Introduction to D3

Maneesh Agrawala

CS 448B: Visualization
Fall 2020

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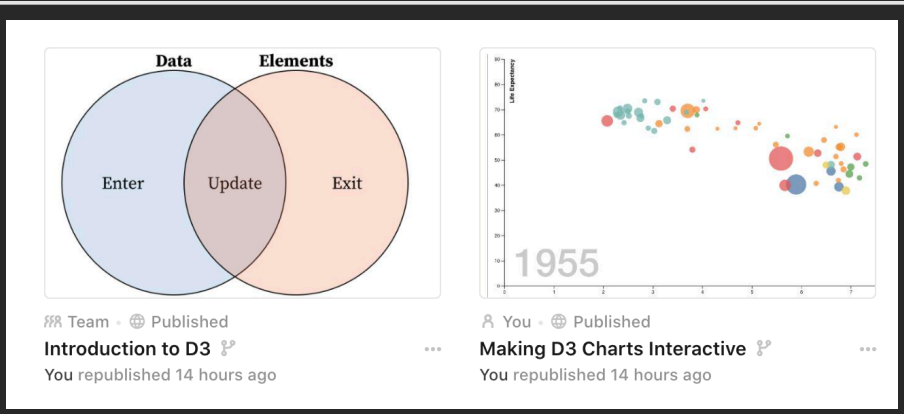
D3 Notebooks



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Last Time: Interaction

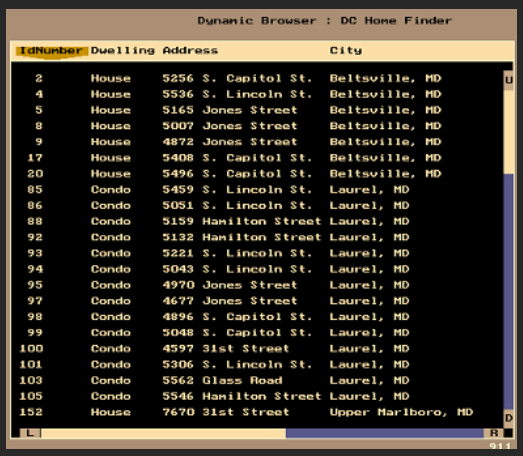
3

Dynamic Queries

6

Query and results

SELECT house
FROM east bay
WHERE price < 1,000,000 AND bedrooms > 2
ORDER BY price



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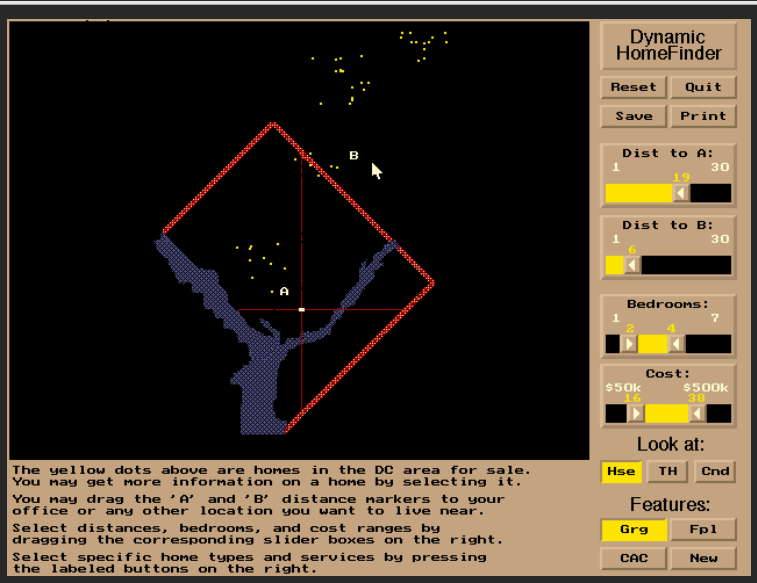
HomeFinder



[Ahlberg and Schneiderman 92]

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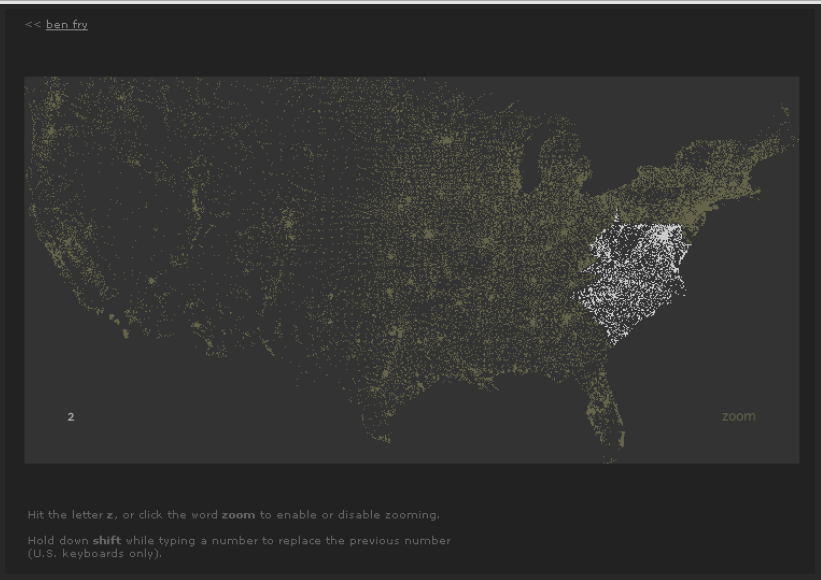
Zipdecode [from Fry 04]



https://benfry.com/zipdecode/

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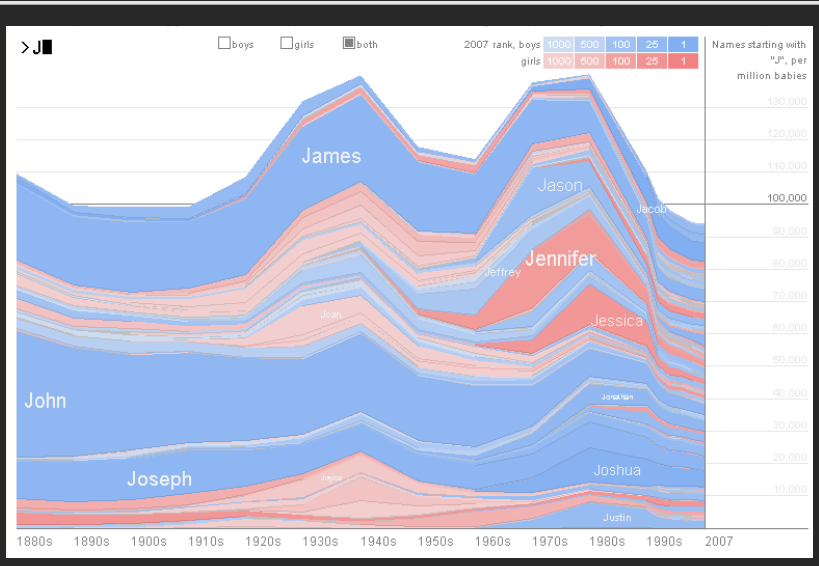
NameVoyager



http://www.babynamewizard.com/voyager

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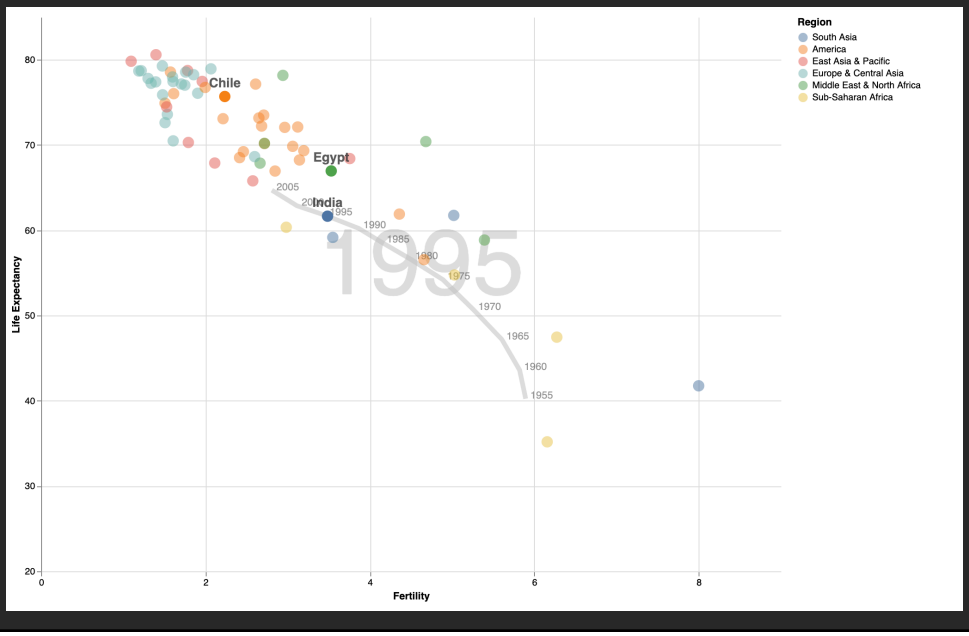
DimpVis [Kondo 14]



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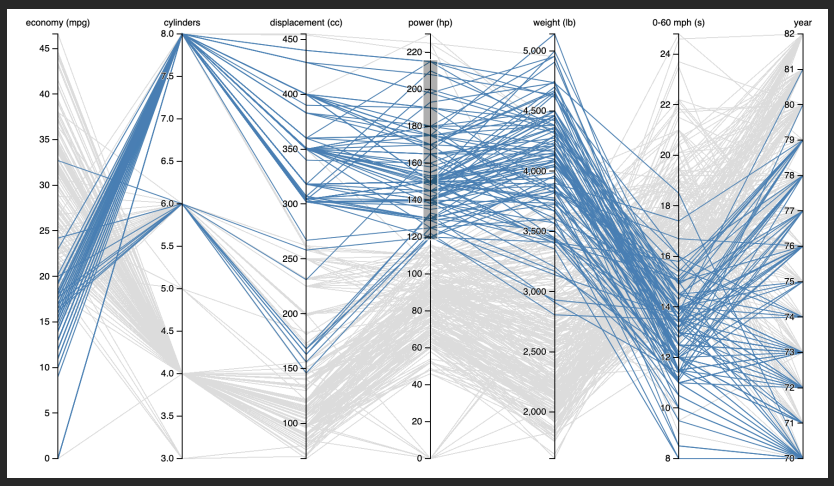
Parallel Coordinates [Inselberg]



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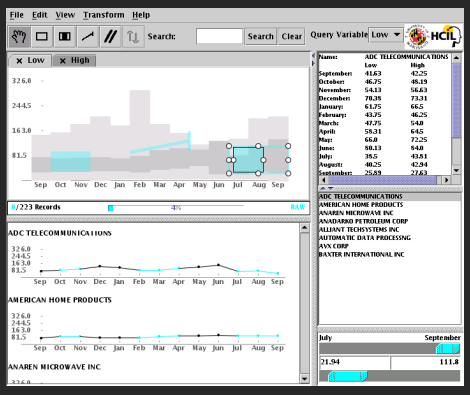
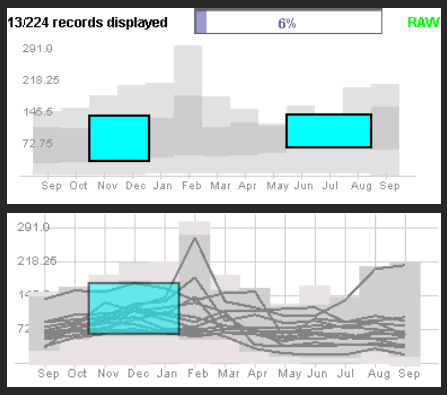
TimeSearcher [Hochheiser & Schneiderman 02]





Based on Wattenberg's [2001] idea for sketch-based queries of time-series data.

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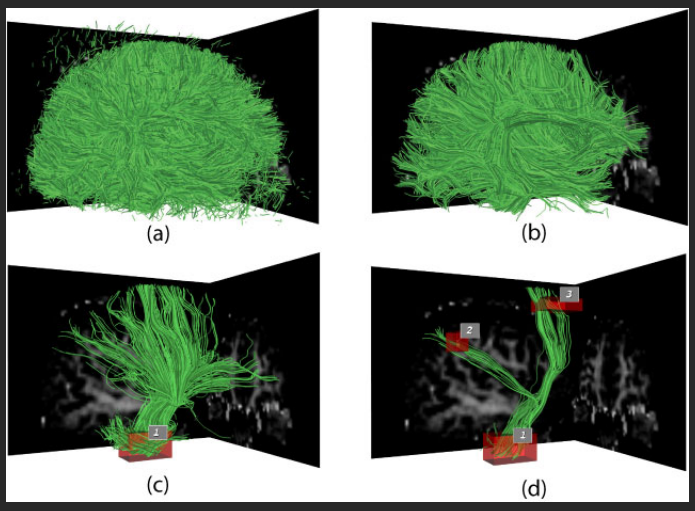
3D dynamic queries [Akers et al. 04]



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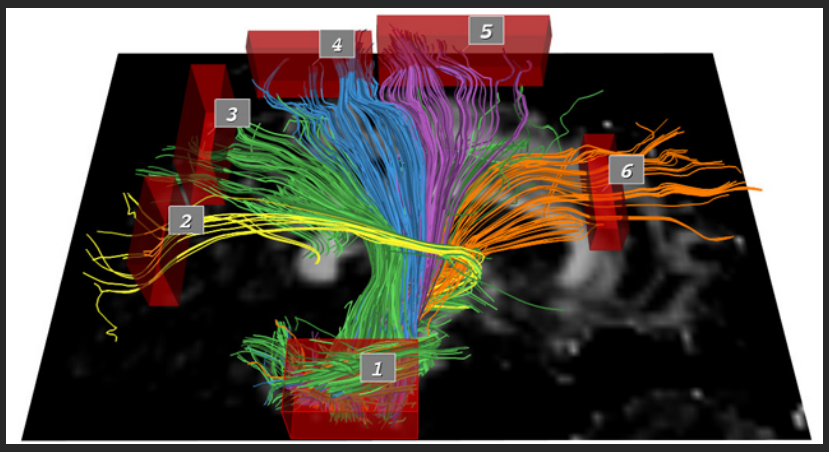
3D dynamic queries [Akers et al. 04]



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Pros and cons

Pros

- Controls useful for both novices and experts
- Quick way to explore data

Cons

- Simple queries
- Lots of controls
- Amount of data shown limited by screen space

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Summary

Most visualizations are interactive

- Note that even passive media elicit interactions

Good visualizations are task dependent

- Pick the right interaction technique

Fundamental interaction techniques

- Selection, Brushing & Linking, Dynamic Queries

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Announcements

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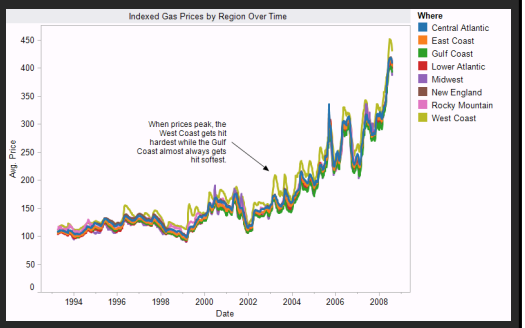
A2: Exploratory Data Analysis

Use Tableau to formulate & answer questions

First steps

Step 1: Pick domain & data
Step 2: Pose questions
Step 3: Profile data
Iterate as needed



Create visualizations

Interact with data
Refine questions

Author a report

Screenshots of most insightful views (10+)
Include titles and captions for each view

Due before class on Oct 6, 2020

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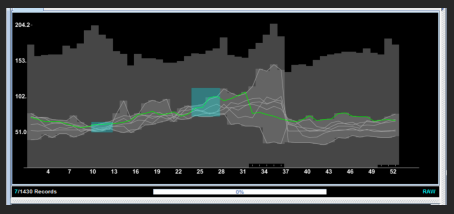
Assignment 3: Dynamic Queries

Create a small interactive dynamic query application similar to TimeSearcher, but for top 100 personalities on Cable TV News.

1. **Implement timeboxes interface**
2. **Submit the application and a short write-up on canvas**



Can work alone or in pairs
Due before class on Oct 20, 2020

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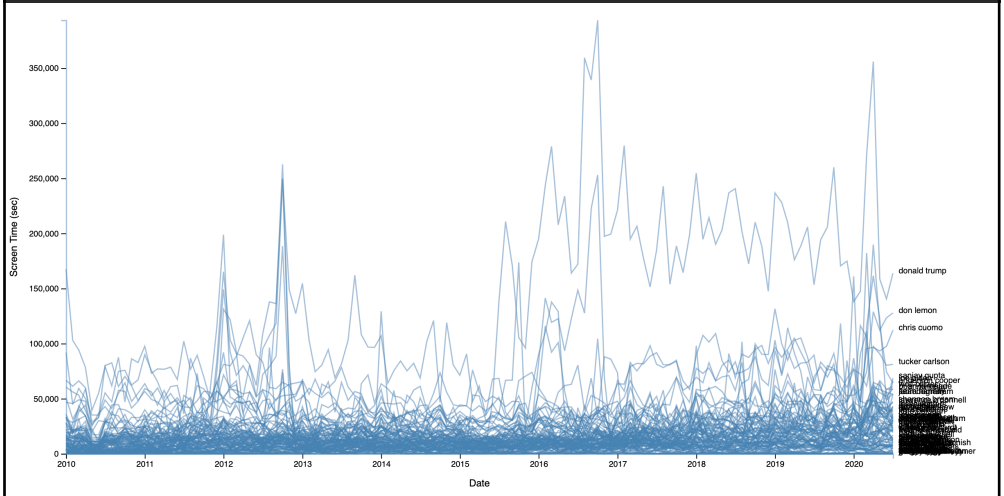

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Introduction to D3

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What is D3?

D3: "Data-Driven Documents"

Data visualization built on top of HTML, CSS, JavaScript, and SVG

Pros:
- Highly-customizable
  - Developing and debugging tools
  - Documentation, resources, community
- Integrates with the web!

Cons:
- Very "low-level"

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hello-world.html

```
<!DOCTYPE html>
<html>
<head>
  <meta charset="utf-8">
</head>

<body>
  Hello, world!
</body>

</html>
```

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hello-world.html

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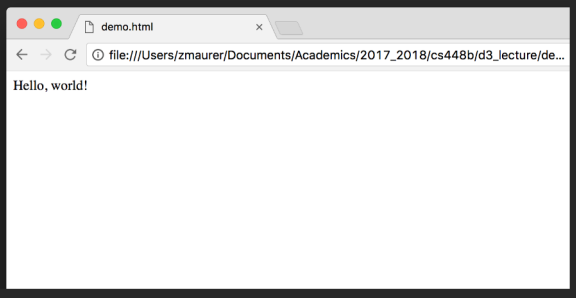
</head>

<body>
  Hello, world!
</body>

</html>
```



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hello-svg.html

```
<!DOCTYPE html>
<html>
<head>
  <meta charset="utf-8">
  <style> /* CSS */ </style>
</head>

<body>
    <svg width="960" height="500">
      <circle cx='120' cy='150' r='60' style='fill: gold;'>
          <animate
            attributeName='r'
            from='2' to='80' begin='0' dur='3'
            repeatCount='indefinite' />
      </circle>
    </svg>
</body>
</html>
```

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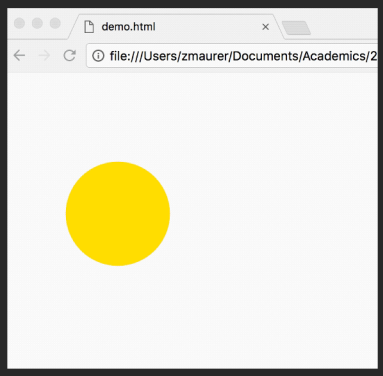
hello-svg.html

```
<!DOCTYPE html>
<html>
<head>
 <meta charset="utf-8">
 <style> /* CSS */ </style>
</head>

<body>
      <svg width="960" height="500">
         <circle cx='120' cy='150' r='60' style='fill:
               gold;'>
            <animate attributeName='r'
               from='2' to='80' begin='0' dur='3'
               repeatCount='indefinite' />
         </circle>
      </svg>
</body>
</html>
```



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hello-javascript.html

```
<!DOCTYPE html>
<html>
<head>
 <meta charset="utf-8">
 <style> /* CSS */ </style>
</head>

<body>
Hello, world!
 <script>
  console.log("Hello, world!");
   function add2(x) {
        return x + 2;
      }
   console.log("2 + 2 is " + add2(2));
 </script>
</body>
</html>
```

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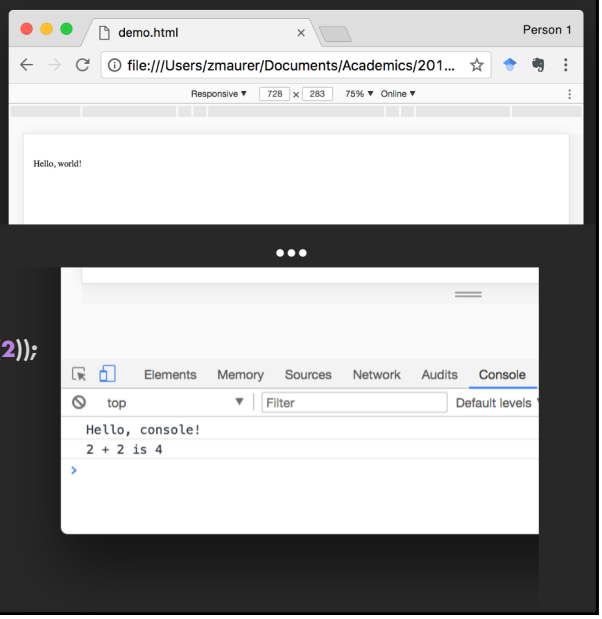
hello-javascript.html

```
<!DOCTYPE html>
<html>
<head>
 <meta charset="utf-8">
 <style> /* CSS */ </style>
</head>

<body>
Hello, world!
 <script>
  console.log("Hello, world!");
    function add2(x) {
          return x + 2;
        }
    console.log("2 + 2 is " + add2(2));
 </script>
</body>
</html>
```



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hello-d3.html

```
<!DOCTYPE html>
<html>
<head>
 <meta charset="utf-8">
 <style> /* CSS */ </style>
</head>

<body>
 <script src="https://d3js.org/d3.v6.min.js"></script>
 <script>

  // JavaScript code that handles the logic of adding SVG elements
  // that make up the visual building blocks of your data visualization

 </script>
</body>
</html>
```

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DOM: Document Object Model

```
<html>
        <head>

        <title></title>
        </head>
        <body>
                <h1></h1>
                <div>

        <p></p>
                </div>
        </body>
</html>
```

[Adapted from Victoria Kirst's cs193x slides.]

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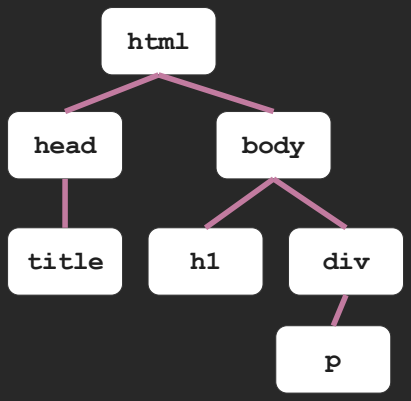
DOM: Document Object Model

```
<html>
        <head>

        <title></title>
        </head>
        <body>
                <h1></h1>
                <div>

        <p></p>
                </div>
        </body>
</html>
```



[Adapted from Victoria Kirst's cs193x slides.]

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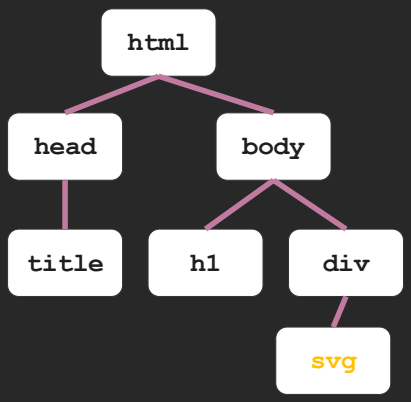
DOM: Document Object Model

```
<html>
        <head>

        <title></title>
        </head>
        <body>
                <h1></h1>
                <div>

        <svg></svg>
                </div>
        </body>
</html>
```



[Adapted from Victoria Kirst's cs193x slides.]

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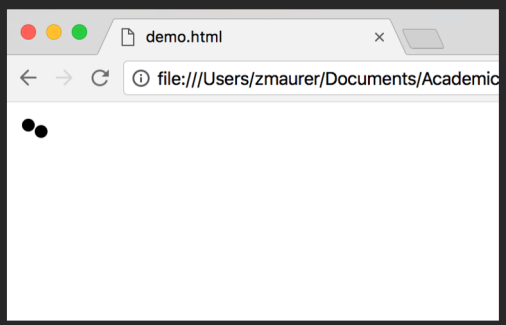
D3: Selection

```
<html>
…
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```



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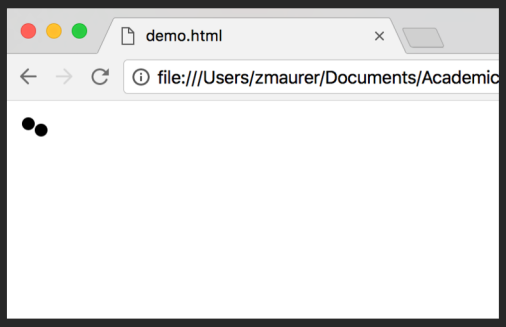
D3: Selection

```
<html>
...
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```




```
<script>

// select all SVG circle
    elements
var circles =
    d3.selectAll("circle");

</script>
```

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D3: Selection & Manipulation

```
<html>
...
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```

```
<script>

// select all SVG circle
    elements
var circles =
    d3.selectAll("circle");


// set attributes and styles
circles.attr("cx", 40);
circles.attr("cy", 50);
circles.attr("r", 24);
circles.style("fill", "red");

</script>
```

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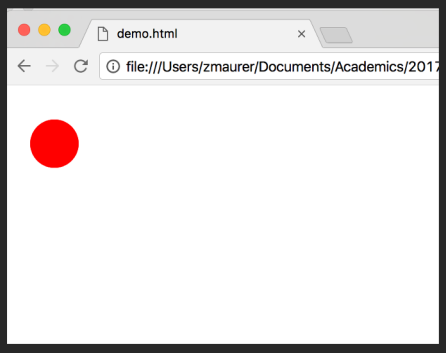
D3: Selection & Manipulation

```
<html>
...
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```




```
<script>

// select all SVG circle
    elements
var circles =
    d3.selectAll("circle");


// set attributes and styles
circles.attr("cx", 40);
circles.attr("cy", 50);
circles.attr("r", 24);
circles.style("fill", "red");

</script>
```

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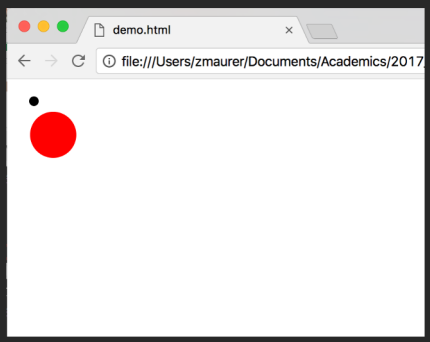
D3: Selection & Manipulation

```
<html>
...
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```




```
<script>

// select all SVG circle
    elements
var circles =
    d3.select("circle");


// set attributes and styles
circles.attr("cx", 40);
circles.attr("cy", 50);
circles.attr("r", 24);
circles.style("fill", "red");

</script>
```

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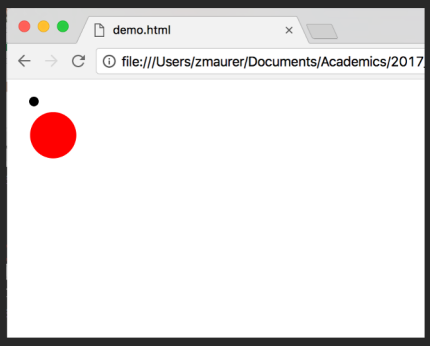
D3: Selection & Manipulation

```
<html>
…
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```




```
<script>

// all together!!
d3.select("circle")
      .attr("cx", 40)
      .attr("cy", 50)
      .attr("r", 24)
      .style("fill", "red");

</script>
```

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Binding Data & Joining DOM Elements

1. China: 1303182268
2. India: 1080264388
3. United States: 295734134
4. Indonesia: 218465000
5. Brazil: 186112794
6. Pakistan: 162419946
7. Bangladesh: 144319628
8. Nigeria: 128765768
9. Japan: 127417244
10. Mexico: 106202903

```
{
  const ol = d3.create('ol');

  ol.selectAll('li') // select all list elements (orange circle above)
    .data(listData)  // bind all our data values (blue circle above)
    .join(
      enter  => enter.append('li'), // append an li element for each entering item
      update => update,             // do nothing with items that match an existing element
      exit   => exit.remove()       // remove li elements whose backing data is now gone
    )
      .text(d => `${d.country}: ${d.pop}`)

  return ol.node();
}
```

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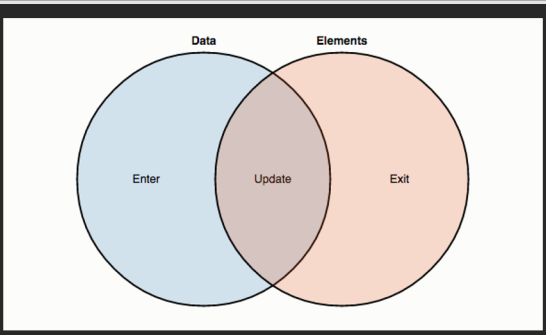
Binding Data & Joining DOM Elements



A *join* creates three sub-selections:

- ***Enter***: selection containing placeholders for every data value that did not have a corresponding DOM element in the original selection
- ***Update***: selection containing *existing* DOM elements that match a bound data value
- ***Exit***: selection that also contains *existing* DOM elements, but for which a matching data value was not found

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Binding Data & Joining DOM Elements

Exercise

Modify the *enter*, *update*, and *exit* functions in the code below such that entering items are colored green, updating items are colored blue, and exiting items are *not* removed but rather colored red.

1. China: 1303182268
2. India: 1080264388
3. United States: 295734134
4. Indonesia: 218465000
5. Brazil: 186112794
6. Pakistan: 162419946
7. Bangladesh: 144319628
8. Nigeria: 128765768
9. Japan: 127417244
10. Mexico: 106202903

```
undefined
```

```
{
  const ol = d3.select('ol#enter-update-exit');

  // use a new dataset, manipulable with the variables defined below
  const newData = gapminder
    .filter(d => d.year === year)
    .sort((a, b) => b.pop - a.pop)
    .slice(0, n);

  ol.selectAll('li') // select all list elements (orange circle above)
    .data(newData)   // bind all our data values (blue circle above)
    .join(
      enter  => enter.append('li').style('color', 'green'),
      update => update.style('color', 'blue'),
      exit => exit.remove()
    )
    .text(d => `${d.country}: ${d.pop}`);
}
```

You can use the variables below to change the elements in the `newData` extracted in the cell above to test your changes to `enter`, `update`, and `exit`. *Note that we are using Observable's ability to automatically figure out the dependency structure between cells so that changes to the cells below correctly update the cells above.*

```
year = 2005
```

```
year = 2005
```

```
n = 10
```

```
n = 10
```

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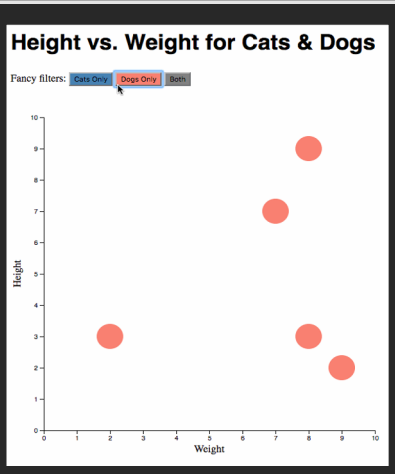
Let's make a scatterplot 🐱 🐶

```
id,animal,weight,height,name
1,cat,10,3,phyllis
2,cat,3,3,oreo
3,cat,9,9,sam
4,cat,3,5,dog
5,cat,6,5,fred
6,cat,5,6,jane
7,cat,1,8,esmerelda
8,dog,9,2,garfield
9,dog,8,9,alpha
10,dog,7,7,omega
11,dog,2,3,zeta
12,dog,8,3,cupcake
```



https://observablehq.com/@stanfordvis/lets-make-a-scatterplot

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