

Introduction to D3

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**CS 448B: Visualization
Fall 2021**

1

Reading Response Questions/Thoughts

How do you balance details with overarching views? How to decide when there is too much vs. too little data in a view?

In the VDQI reading, it was stated that we can increase data density in two ways: increasing the number of data points or decreasing the size of the graph... When it is advisable to reduce the size of our graph to increase the density? ... Are there any quantitative metrics to assess visualization interpretability?

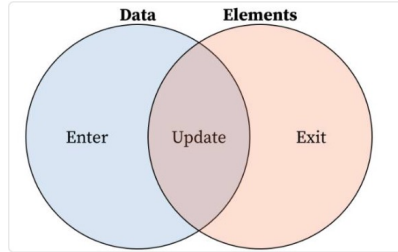
From an accessibility standpoint, I wonder if there are ways to facilitate micro-macro reading through haptic and audio means?

And more generally, what are instances where poor design choices on the micro level can obscure the types of insights gained at the macro level?

When is it appropriate to exclude outlying data points? For datasets of the Challenger launch tests, the outliers were everything. All data is prone to some degree of variation, so how much significance should we place on outliers?

2

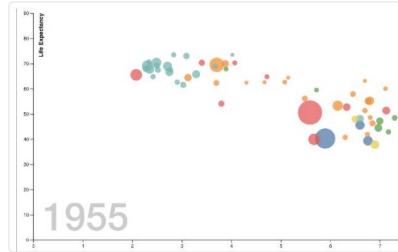
D3 Notebooks



Team · Published

Introduction to D3

You republished 14 hours ago



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Making D3 Charts Interactive

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3

Last Time: Interaction

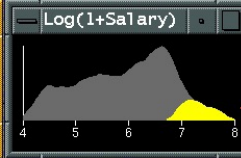
4

Baseball statistics [from Wills 95]

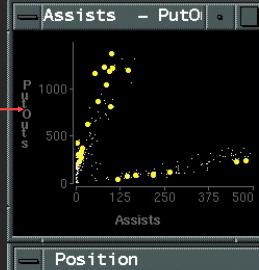
how long
in majors



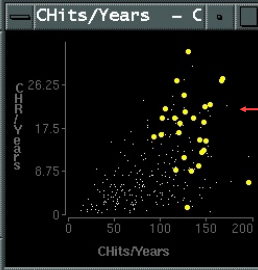
select high
salaries



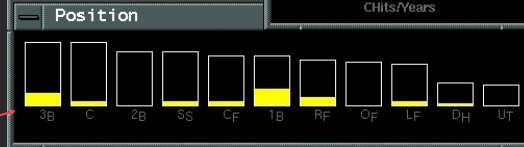
avg assists vs
avg putouts
(fielding ability)



avg career
HRs vs avg
career hits
(batting ability)



distribution
of positions
played



6

Dynamic Queries

7

Query and results

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

Dynamic Browser : DC Home Finder

IdNumber	Dwelling	Address	City
2	House	5256 S. Capitol St.	Beltsville, MD
4	House	5536 S. Lincoln St.	Beltsville, MD
5	House	5165 Jones Street	Beltsville, MD
8	House	5007 Jones Street	Beltsville, MD
9	House	4872 Jones Street	Beltsville, MD
17	House	5408 S. Capitol St.	Beltsville, MD
20	House	5496 S. Capitol St.	Beltsville, MD
85	Condo	5459 S. Lincoln St.	Laurel, MD
86	Condo	5051 S. Lincoln St.	Laurel, MD
88	Condo	5159 Hamilton Street	Laurel, MD
92	Condo	5132 Hamilton Street	Laurel, MD
93	Condo	5221 S. Lincoln St.	Laurel, MD
94	Condo	5043 S. Lincoln St.	Laurel, MD
95	Condo	4970 Jones Street	Laurel, MD
97	Condo	4677 Jones Street	Laurel, MD
98	Condo	4896 S. Capitol St.	Laurel, MD
99	Condo	5048 S. Capitol St.	Laurel, MD
100	Condo	4597 31st Street	Laurel, MD
101	Condo	5306 S. Lincoln St.	Laurel, MD
103	Condo	5562 Glass Road	Laurel, MD
105	Condo	5546 Hamilton Street	Laurel, MD
152	House	7670 31st Street	Upper Marlboro, MD

8

HomeFinder

Dynamic HomeFinder

Reset Quit
Save Print

Dist to A: 1 30
10

Dist to B: 1 30
6

Bedrooms: 1 2 4 7
4

Cost: \$50k \$500k
15

Look at:
Hse TH Cnd

Features:
Grg Fp1
CAC New

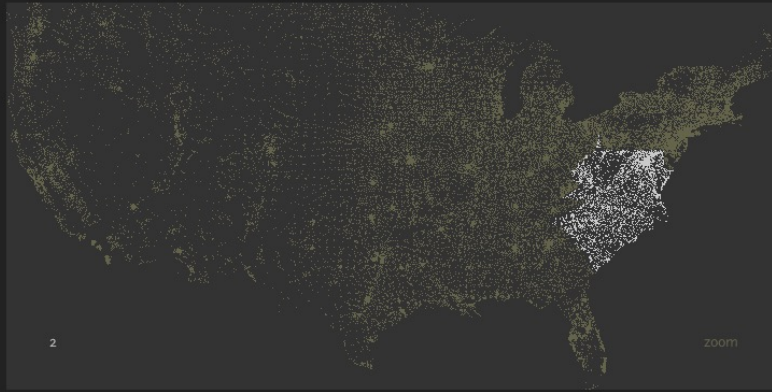
The yellow dots above are homes in the DC area for sale. You may get more information on a home by selecting it. You may drag the 'A' and 'B' distance markers to your office or any other location you want to live near. Select distances, bedrooms, and cost ranges by dragging the corresponding slider boxes on the right. Select specific home types and services by pressing the labeled buttons on the right.

[Ahlberg and Schneiderman 92]

10

Zipcode [from Fry 04]

<< ben fry

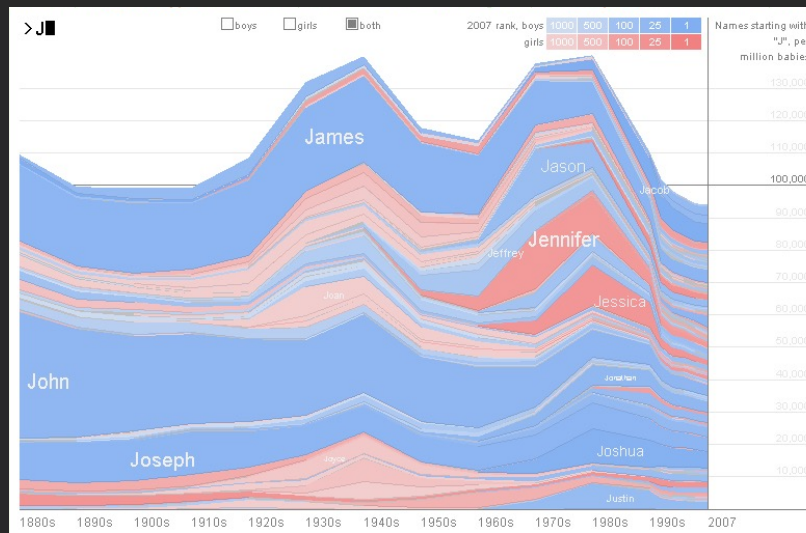


Hit the letter z, or click the word zoom to enable or disable zooming.
Hold down shift while typing a number to replace the previous number
(U.S. keyboards only).

<https://benfry.com/zipcode/>

18

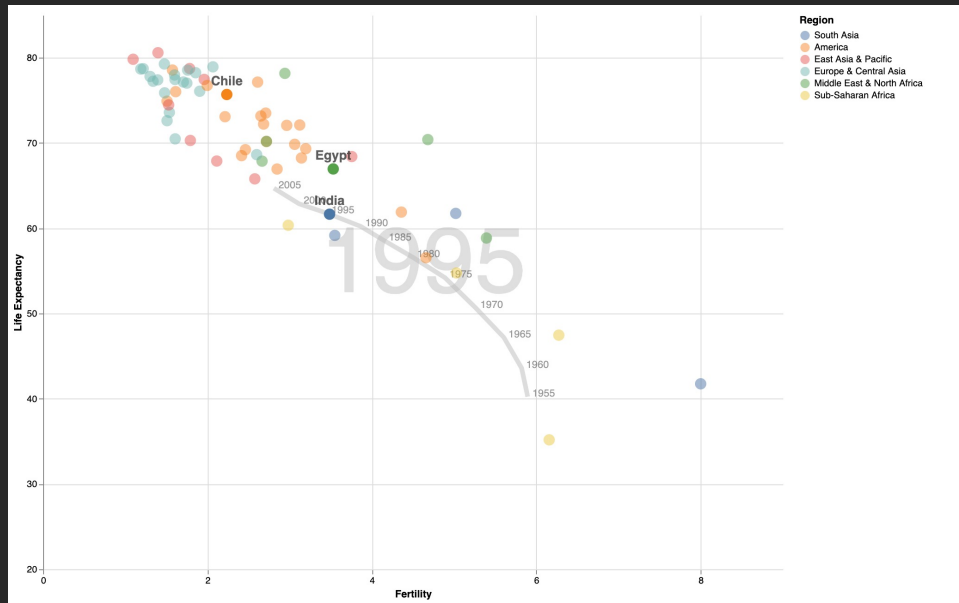
NameVoyager



<http://www.babynamewizard.com/voyager>

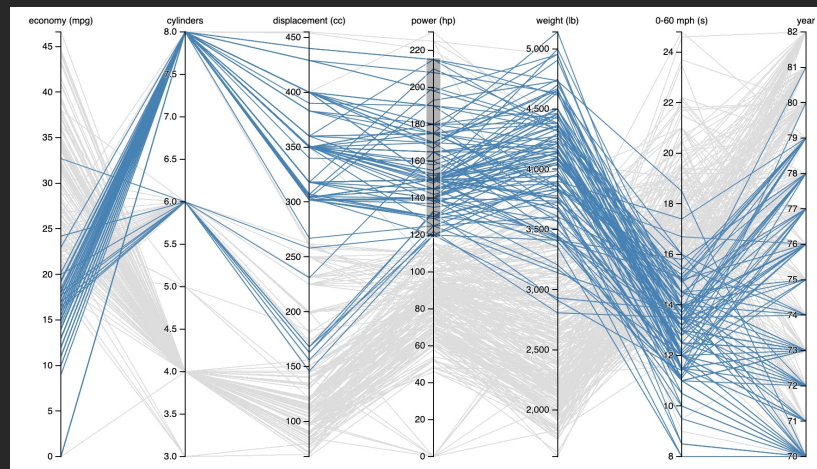
19

DimpVis [Kondo 14]



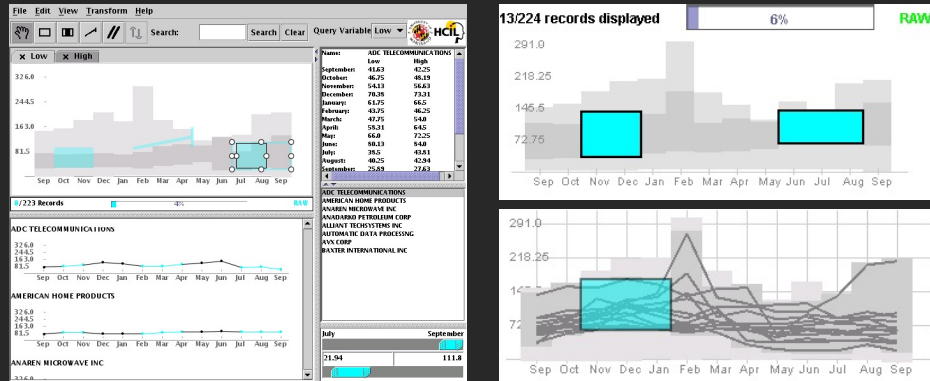
20

Parallel Coordinates [Inselberg]



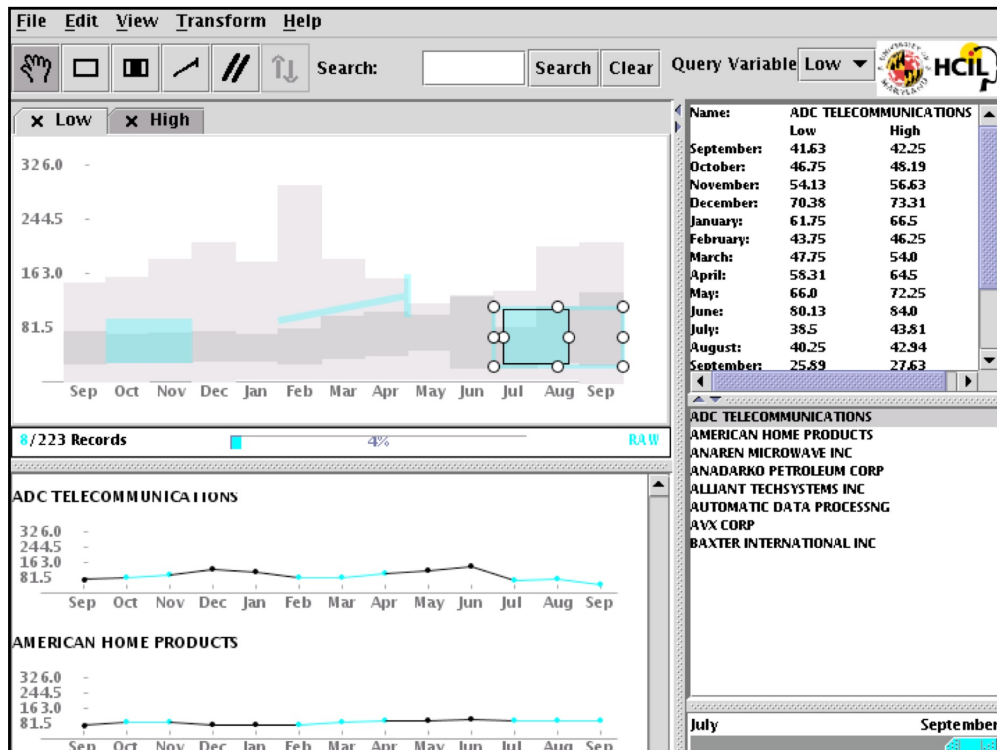
21

TimeSearcher [Hochheiser & Schneiderman 02]



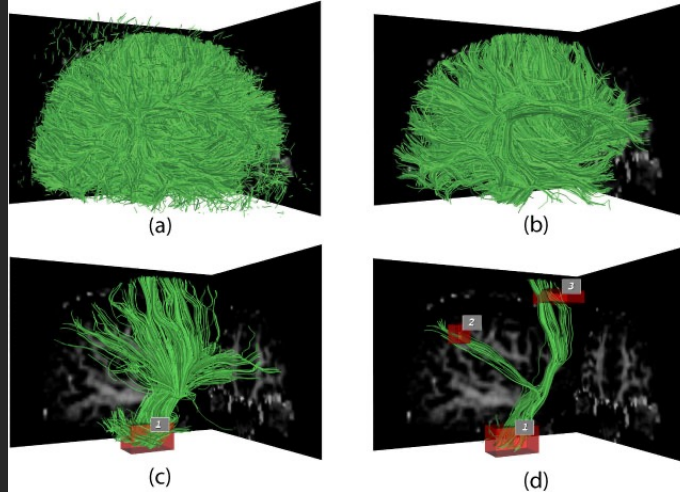
Based on Wattenberg's [2001] idea for sketch-based queries of time-series data

22



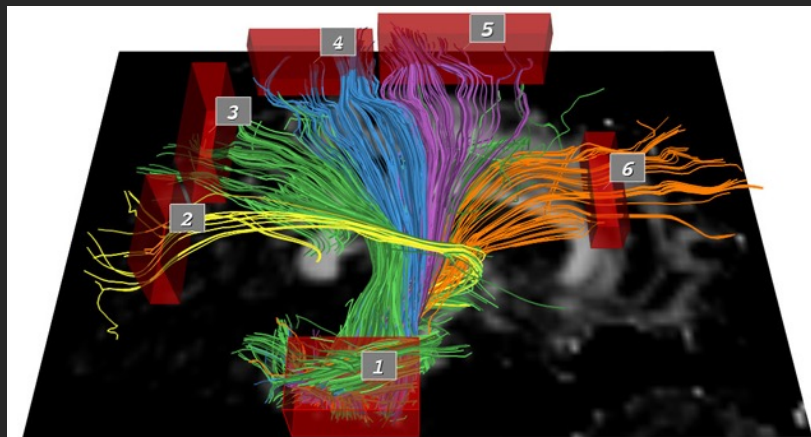
23

3D dynamic queries [Akers et al. 04]



24

3D dynamic queries [Akers et al. 04]



25

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

26

Summary

Good visualizations are task dependent

- Pick the right interaction technique

Fundamental interaction techniques

- Selection, Brushing & Linking, Dynamic Queries

27

Announcements

28

A2: Exploratory Data Analysis

Use **Tableau** or **Vega-Lite** to formulate & answer questions

First steps

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

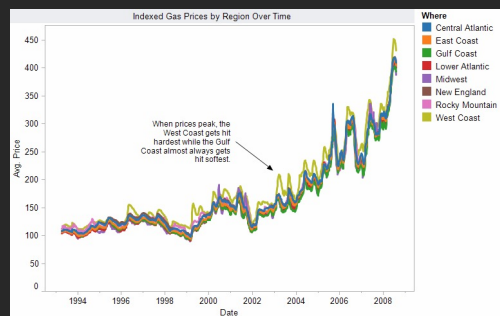
Create visualizations

- See different views of data
- Refine questions

Author a report

- Screenshots of most insightful views (8+)
- Include titles and captions for each view

Due before class on Oct 11, 2021



29

Assignment 3: Dynamic Queries

Create a **small** interactive dynamic query application similar to HomeFinder, but for restaurants data.

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



Can work alone or in pairs
Due before class on **Oct 25, 2021**

30

Instructions: You can use the various filters here including restaurant name (starting few characters), city, zipcode, and inspection results.

Restaurant Name:

City: ALVISO CUPERTINO LOS ALTOS LOS ALTOS HILLS MOUNTAIN VIEW PALO ALTO SAN JOSE SANTA CLARA STANFORD SUNNYVALE

Zipcode: 10017 28217 90487 94 94022 94024 94028 94031 94036 94039 94040 94041 94043 94045 94065 94080 94091 94095 94096 94087 94088 94089 94091 94102 94104 94121 94301 94302 94303 94304 94305 94306 94309 94503 94559 94590 94603 94605 95002 95014 95015 95050 95051 95054 95086 95104 95129 95134 95762

Inspection Grade: Pass Conditional Pass Fail Closure Not Available

Inspection Score Range: 0 - 100

The red circle indicates regions within 3 miles from point A and the green circle indicates regions within 3 miles from point B. You can adjust their positions by dragging on the interior of the circles and adjust their sizes by dragging on their circumference.

31

Introduction to D3

32

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”**

33

hello-world.html

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

<body>
  Hello, world!
</body>

</html>
```

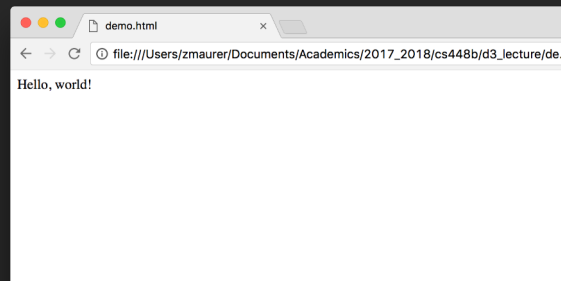
34

hello-world.html

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

<body>
  Hello, world!
</body>

</html>
```



35

hello-svg.html

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

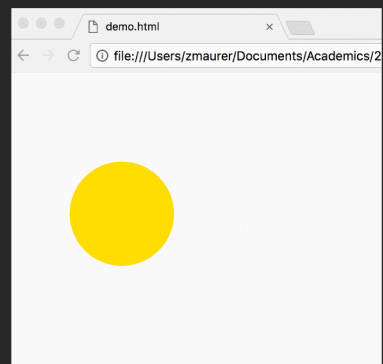
<body>
  <svg width="960" height="500">
    <circle cx='120' cy='150' r='60' style='fill: gold;'>
      <animate
        attributeName='r'
        from='2' to='80' begin='0' dur='3'
        repeatCount='indefinite' />
    </circle>
  </svg>
</body>
</html>
```

38

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>
```



39

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](#).]

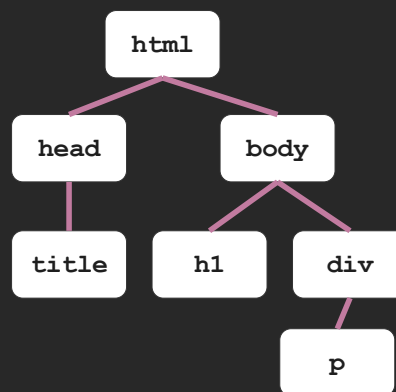
42

DOM: Document Object Model

```
<html>
  <head>

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

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

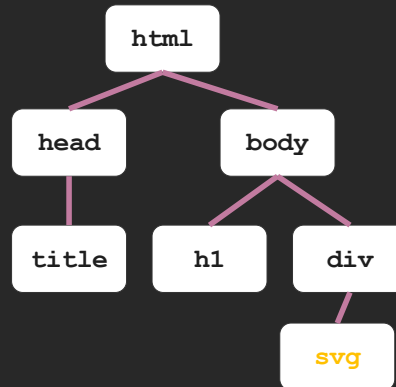


[Adapted from Victoria Kirst's [cs193x slides](#).]

43

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](#).]

44

hello-d3.html

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

<body>
  <script src="https://d3js.org/d3.v7.min.js"></script>
  <script>

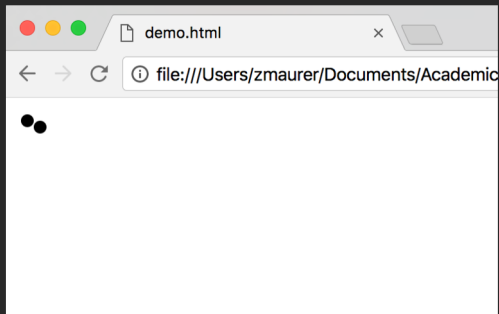
    // JavaScript code that handles the logic of adding SVG elements
    // that make up the visual building blocks of your data visualization

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

45

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>
```



46

D3: Selection

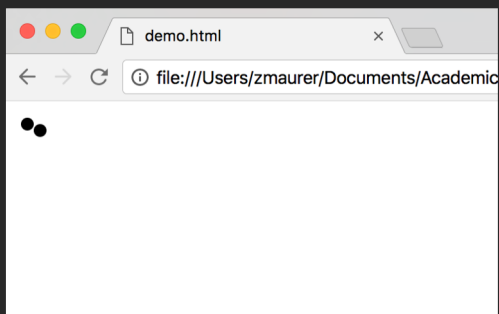
```
<html>
...
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>
```

```
<script>
```

```
// select all SVG circle
  elements
```

```
var circles =
  d3.selectAll("circle");
```

```
</script>
```



47

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>
```

48

D3: Selection & Manipulation

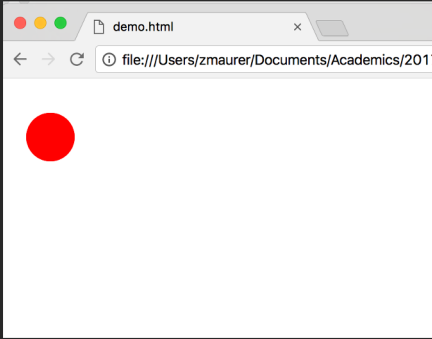
```
<html>
...
<svg width="960" height="500">
  <circle cx="10" cy="10" r="5"></circle>
  <circle cx="20" cy="15" r="5"></circle>
</svg>

<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>
```

A screenshot of a web browser window titled "demo.html". The address bar shows the file path "file:///Users/zmaurer/Documents/Academics/2017...". The main content area of the browser displays a single, solid red circle centered on a white background.

49

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>
```

50

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");

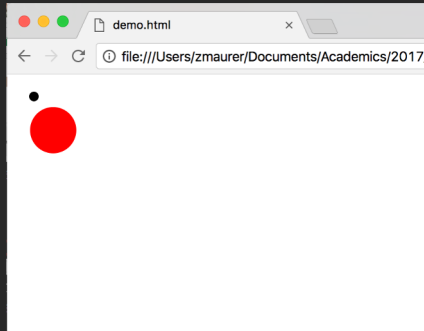
</script>
```

A screenshot of a web browser window titled "demo.html". The address bar shows the file path "file:///Users/zmaurer/Documents/Academics/2017...". The main content area of the browser displays a white square with a small black dot at the top left and a larger red circle below it, representing the result of the D3.js manipulation.

51

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>
```

52

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
```

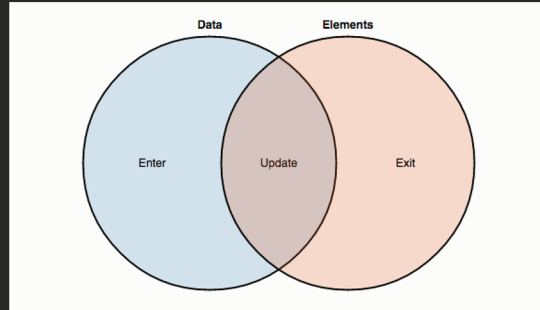
```
{
  const ol = d3.create('ol');

  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();
}
```

53

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

55

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 = gpnfinder
    .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.

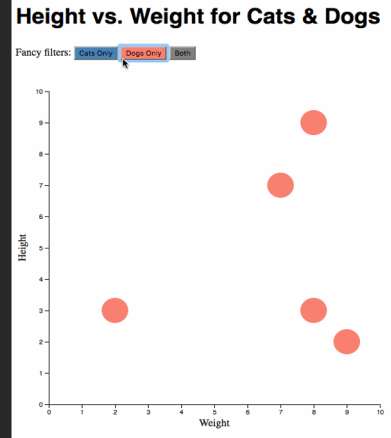
```
year = 2005
year = 2005
n = 10
n = 10
```

56

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>