

Data Visualization (CSCI 627/490)

Web Programming

Dr. David Koop

Languages of the Web

- HTML
- CSS
- SVG
- JavaScript
 - Versions of Javascript: ES6, ES2015, ES2020...
 - Specific frameworks: react, jQuery, bootstrap, D3

Hyper Text Markup Language (HTML)

- Markup languages allow users to encode the **semantics** of text
- Elements structure a document
 - Elements delineated by tags: `<h1>An element</h1>`
 - Document Object Model (DOM)
 - We can **navigate** this tree
- Identifying and Classifying elements: `id` and `class` attributes
 - `id` identifies a **single** element—use for a unique case
 - `class` may identify **multiple** elements—use for common cases
 - Each element may have multiple classes, separate by spaces
 - Use normal identifiers: don't start the name with a number

Cascading Style Sheets (CSS)

- Separate style from content, just specifies how to style the content
- Style information appears in three places: external, head, ~~individual elements~~
- Statement: `<selectors>: { <style definitions> }`
- Cascading:
 - use inheritance idea
 - properties that apply to children cascade down
- Selectors: element types (`strong`), ids (`#main-section`), classes (`.cool`)
 - Can combine to be more specific
 - `#main-section em, .cool > strong, p.cool`
 - Can group: `#main-section, p.cool { font-size: 16pt; }`

Example CSS

```
body {  
    font-face: sans-serif;  
    font-size: 12pt;  
}  
em { color: green; }  
em u { color: red; }  
em > strong { color: blue; }  
img { border: 4px solid red; }
```

- What colors are displayed for this HTML (with the above stylesheet)?
 - `This is cool. What about
<u>this?</u>`

CSS Specificity

- Example:

- CSS:

```
p.exciting { color: red; }  
p { color: blue; }
```

- What is the color of the paragraph

```
<p class="exciting">Cool</p>?
```

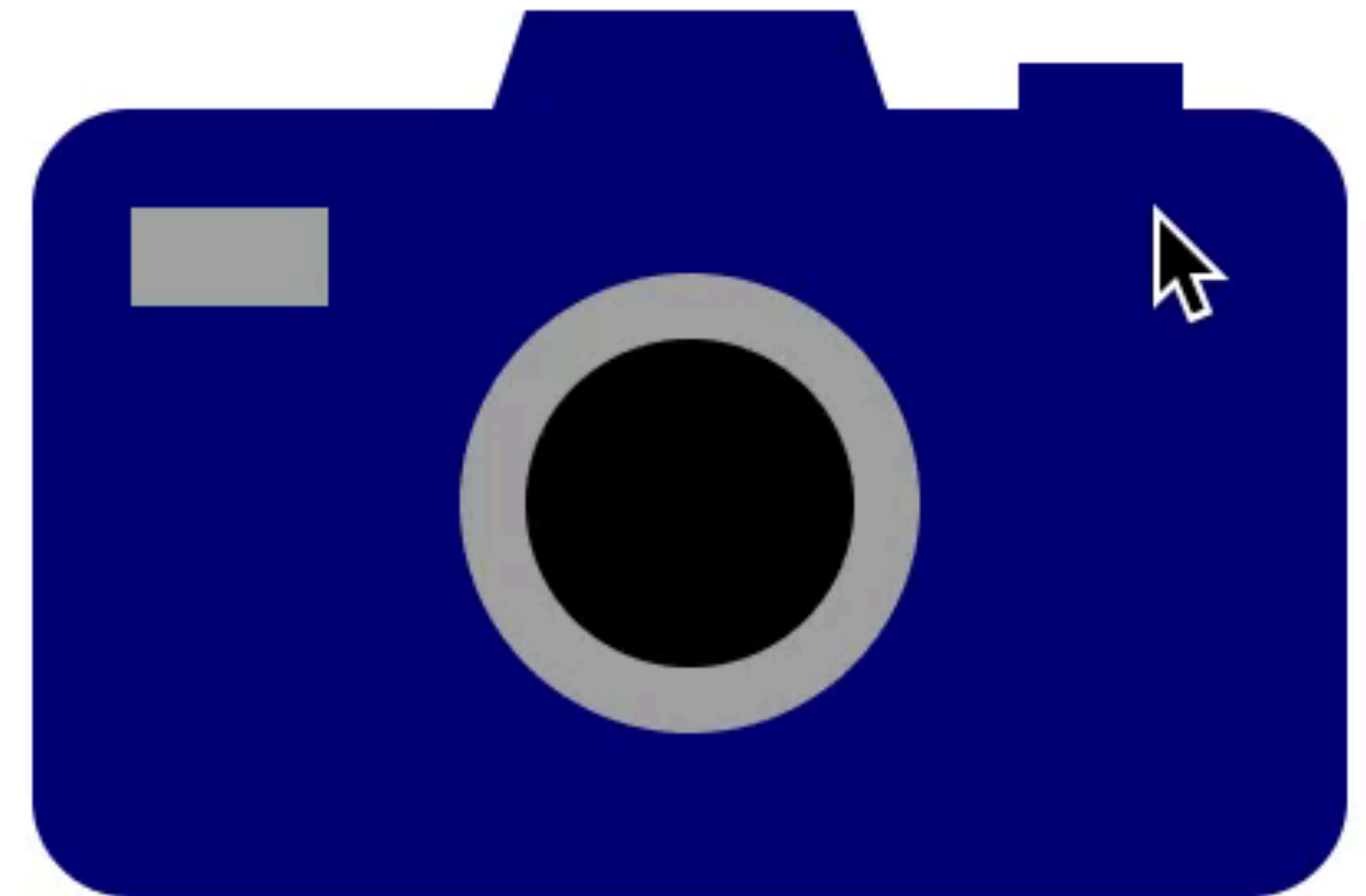
- Generally, last rule listed overrides previous rules
- ...but anytime a selector is **more specific**, it has precedence
- `p.exciting` is a more specific selector
- When in doubt, **test it** in a browser

How to add CSS to HTML

- External: a separate file via a link element (in the <head> section):
 - `<link rel="stylesheet" href="styles.css">`
- Embedded: in the header:
 - `<style type="text/css"> ... </style>`
- Inline: for a specific element: (**Discouraged!**)
 - `<p style="font-weight: bold;">Some text</p>`

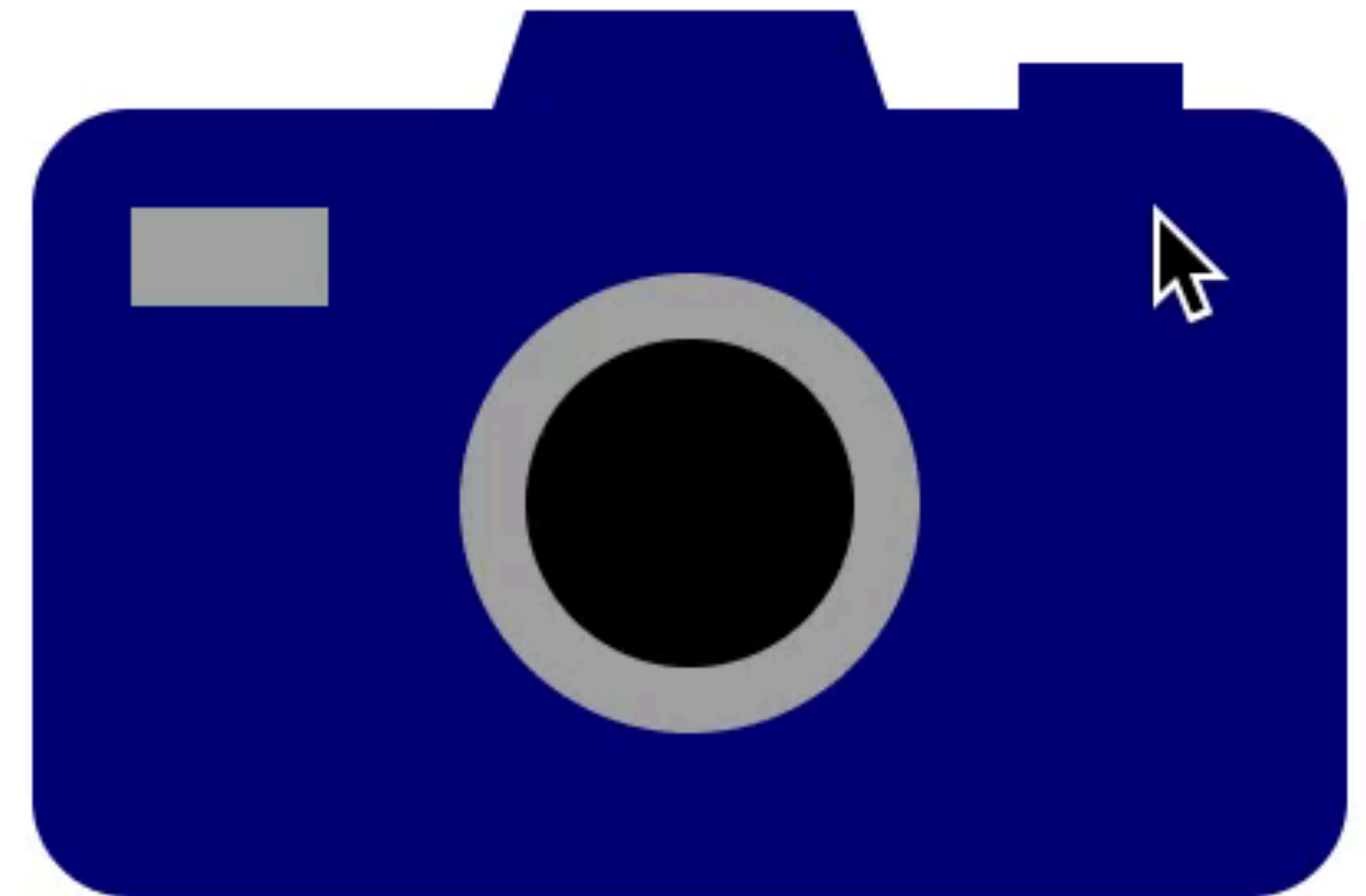
Assignment 1

- Write HTML, CSS, and SVG
- Text markup and styling (information)
- Drawing markup and styling (camera)
- Draw Bar chart using Plot library
- Due Wednesday, Jan. 29



Assignment 1

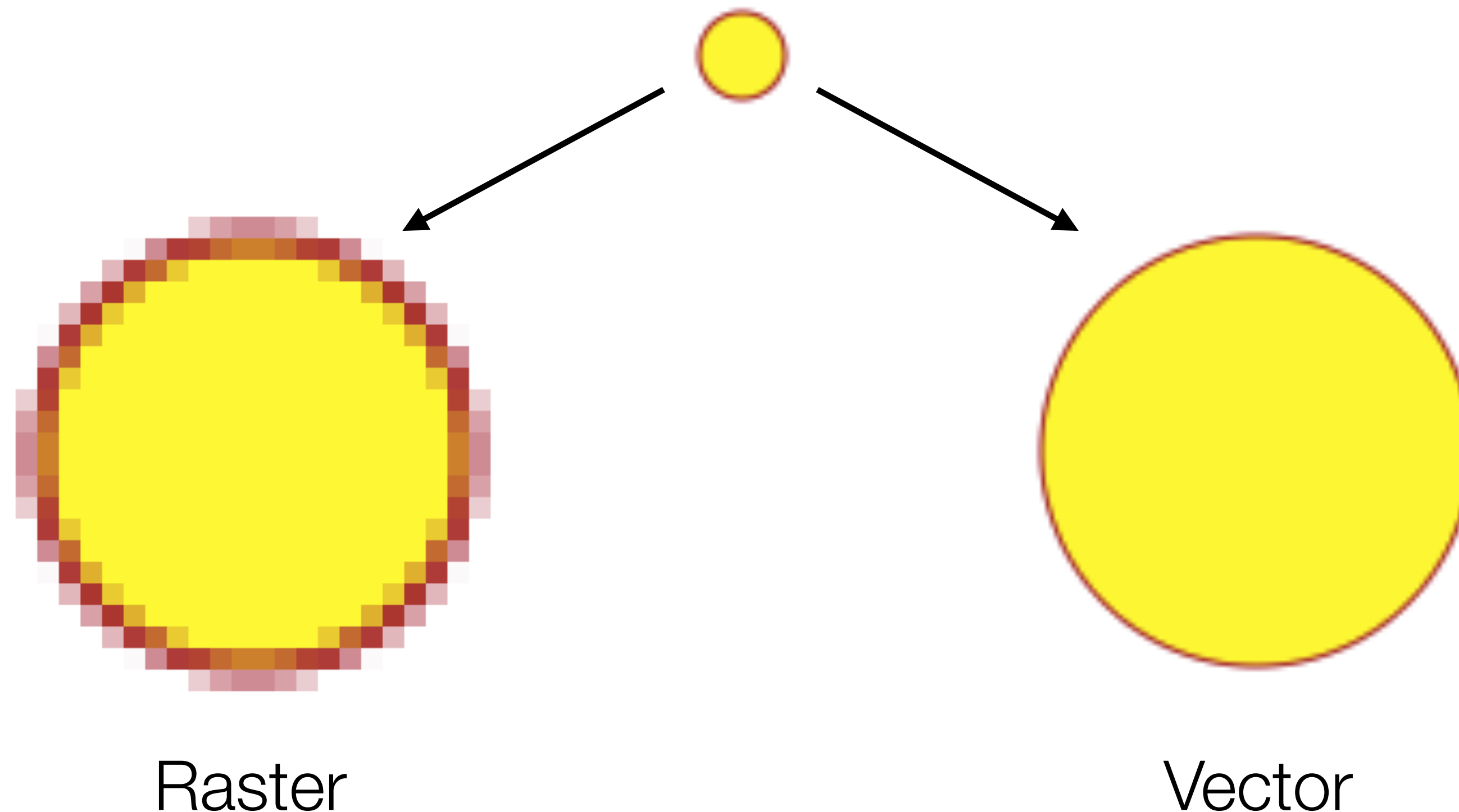
- Write HTML, CSS, and SVG
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What is the difference between
vector and raster graphics?

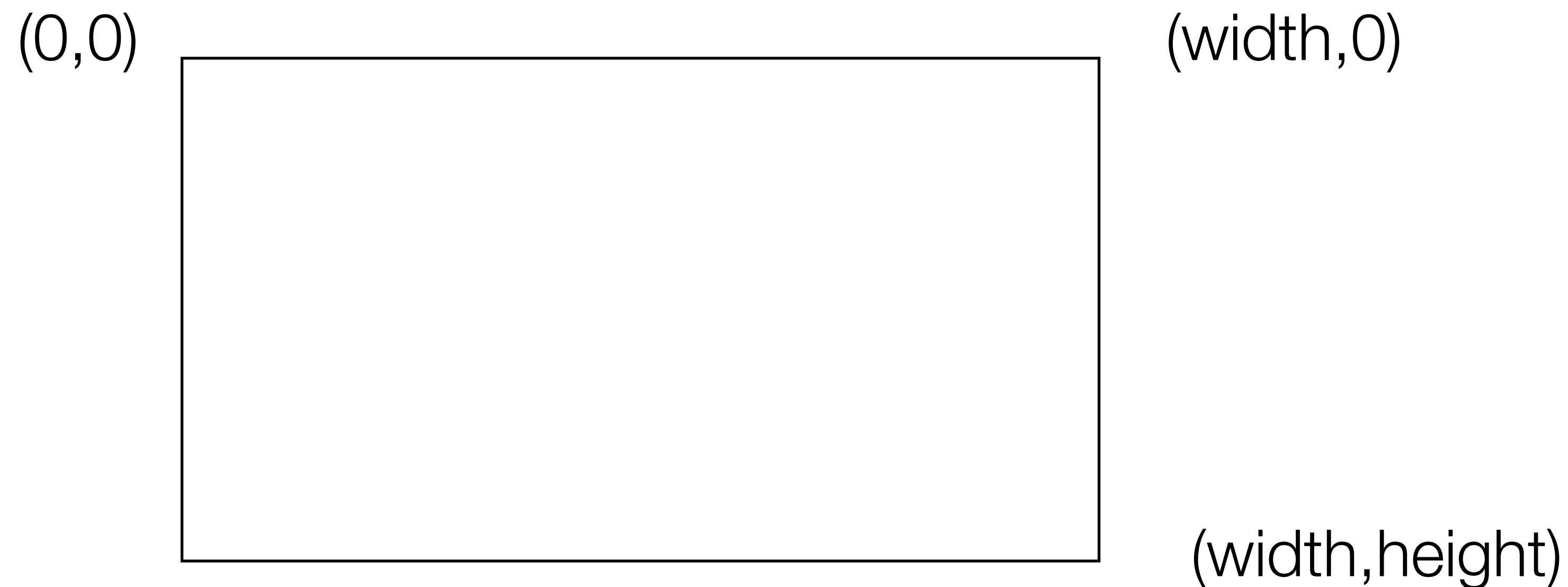
Scalable Vector Graphics (SVG)

- Vector graphics vs. Raster graphics
- Drawing commands versus a grid of pixels
- Why vector graphics?



SVG Background

- Another markup language:
 - Describe the shapes and paths by their endpoints, characteristics
- SVG can be embedded into HTML5 documents!
- Pixel Coordinates: **Top-left** origin



SVG Elements

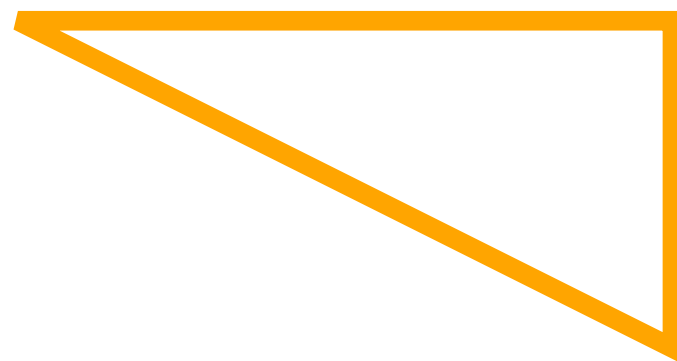
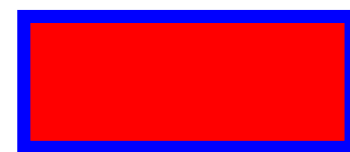
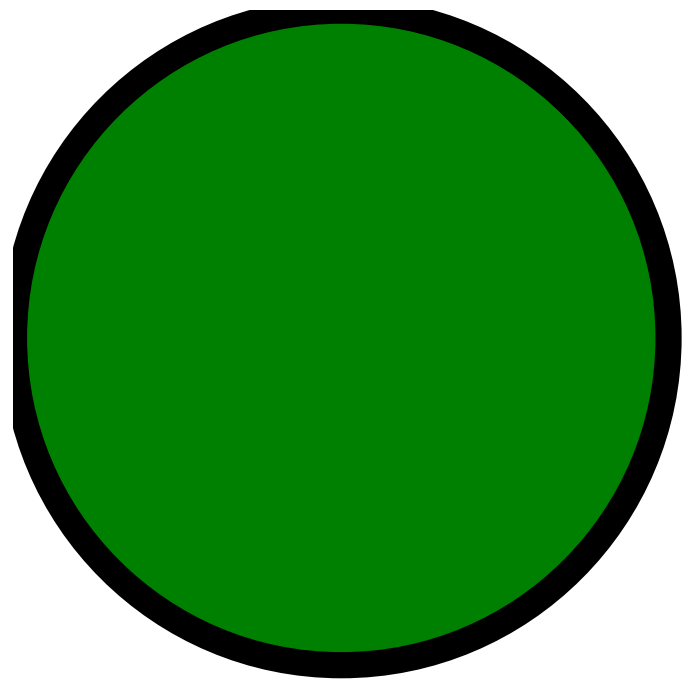
- Drawing primitives:
 - Lines, Circles, Rects, Ellipses, Text, Polylines, Paths
 - Work by specifying information about **how** to draw the shape
 - Lots more: see [MDN Documentation](#)
- Ordering/Stacking:
 - SVG Elements are drawn in the order they are specified
- Paths: directions for drawing
 - <https://developer.mozilla.org/en-US/docs/Web/SVG/Tutorial/Paths>

SVG Styles

- We can specify styles of SVG elements in CSS!
- Example:

```
circle { fill: green; stroke: black;
        stroke-width: 4px; }
.normal { fill: red; stroke: blue;
          stroke-width: 2px; }
#p1 { fill: none; stroke: red; stroke-width: 3px; }
```


SVG Example



```
<svg id="mysvg" width="300" height="600">
  <circle cx="50" cy="50" r="50"/>
  <rect class="lego" x="150" y="150"
        width="50" height="20"/>
  <path id="triangle" d="M 20 200
                        L 120 200 L 120 250 Z"/>
```

```
</svg>
```

```
circle { fill: green; stroke: black;
          stroke-width: 4px; }
```

```
.lego { fill: red; stroke: blue;
        stroke-width: 2px; }
```

```
#triangle { fill: none; stroke: orange;
            stroke-width: 3px; }
```


SVG Grouping

- Very powerful, useful for animations and transformations
- `<g> <circle .../> <circle ... /> <circle ... /></g>`
- Can add transforms to the group:

```
<svg width="200" height="200">
  <g transform="translate(0, 200) scale(1, -1)">
    <circle cx="50" cy="50" r="10"/>
    <circle cx="80" cy="80" r="10"/>
    <circle cx="110" cy="50" r="10"/>
    <circle cx="140" cy="90" r="10"/>
  </g>
</svg>
```



[[SVG Example](#), Scheidegger, 2016]

JavaScript in one slide

- Interpreted and Dynamically-typed Programming Language
- Statements end with semi-colons, normal blocking with brackets
- Variables: `var a = 0; let b = 2; const d = 4;`
- Operators: `+, -, *, /, [ ]`
- Control Statements: `if (<expr>) {...} else {...}, switch`
- Loops: `for, while, do-while`
- Arrays: `var a = [1,2,3]; a[99] = 100; console.log(a.length);`
- Functions: `function myFunction(a,b) { return a + b; }`
- Objects: `var obj = {x: 2, y: 4}; obj.x = 3; obj.y = 5;`
 - Prototypes for instance functions
- Comments are `/* Comment */` or `// Single-line Comment`

JavaScript References

- Learn Just Enough JavaScript: Introduction, P. Boffa
- Eloquent JavaScript, M. Haverbeke
- MDN Tutorials
- Interactive Data Visualization for the Web, Murray

JavaScript Objects

- `var student = {name: "John Smith", id: "000012345", class: "Senior", hometown: "Peoria, IL, USA"};`
- Objects contain multiple values: key-value pairs called **properties**
- Accessing properties via dot-notation: `student.name`
- May also contain functions:
 - `var student = {firstName: "John",
 lastName: "Smith",
 fullName: function() {
 return this.firstName + " " + this.lastName; } };`
`student.fullName()`
- JavaScript Object Notation (JSON): data interchange format
 - nested objects and arrays (data only, no functions!), **subset** of JavaScript

Objects as Associative Arrays/Dictionaryes

- Objects have key-value pairs and can be addressed via those keys, either via dot-notation or via bracket notation: [`<key>`]
- Example:

```
states = {"AZ": "Arizona", "IL": "Illinois", ...};  
// Get a state's name given it's abbreviation  
console.log("IL is " + states["IL"]);
```
- Similar to dictionaries or associative arrays in other languages (e.g. Python)
- Dot-notation only works with certain identifiers, bracket notation works with more identifiers
- Notebook