Where do I Draw?
(coordinate systems and 2D Transforms)

CS559 – Spring 2017

Lecture 2

January 19th, 2017

Key Idea #1

Work in convenient coordinate systems. Use transformations to get from where you want to be to where you need to be. Hierarchical modeling lets us build things out of pieces.

Today:
Let’s Draw a Line!

HTML

```
<!DOCTYPE html>
<html>
<head>
   <meta name="description"
         content="Draw A Line">
</head>
<body>
   <canvas id="myCanvas"
     width="200" height="200"
     style="border:1px solid #000;">
   </canvas>
</body>
<!-- CS559 Tutorial by Michael
Gleicher -->
</html>
```

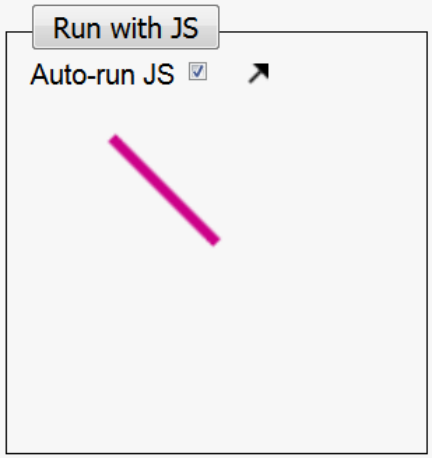
JavaScript

```
var canvas =
document.getElementById('myCanvas');
var context = canvas.getContext('2d');

// a fat purple line
context.lineWidth = 5;
context.strokeStyle = "#C08";

// the actual line
context.beginPath();
context.moveTo(50,50);
context.lineTo(100,100);
context.stroke();
```

Output



http://jsbin.com/satunaromo/edit

Why this?

A little web programming

so you can do the assignment

Exposure to a graphics library (API)

Some important graphics concepts

What does this program do?

What does this program do?

It draws a line

What does this program do?

It draws a thick red diagonal line

What does this program do?

It puts a drawing space on the page

called a **canvas**

It causes a bunch of pixels to be changed from the background color to purple

The HTML

You need some

Make a **canvas**

Give it an **id**

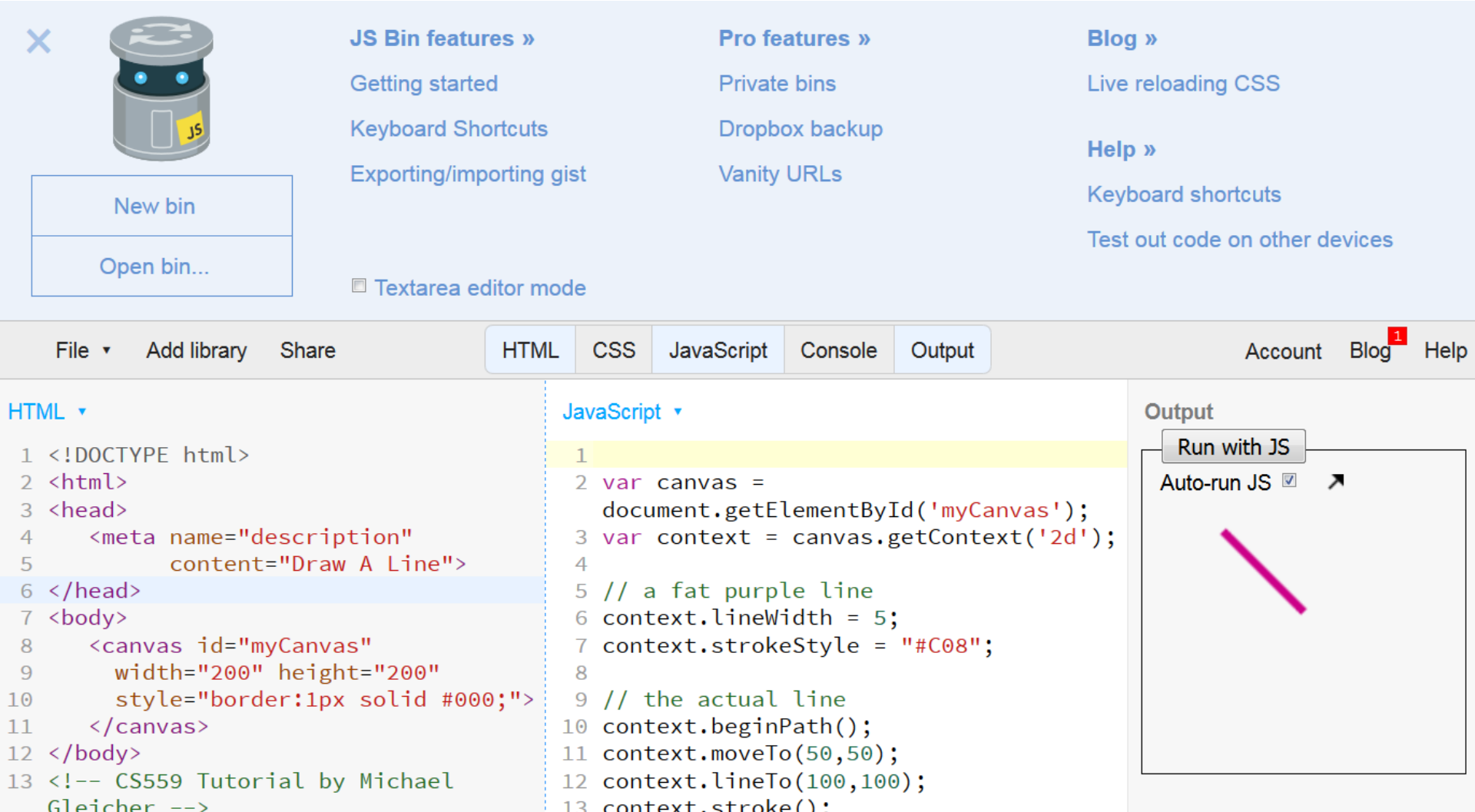
Not really graphics…

HTML ▾

```
1  <!DOCTYPE html>
2  <html>
3  <head>
4     <meta name="description"
5           content="Draw A Line">
6  </head>
7  <body>
8     <canvas id="myCanvas"
9       width="200" height="200"
10      style="border:1px solid #000;">
11    </canvas>
12 </body>
13 <!-- CS559 Tutorial by Michael
   Gleicher -->
14 </html>
15
```

JSBin...

Sticks the JavaScript into the HTML body



The JavaScript

Warning:
read the tutorial on when code runs!

The JavaScript

Find the canvas

Get the context

Draw

JavaScript ▾

```
1
2 var canvas =
  document.getElementById('myCanvas');
3 var context = canvas.getContext('2d');
4
5 // a fat purple line
6 context.lineWidth = 5;
7 context.strokeStyle = "#C08";
8
9 // the actual line
10 context.beginPath();
11 context.moveTo(50,50);
12 context.lineTo(100,100);
13 context.stroke();
14
15
```

Context?

An API with state

Set the style for the next drawing commands

JavaScript ▾

```
1
2  var canvas =
   document.getElementById('myCanvas');
3  var context = canvas.getContext('2d');
4
5  // a fat purple line
6  context.lineWidth = 5;
7  context.strokeStyle = "#C08";
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12 context.lineTo(100,100);
13 context.stroke();
14
15
```

Context

What pen and paper are we using?

The state needed to know how to draw

- where are we drawing?
- any mode information
- properties to use for next commands
- other info

Object oriented APIs

- receieves drawing commands

Drawing – immediate mode

Drag the pen along the path

Now

JavaScript ▾

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12 context.lineTo(100,100);
   context.stroke();
14
15
```

Immediate vs. Retained

2 types of APIs

Immediate: draw now

Retained: store the object

gather them all up

draw them all at once

Drawing – immediate mode

The line never "exists"

Only gets turned into pixels

JavaScript ▾

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```

Immediate Mode

Pros:

- easy – does what you want
- control over timing

Cons:

- can't change things (need to redraw)
- can't analyze collection
- can't send things in bulk

Pen and Path Model

Move pen around

Stroke or Fill
in current style

JavaScript ▾

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2  var canvas =
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```

Not for today...

How do we convert from
primitives (the line) to **pixels**?

Need to determine which pixels to set to which colors.

rasterization

rendering

Coordinates and Coordinate Systems

What does 50,50 mean?

JavaScript ▾

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```

Interpreting coodinates **with** coordinate systems

Need to know what it means

Want to use convenient numbers

Need to be able to translate between systems

Manipulate systems to move objects

A tuple (ordered list) of numbers

50,50 – is just a list of numbers

Vectors – a movement, a displacement, …

Represented in a tuple / array

Point / position – specific place

Represented in a tuple / array