Data Visualization (DSC 530/CIS 602-01)

CSS, SVG, and JavaScript

Dr. David Koop
Definition of Visualization

“Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.”

— T. Munzner
Why Visual?

[F. J. Anscombe]
Why Visual?
Why Computers?
Limitations

[C. G. Healey]
Design Space: Think Broad

[Design Study Methodology, Sedlmair et al., 2012]
A Nine-Stage Framework

[Design Study Methodology, Sedlmair et al., 2012]
Administrivia

- Course Web Site
- Syllabus
  - Plagiarism
  - Accommodations
- Books:
  - Required: Munzner (VAD)
  - Rec'd: Murray (IDV)
- Assignments
- Exams
- Project: Create an interactive vis
- Registration: Everyone should be registered for the course by now
What languages do we use on the Web?
Languages of the Web

- HTML
- CSS
- SVG
- JavaScript
  - Versions of Javascript: ES6, ES2015, ES2017...
  - Specific frameworks: react, jQuery, bootstrap, D3
Basic HTML File

<!DOCTYPE html>
<html>
  <head>
    <title>A Basic Web Page</title>
  </head>
  <body>
    <h1>My Wicked Awesome Web Page</h1>
    <p><em>This is <strong>cool</strong>. What about <u><strong>this?</strong></u></em></p>
    <img src="patriots.jpg"/>
  </body>
</html>
HTML Elements and Attributes

• Tags denote **elements** of the content (e.g. sections, paragraphs, images)

• Each element may have **attributes** which define other information about the element
  
  - An attribute has a **key** and **value** *(key=“value”)*
  
  - e.g. `<img src=“mypicture.png” alt=“My Image”>`

• Many different elements available
  
  - Common: headers (h1, …, h6), paragraph (p), lists (ul, ol, li), emphasis (em, strong), link (a), spans & divisions (span, div)
  
  - Lots more (e.g. abbr): see [MDN Documentation](#)

• Many different attributes available
  
  - See [MDN Documentation](#): note that some are legacy due to CSS
How to write HTML

• Use a standard text editor
• Use a web site like jsfiddle, jsbox, codepen, etc.
• Use an IDE like WebStorm
Cascading Style Sheets (CSS)

- Separate from content, just specifies how to style the content
- Style information can appear in three places:
  - External file
  - In a style element at the beginning of the HTML file
  - In a specific element in the body of a document (least preferable)
- Why Cascading?
  - Don’t want to have to specify everything over and over
  - Often want to use the same characteristics in a region of the DOM
  - Use inheritance: properties that apply to children cascade down
CSS Selectors

• How do we specify what part(s) of the page we want to style?
• The **element types** themselves (the HTML tag)
  - `strong { color: red; }`
• **Classes** of elements (ties to HTML `class` attribute)
  - `.cool { color: blue; }`
• A **specific** element (ties to HTML `id` attribute)
  - `#main-section { color: green; }
• Relationships
  - Descendant: `p em { color: yellow; }
  - Child: `p > em { color: orange; }
• Pseudo-classes: `a:hover { color: purple; }`
Other CSS Bits

• Comments: /* This is a comment in CSS */
• Grouping Selectors: `p, li { font-size: 12pt; }`
• Multiple Classes: `.cool.temp { color: blue; }`
• Colors:
  - Names (Level 1, 2, & 3): `red, orange, antiquewhite`
  - Hash notation (3- & 6-character): `#fff, #00ff00`
  - Integer or % RGB and HSL Functions: `rgb(255, 0, 0),
    rgb(50%, 50%, 0%), hsl(120, 100% 50%)`
    - Also `background-color`
• Watch out for multiple rules (look at how a web browser parses)
• Again, much more documentation at MDN
Sample 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)?
  - <em>This is <strong>cool</strong>. What about <u><strong>this</strong></u></em>
CSS Specificity

• Example:
  
  - CSS:

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

    - What is the color of the paragraph

      ```
      <p class="highlight">Cool</p>
      ```

  
  • Generally, last rule listed overrides previous rules
  
  • …but anytime a selector is more specific, it has precedence

  • `p.highlight` 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>`
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?

Raster → Vector
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

\[(0,0) \quad \text{to} \quad (width, 0) \quad \text{to} \quad (width, height)\]
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
SVG Example

```xml
<svg id="mysvg" width="400" height="300">
  <circle cx="50" cy="50" r="50"
       style="fill:green; stroke:black; stroke-width:4px"/>
  <rect x="150" y="150" width="50" height="20"
       style="fill:red; stroke: blue; stroke-width: 2px;"/>
  <path d="M 200 10 L 300 10 L 300 50 Z"
        style="fill: none; stroke: red; stroke-width:3px;"/>
</svg>
```

• Note that the style is separate…
• Paths are raw drawing commands (ever see Logo?)
• What does this look like?