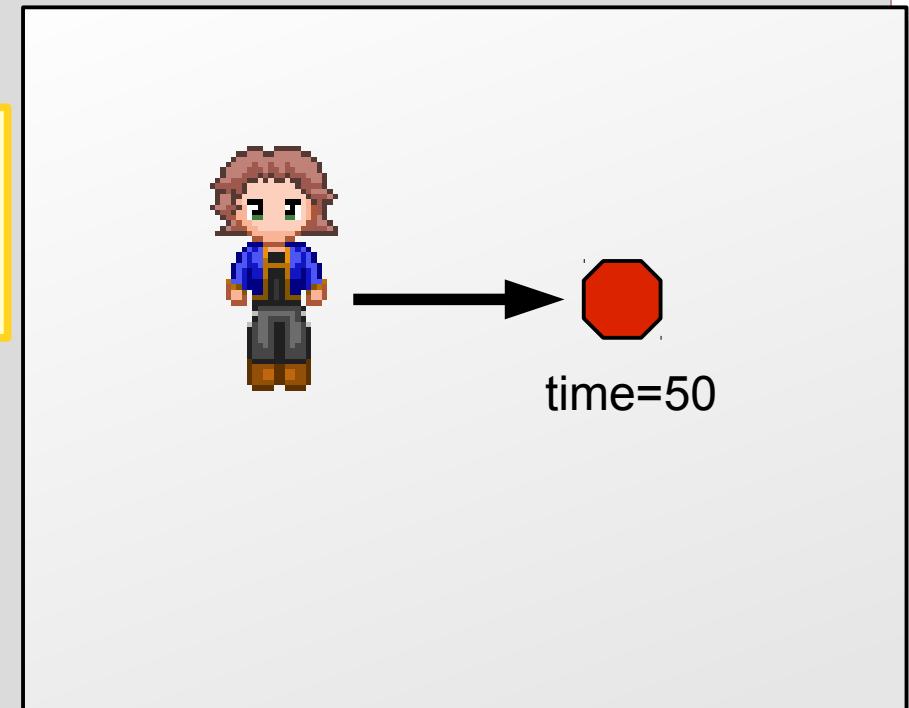
```
...  
repeat(function() {  
  
    c.clear();  
    c.drawImage(a, x, y);  
    time = time + 1;  
    if (time > 1 && time < 50) {  
        x = x + 1;  
    }  
});
```



What Time Is It?

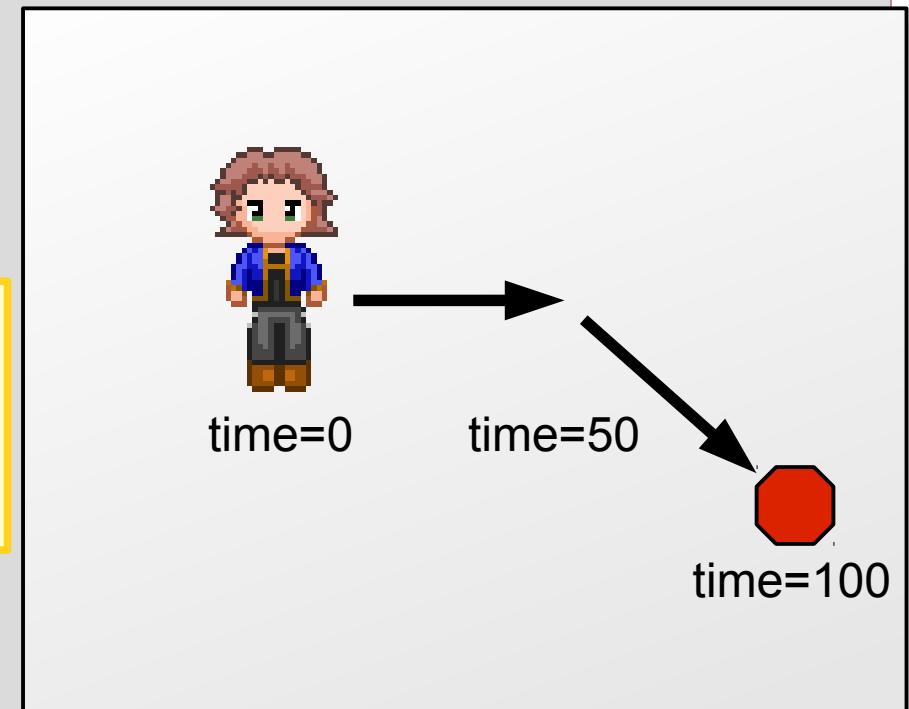
```
...
repeat(function() {
    c.clear();
    c.drawImage(a, x, y);
    time = time + 1;
    if (time > 1 && time < 50) {
        x = x + 1;
    }
});
```

When time is
between 1 and 50,
move right



What Time Is It?

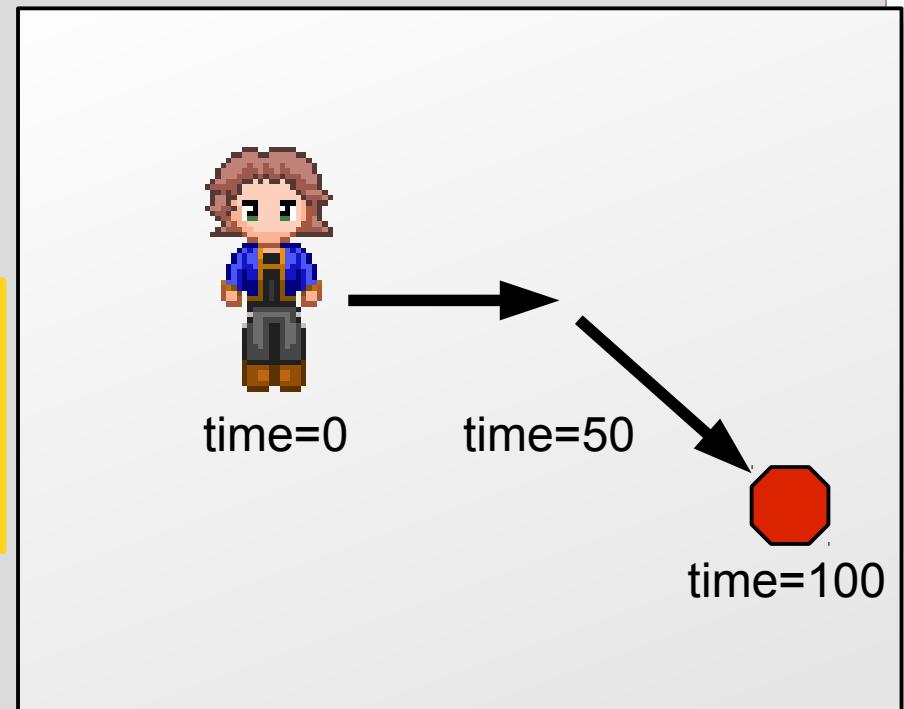
```
...  
repeat(function() {  
  
  c.clear();  
  c.drawImage(a, x, y);  
  time = time + 1;  
  if (time > 1 && time < 50) {  
    x = x + 1;  
  }  
  if (time > 50 && time < 100) {  
    x = x + 1;  
    y = y + 1;  
  }  
}) ;
```



What Time Is It?

```
...  
repeat(function() {  
  
  c.clear();  
  c.drawImage(a, x, y);  
  time = time + 1;  
  if (time > 1 && time < 50) {  
    x = x + 1;  
  }  
  if (time > 50 && time < 100) {  
    x = x + 1;  
    y = y + 1;  
  }  
});
```

When time is
between 50 and 100,
move right and down



```

a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
y = 50;
time = 1;
repeat(function() {

c.clear();
c.drawImage(a, x, y);
time = time + 1;
if (time > 1 && time < 50) {
  x = x + 1;
}
if (time > 50 && time < 100) {
  x = x + 1;
  y = y + 1;
}
});
```

- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it

[http://o.ooli.ca/ ...
 ele.png
 dog.png
 person.png
 car_top.png
 mona.jpg
 tree.png
 leaves.png
 stone.png
 brick.png
 grass.png](http://o.ooli.ca/ele.png)



F12

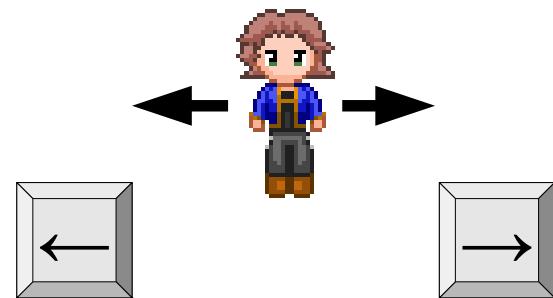


ctrl - shift ⌘ J



cmd⌘ - option⌥ - alt - C

Using the Keyboard



Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```

Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```

Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```

Animation Review

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



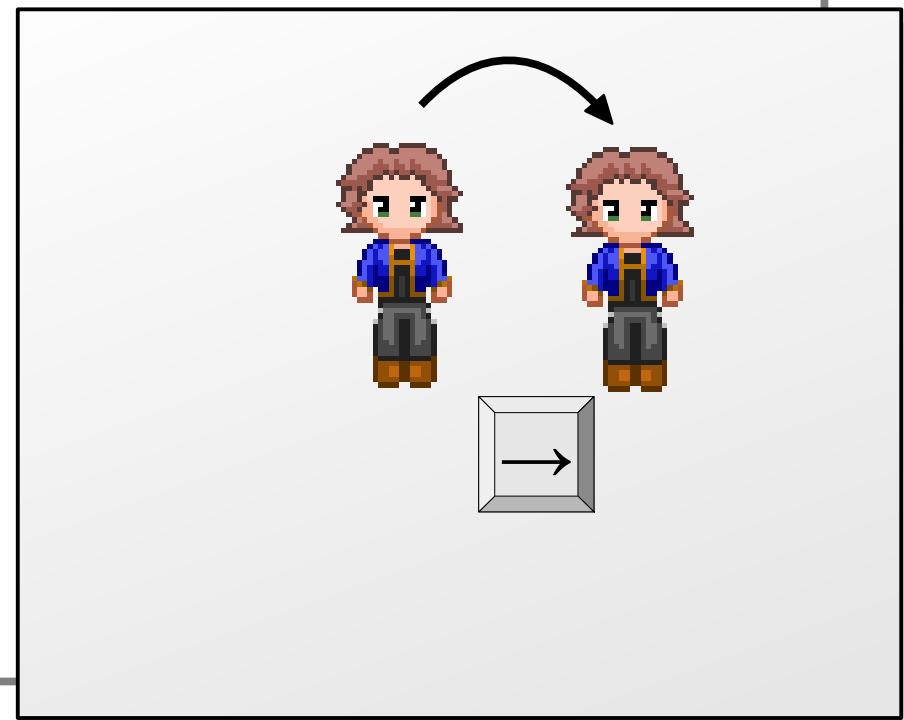
Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
});
```



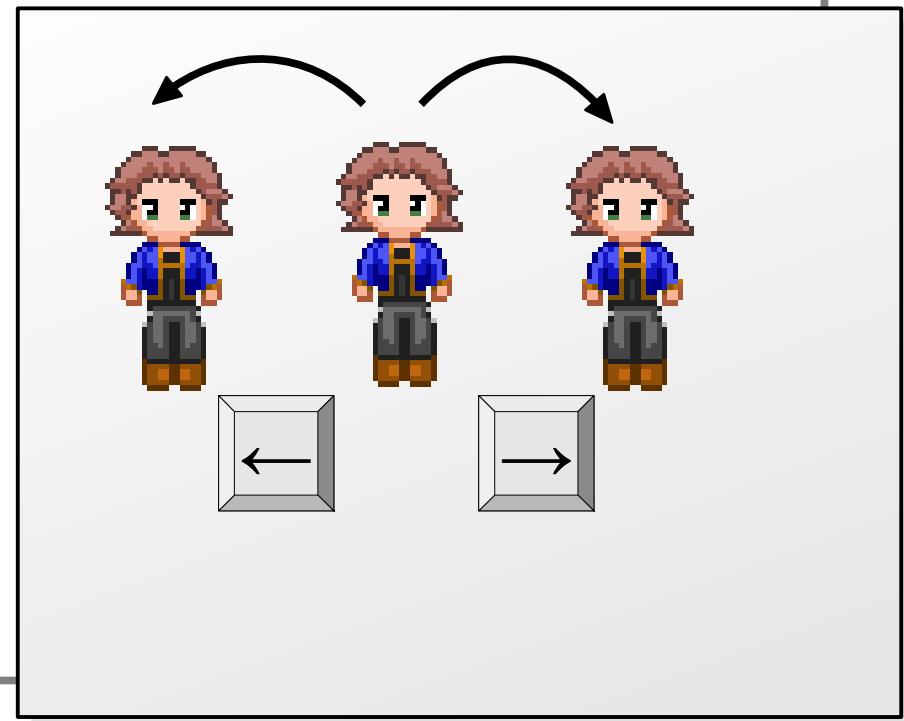
Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
}) ;
```



Keyboard: dx

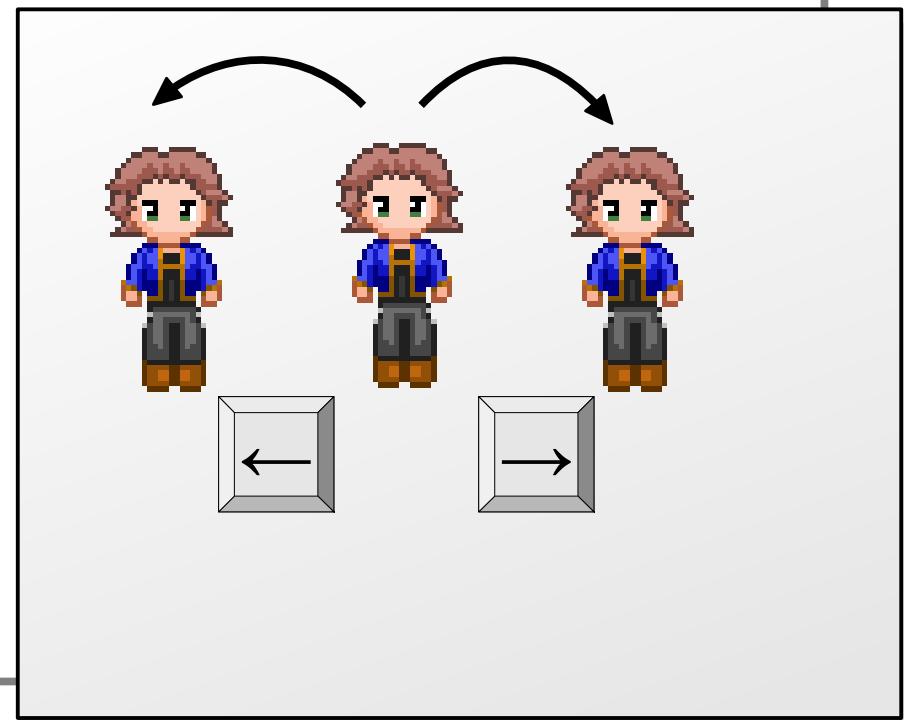
```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
}) ;
```



Keyboard: dx

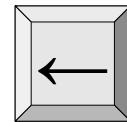
```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
}) ;
```

Done!

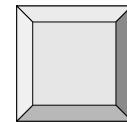


Keyboard: dx

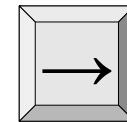
- Special variable dx



$dx = -1$



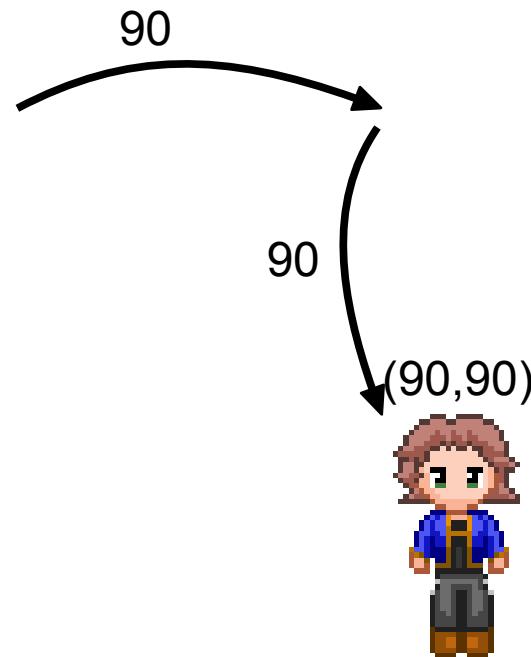
$dx = 0$



$dx = +1$

Keyboard: Why Does This Work?

- Remember, use (x, y) for positions



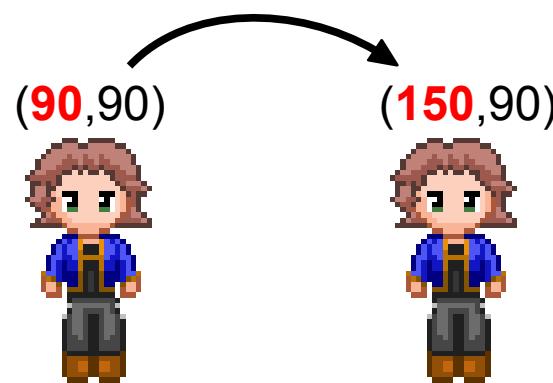
Keyboard: Change in Positions

- To go right, **x** should get **bigger**
- To go left, **x** should get **smaller**



Keyboard: Change in Positions

- To go right, **x** should get **bigger**
- To go left, **x** should get **smaller**



Keyboard: Change in Positions

- To go right, **x** should get **bigger**
- To go left, **x** should get **smaller**



Change in x

- To go right, x should get **bigger**
- To go left, x should get **smaller**



Change in x

$$\mathbf{x = x + 1}$$

- To go right, ~~x should get bigger~~
- To go left, x should get **smaller**



Change in x

$$\mathbf{x = x + 1}$$

- To go right, ~~x should get bigger~~

$$\mathbf{x = x - 1}$$

- To go left, ~~x should get smaller~~



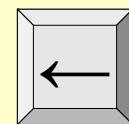
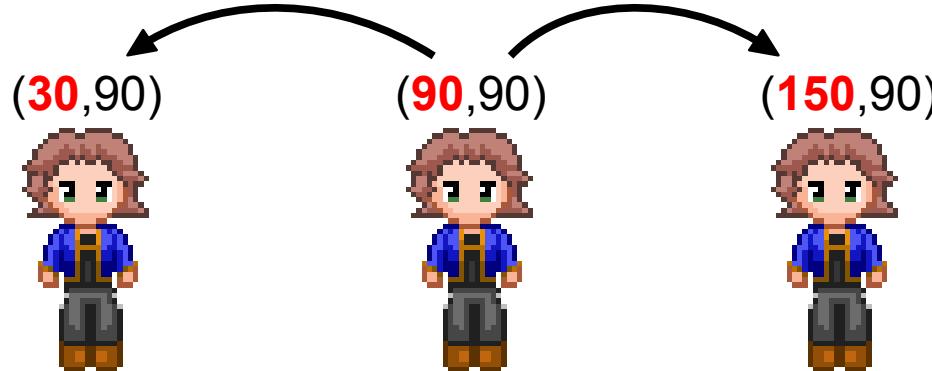
Keyboard

$$\textcolor{red}{x = x + 1}$$

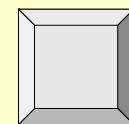
- To go right, ~~x should get bigger~~

$$\textcolor{red}{x = x - 1}$$

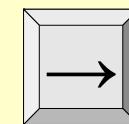
- To go left, ~~x should get smaller~~



$dx = -1$

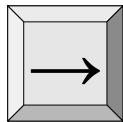


$dx = 0$



$dx = +1$

Keyboard

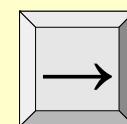
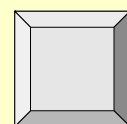
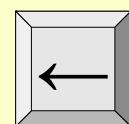
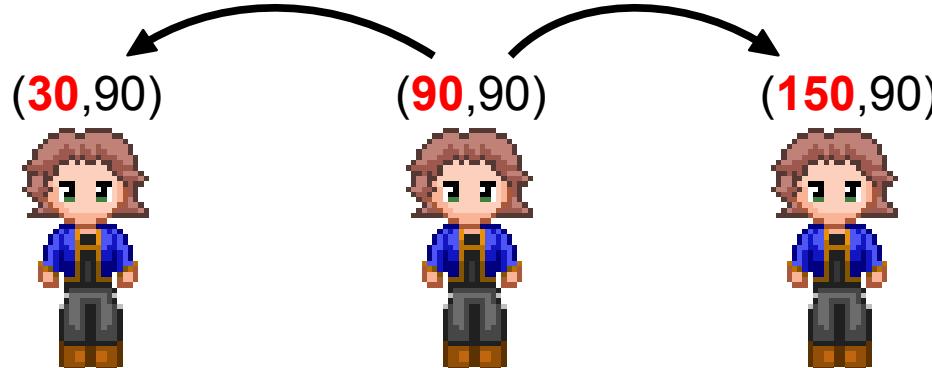


$$\textcolor{red}{x = x + 1}$$

- To go right, x should get **bigger**

$$\textcolor{red}{x = x - 1}$$

- To go left, x should get **smaller**

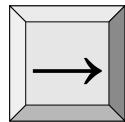


$$dx = -1$$

$$dx = 0$$

$$dx = +1$$

Keyboard

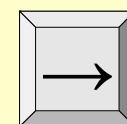
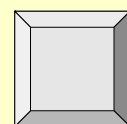
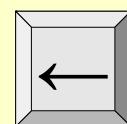
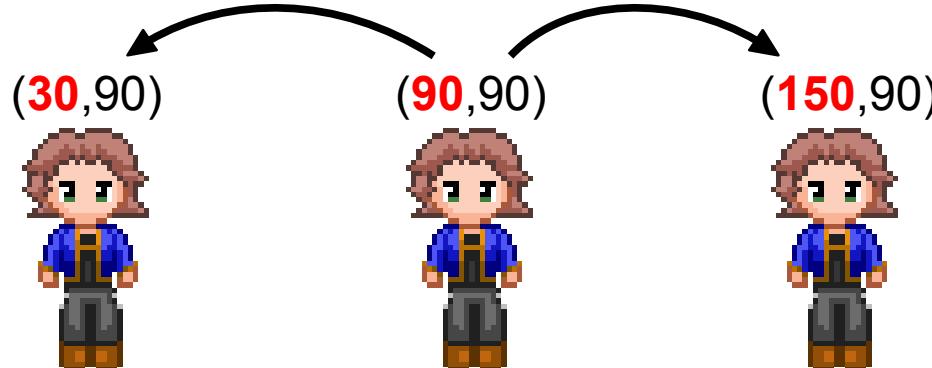


$$x = x + \downarrow dx$$

- To go right, x should get **bigger**

$$x = x - 1$$

- To go left, x should get **smaller**

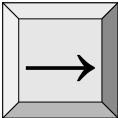
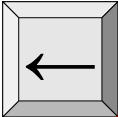


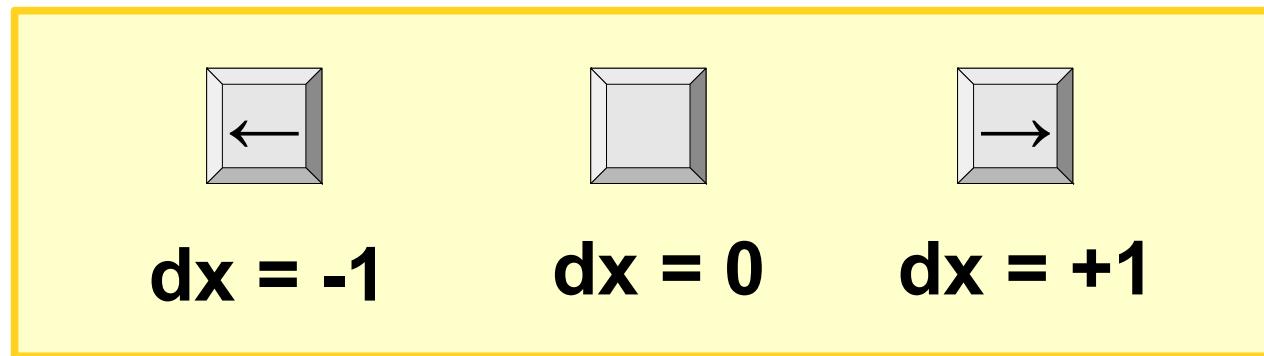
$dx = -1$

$dx = 0$

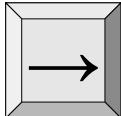
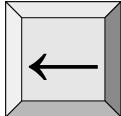
$dx = +1$

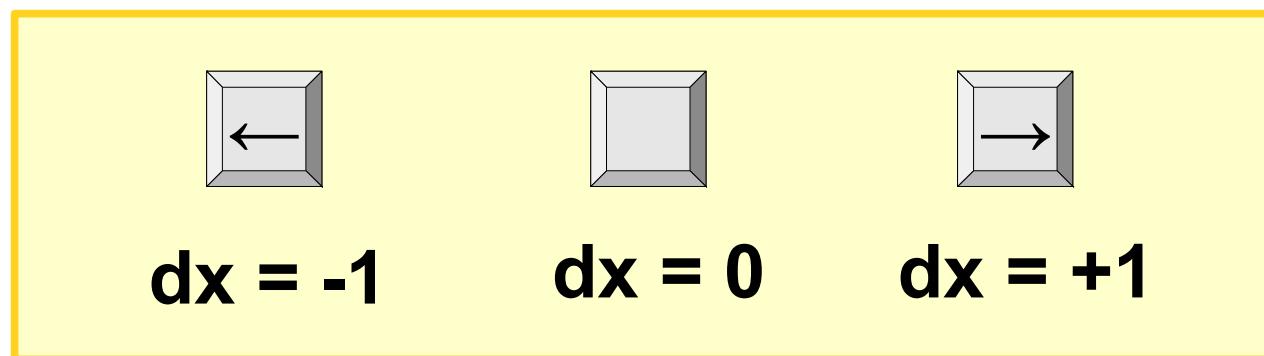
Keyboard

- To go right, ~~x should get bigger~~

$$x = x + \cancel{dx}$$
- To go left, ~~x should get smaller~~

$$x = x - 1$$



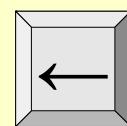
Keyboard

- To go right, ~~x~~ should get **bigger**

$$x = x + \cancel{dx}$$
- To go left, ~~x~~ should get **smaller**

$$x = x \cancel{-} + dx$$

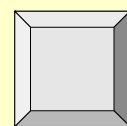


Keyboard

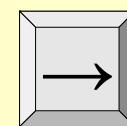
- To go right, ~~x should get bigger~~ $x = x + dx$
- To go left, ~~x should get smaller~~ $x = x - dx$



$dx = -1$



$dx = 0$



$dx = +1$

Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + 1;
});
```



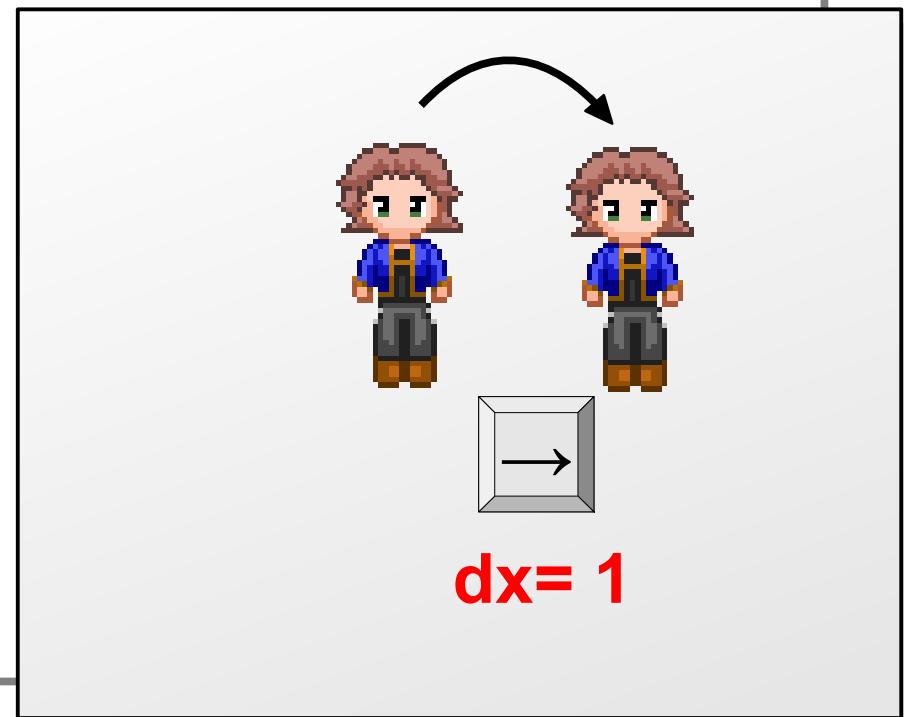
Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
});
```



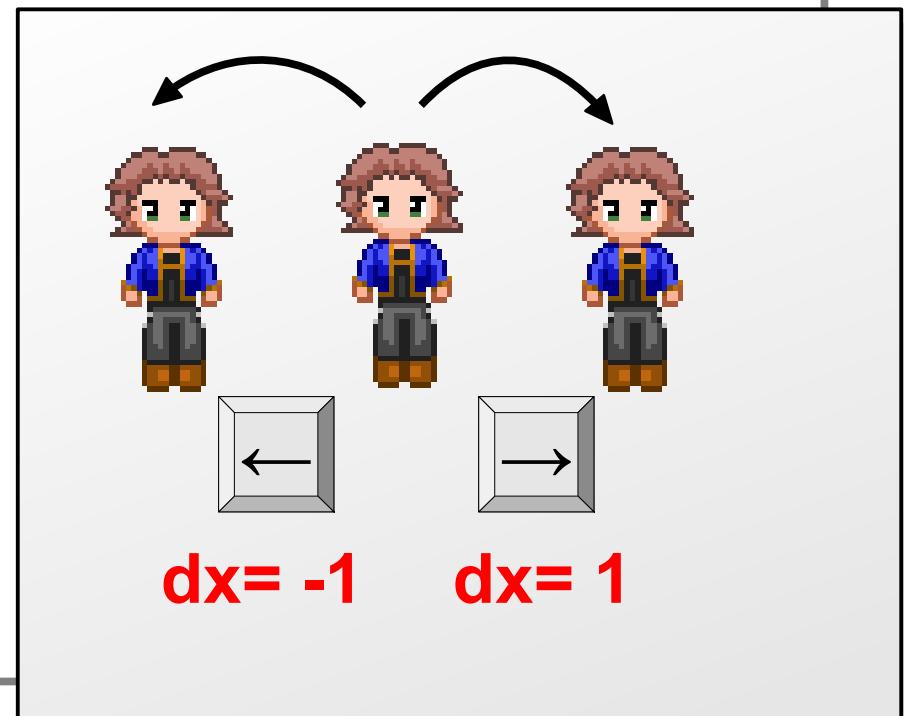
Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
}) ;
```



Keyboard: dx

```
a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
}) ;
```



Click on Canvas to Use Keyboard

JS Bin Add library Share **HTML** CSS JavaScript Console Output

HTML ▼

```
<!DOCTYPE html>
<html>
<canvas id="canvas" width="500" height="500">
</canvas>
<script>
```

 canvas =
 document.getElementById('canvas');
 c =
 canvas.getContext('2d');

JavaScript ▼

```
a = new Image();
a.src = 'http://o.oli.ca/person.png';
x = 50;
repeat(function() {
    c.clearRect();
    c.drawImage(a, x, 50);
    x = x + dx;
});
```

Output

Run with JS

Auto-run JS 



292

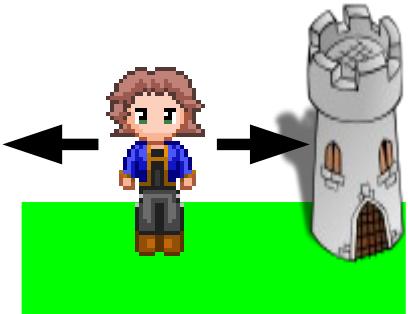
```

a = new Image();
a.src = 'http://o.ooli.ca/person.png';
x = 50;
repeat(function() {
    c.clear();
    c.drawImage(a, x, 50);
    x = x + dx;
});
```

- Find an image
- Right-click (ctrl-click)
- Copy
 - Copy Image URL
 - Copy Image Location
 - Copy Image Address
 - Properties...Address
- Paste it

[http://o.ooli.ca/ ...](http://o.ooli.ca/)
 ele.png
 dog.png
 person.png
 car_top.png
 mona.jpg
 tree.png
 leaves.png
 stone.png
 brick.png
 grass.png

Ideas



F12



ctrl - shift ⌘ J



cmd ⌘ - option ⌘ - alt - C

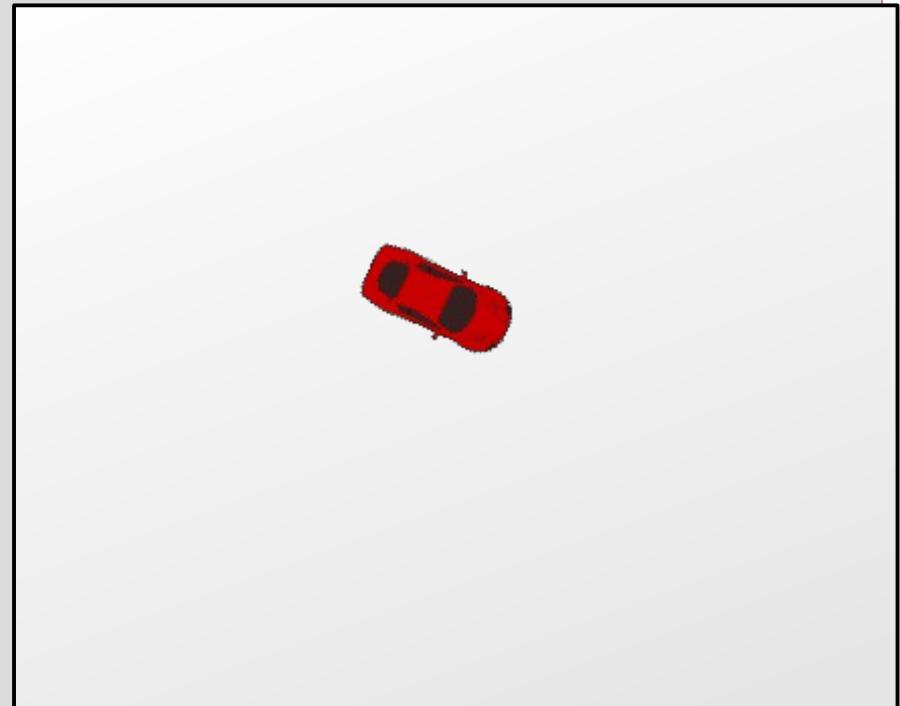
Driving Car

```
a = new Image();
a.src = 'http://o.ooli.ca/car_top.png';
x = 50;
y = 50;
angle = 0;
repeat(function() {

    angle = angle + dx;
    x = x - dy * Math.cos(angle * Math.PI / 180);
    y = y - dy * Math.sin(angle * Math.PI / 180);

    c.clear();
    c.translate(x, y);
    c.rotate(angle * Math.PI / 180);
    c.translate(-37, -19);
    c.drawImage(a, 0, 0);

    c.setTransform(1,0,0,1,0,0); // reset
});
```



Art Credits

Mage City Arcanos
Hyptosis
opengameart.org

Baurn
Rachel J. Morris
ArtSader

Justin Bieber
Kevin Aranibar of Kerosene Photography
CC Attribution 2.0 Generic

Chad Kroeger
James Anderson
CC Attribution-Share Alike 3.0 Unported

Celine Dion
Georges Biard
CC Attribution-Share Alike 3.0 Unported

neo1973
ryanlerch
openclipart.org

TV icon
jhni4
openclipart.org

Architetto -- macchina fotografica
Anonymous (francesco rollandin)
openclipart.org

Edit Hand Holding Pencil
darrenbeck
openclipart.org

tango style pen
(remix of tango pen)
warszawianka
openclipart.org

Brunette Female Driver
Merlin2525
openclipart.org

horse
machovka
openclipart.org

RPG man symbols: Round Tower
nicubunu
openclipart.org