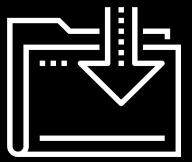
Bar and Line Charts with D3

Data Boot Camp

Lesson 16.2



Class Objectives

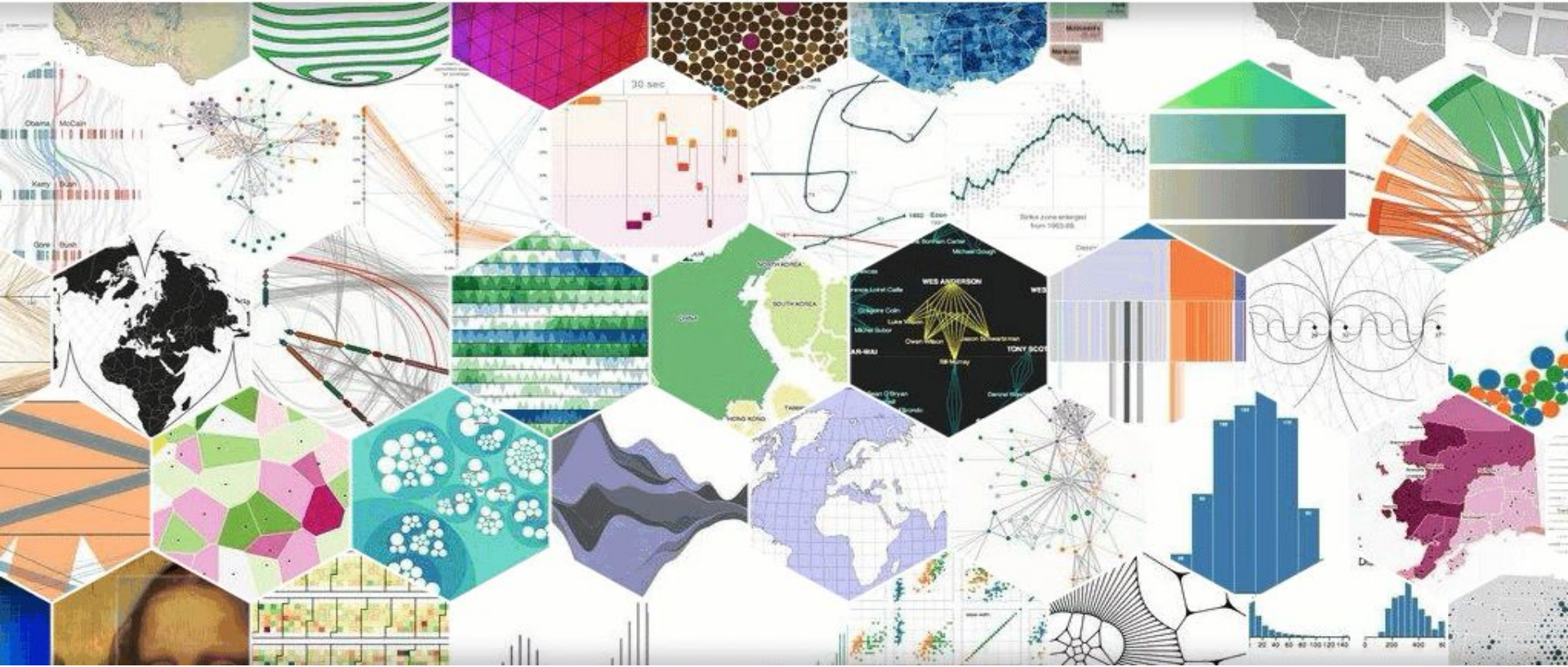
By the end of today's class you will be able to:

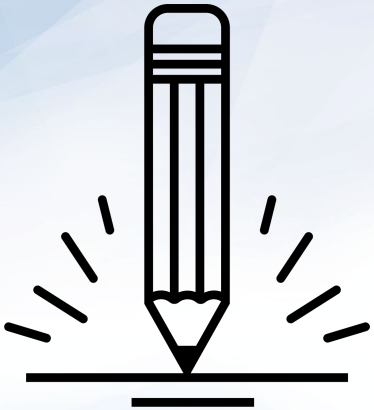
Deepen their knowledge of the D3 library.

Create different types of charts and graph using D3.

Cover creating scales and axes in D3.

Data-Driven Documents





Activity: Review

In this activity, you and your partner will discuss and answer the questions sent to you.

Suggested Time:
10 Minutes

Activity: Review

Instructions:

- Open questions.js (check your slack) and answer the following questions after discussing with a partner.

1. What does **SVG** stand for? How are they used with **D3**?
2. What's data binding?
3. Given the following and an HTML page with no elements currently in the body, use the `enter()` pattern to render three `<li>` elements to the page with text matching the integers in the array.

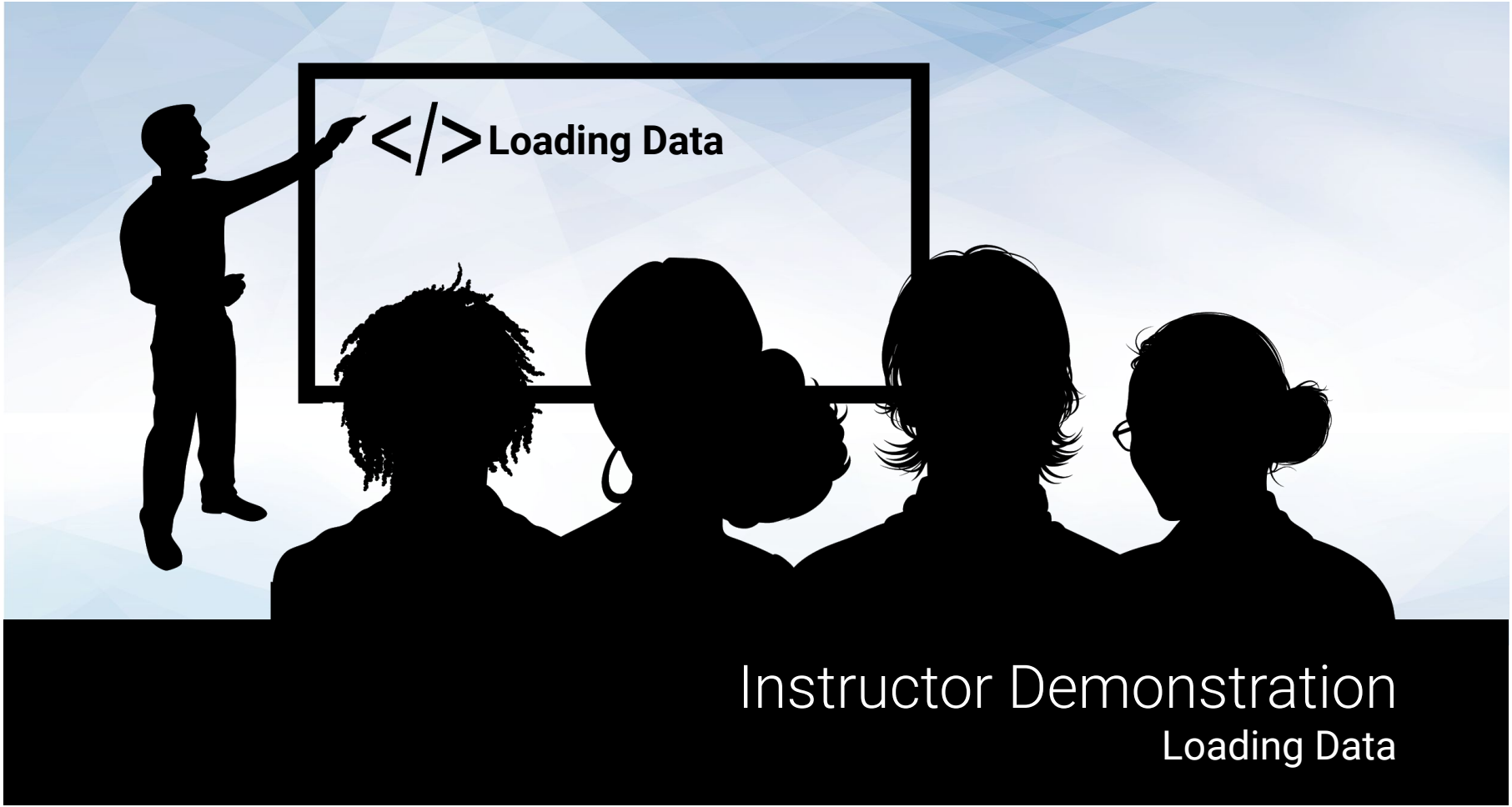
```
var arr = [1, 2, 3];
var ul = d3.select("body").append("ul");
```

4. Imagine three <li> elements already exist on the page. Create code to update the text of those elements while also adding three new elements to match the array below. Leave the number 3 code uncommented as it is needed for number 4 to work properly.

```
var arr = [1, 1, 2, 3, 5, 8];
var ul = d3.select("ul");
```

- **Bonus**
  - Refactor your solution to number 4 above using the ES6 syntax for arrow functions. Then, modify the code to set the text of each element to "`<index in the array>: <item from the array>`"
  - Be sure to comment your number 4 code (not the `arr` or `ul` variables) before running the code.

Time’s Up! Let’s Review.

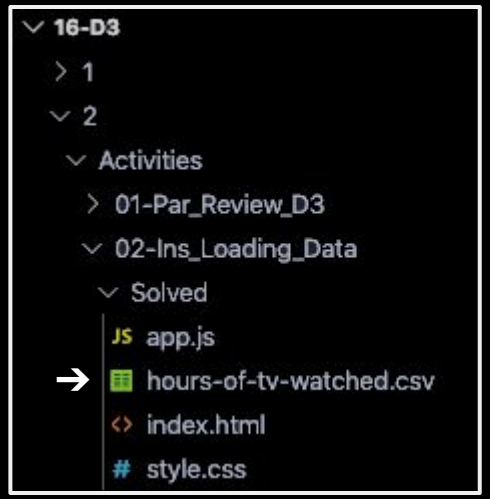


Instructor Demonstration

Loading Data

Loading Data

- File Structure:

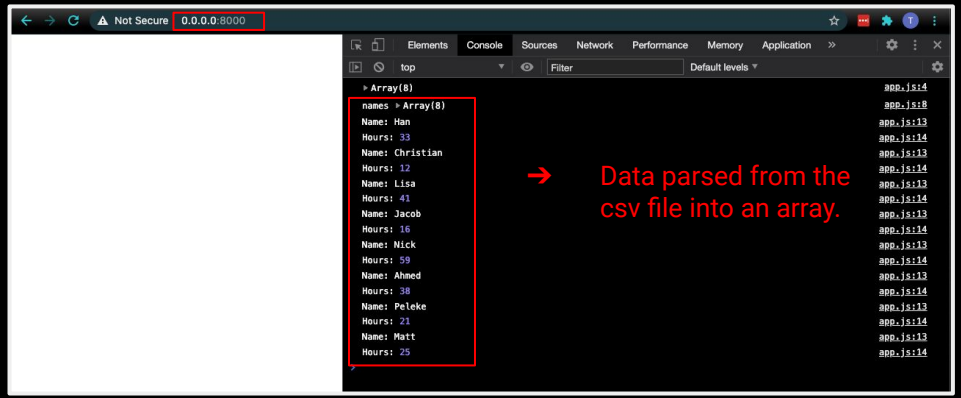


➔ We need to parse the CSV file using `d3.csv()`

Loading Data

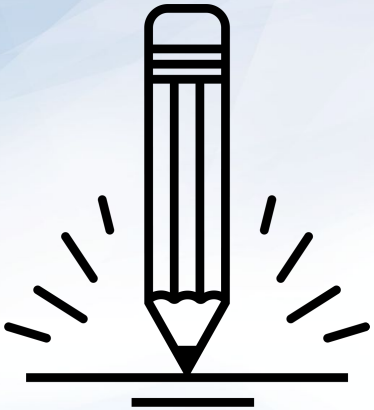
- Open Terminal:
  - Activate the appropriate virtual environment.
  - Go to the appropriate directory.
  - Run: `python -m http.server`.

- Open browser



➔ Data parsed from the csv file into an array.

➔ Visit `http://0.0.0.0:8000/`



Activity: Bar Chart from CSV

In this activity, you and your partner will be challenged to interpret and complete the starter code with the goal of creating a bar chart to reflect CSV data.

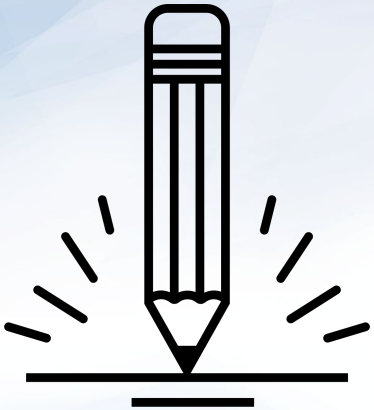
Suggested Time:
15 Minutes

Activity: Bar Chart from CSV

Instructions:

- First, take a few minutes to review the code and discuss what you need to do with a partner.
- Organize the provided files in a folder, open the folder, and start the server. All code which you will write will be inside of the callback method passed into `d3.csv`.
- Using chartGroup, select all of the elements inside with a class of `bar` and bind the `tvData` data to the selection.
- Still chaining to the code written in the previous step, run the `.enter()` method and append a `rect` with a class of bar for each element in the array.
- Set the `width` property of each rectangle to `barWidth`.
- Set the `height` property of each rectangle using a callback function, which is passed the data bound to the rectangle. Scale the height of the rectangle by the value of `Yscale`.
- Set the `x` attribute of each rectangle using a callback function which is passed the data bound to the rectangle. Space the rectangles by the value of 'barSpacing`.
- Set the `y` attribute of each rectangle using a callback function which is passed the data bound to the rectangle. Remember to invert your y values using the chartHeight so that the bar chart is right-side-up.
- **Hints**:
  - For assistance understanding data joins with D3, see the article slacked to you written by Mike Bostock, the creator of **D3**.
  - For more information on transformations with SVG files, see the Tutorial on Basic Transformations slacked to you.

Time’s Up! Let’s Review.



Everyone Do: D3 Scales

In this activity, we all will work on **D3** Scales.

Suggested Time:
15 Minutes

Everyone Do: D3 Scales

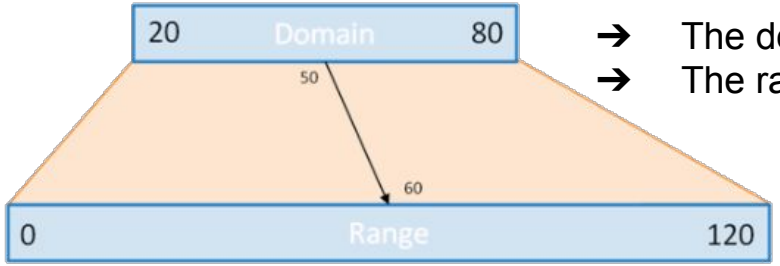
- Finding the min and max in a JavaScript Array using **D3**.

  - `min()` Returns the lowest element value in an array.
  - `max()` Returns the highest element value in an array.
  - `extent()` Returns both, the highest and the lowest elements in an array.

```
> var dataArr = [10, 20, 2000];

console.log("min value ", d3.min(dataArr));
console.log("max value ", d3.max(dataArr));
console.log("min and max values ", d3.extent(dataArr));
  min value  10                                          VM98:3
  max value  2000                                        VM98:4
  min and max values  ▶ (2) [10, 2000]                   VM98:5
```

Everyone Do: D3 Scales

- `scaleLinear()`
  - ➔ In order to give an accurate visual representation, the data represented in a graph is scaled.
  - ➔ D3 provides an easy way to convert those values to suit the visualization.



- ➔ The domain is the bounds of the data.
- ➔ The range is the bounds of the chart.

```
> var yScale = d3.scaleLinear()
      .domain([0, 100])
      .range([0, 1000]);

  console.log(`50 returns ${yScale(50)}`);
  console.log(`75 returns ${yScale(75)}`);
  console.log(`100 returns ${yScale(100)}`);
  50 returns 500                                    VM13:5
  75 returns 750                                    VM13:6
  100 returns 1000                                  VM13:7
< undefined
```

Everyone Do: Scales

- `d3.max()`
  - ➔ The parameters passed in this part of the code is slight different.
  - ➔ We want the highest element of testScores for the max of the domain.
  - ➔ We use a variable for the upper boundary in range.

```
> var testScores = [50, 90, 95, 75, 85];

  var svgHeight = 1000;

  var yScale = d3.scaleLinear()
    .domain([0, d3.max(testScores)])
    .range([0, svgHeight]);


  console.log(`50 returns ${yScale(50)}`);
  console.log(`75 returns ${yScale(75)}`);
  console.log(`95 returns ${yScale(95)}`);
  50 returns 526.3157894736842                    VM40:10
  75 returns 789.4736842105264                    VM40:11
  95 returns 1000                                 VM40:12
< undefined
```

Everyone Do: Scales

- `d3.extent()`
  - ➔ In this instance we are using a function to pass the highest and the lowest element of the array.

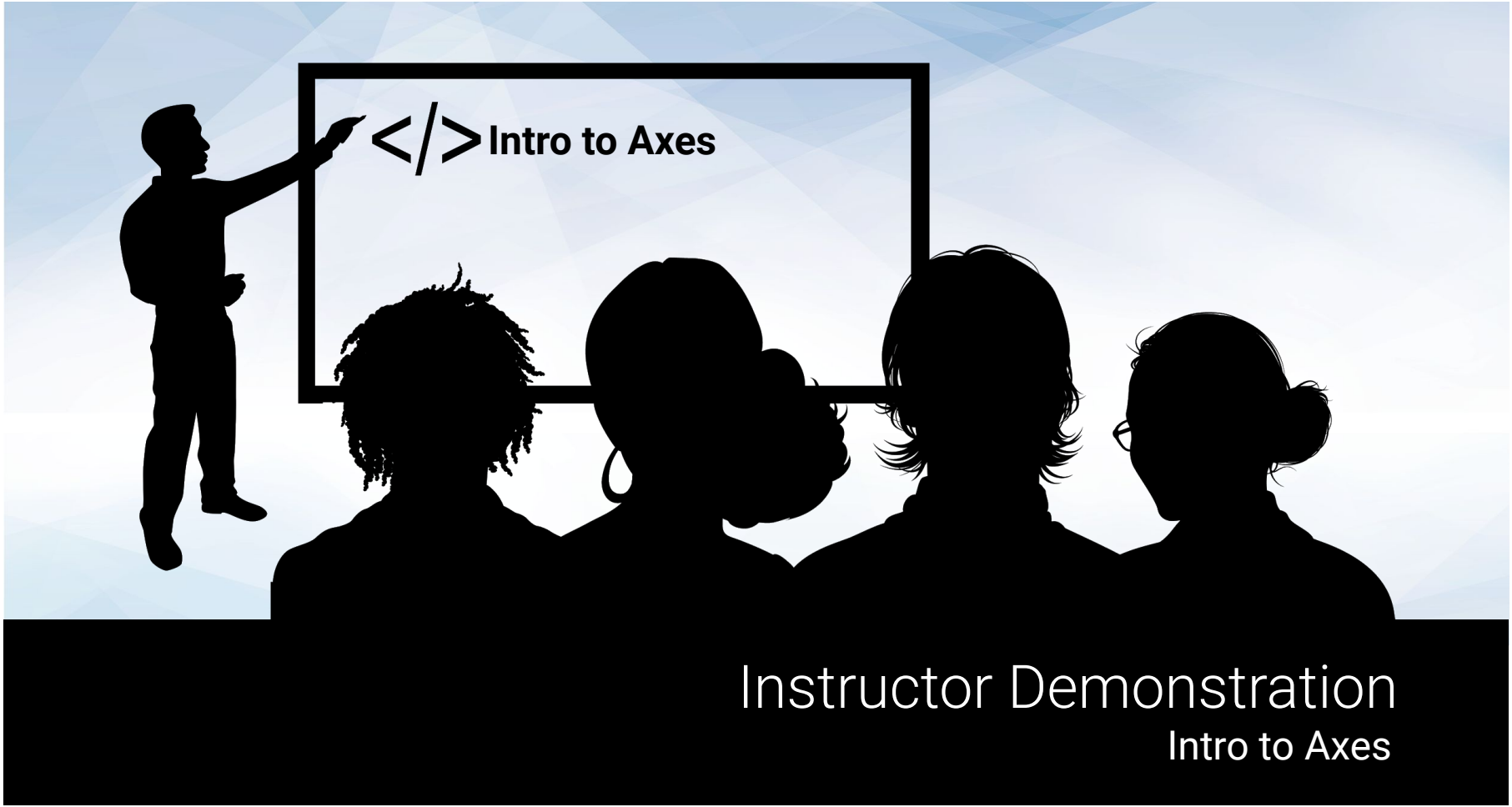
```
> var testScores = [50, 90, 95, 75, 85];

  var svgHeight = 1000;

  var yScale = d3.scaleLinear()
    .domain(d3.extent(testScores))
    .range([0, svgHeight]);


  console.log(`50 returns ${yScale(50)}`);
  console.log(`75 returns ${yScale(75)}`);
  console.log(`95 returns ${yScale(95)}`);
  50 returns 0                                    VM65:10
  75 returns 555.5555555555555                    VM65:11
  95 returns 1000                                 VM65:12
< undefined
```

Everyone Do: D3 Scales

- `scaleBand()`
  - ➔ This function is used to build a new band scale with the domain as an array of categorical data values and the range as the min and max extents of it. It will split the range into `x` bands where `x` is the number of values in the domain array.

```
> svgHeight = 600;
  var svgWidth = 1000;

  testScores = [90, 85, 75, 90];
  var students = ["Han", "Sarah", "Matt", "Ruchi"];

  var xScale = d3.scaleBand()
    .domain(students)
    .range([0, svgWidth]);

  console.log(`Han's x-coordinate: ${xScale("Han")}`);
  console.log(`Sarah's x-coordinate: ${xScale(students[1])}`);
  console.log(`Matt's x-coordinate: ${xScale("Matt")}`);
  console.log(`Ruchi's x-coordinate: ${xScale(students[3])}`);

  console.log(`Each band is ${xScale.bandwidth()} pixels wide.`);

  // The y values are scaled separately.

  var yScale = d3.scaleLinear()
    .domain([0, 100])
    .range([0, svgHeight]);

  console.log(`The height of Han's bar: ${yScale(testScores[0])}`);
```

```
Han's x-coordinate: 0
Sarah's x-coordinate: 250
Matt's x-coordinate: 500
Ruchi's x-coordinate: 750
Each band is 250 pixels wide.
The height of Han's bar: 540
```



Instructor Demonstration

Intro to Axes

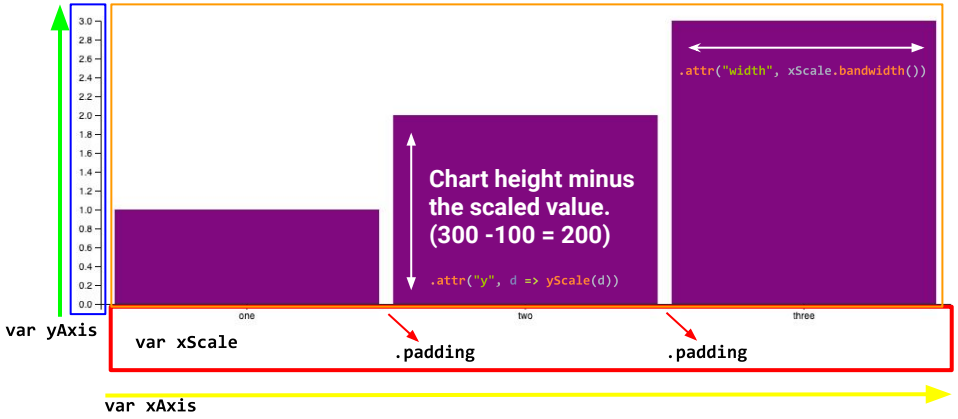
Intro to Axes

```
<!DOCTYPE html>
<html lang="en">
▶<head>…</head>
▼<body> == $0
  ▼<div id="svg-area">
    ▼<svg height="400" width="1000">
      ▼<g transform="translate(50, 50)">
        ▼<g transform="translate(0, 300)" fill="none" font-size="10" font-family="sans-serif" text-anchor="middle">
          <path class="domain" stroke="currentColor" d="M0.5,6V0.5H900.5V6"></path>
          ▼<g class="tick" opacity="1" transform="translate(154.9180327868852,0)">
            <line stroke="currentColor" y2="6"></line>
            <text fill="currentColor" y="9" dy="0.71em">one</text>
          </g>
          ▶<g class="tick" opacity="1" transform="translate(449.99999999999994,0)">…</g>
          ▶<g class="tick" opacity="1" transform="translate(745.0819672131147,0)">…</g>
        </g>
        ▶<g fill="none" font-size="10" font-family="sans-serif" text-anchor="end">…</g>
        <rect class="bar" x="14.75409836065569" y="200.00000000000003" width="280.327868852459" height="99.99999999999997"></rect>
        <rect class="bar" x="309.83606557377044" y="100.00000000000001" width="280.327868852459" height="200"></rect>
        <rect class="bar" x="604.9180327868852" y="0" width="280.327868852459" height="300"></rect>
      </g>
    </svg>
  </div>
  <script src="https://d3js.org/d3.v5.min.js"></script>
  <script type="text/javascript" src="app.js"></script>
</body>
</html>
```

➔ One “g” tag per axis

➔

One `rect` per element in the array. Attributes calculated with the scale functions



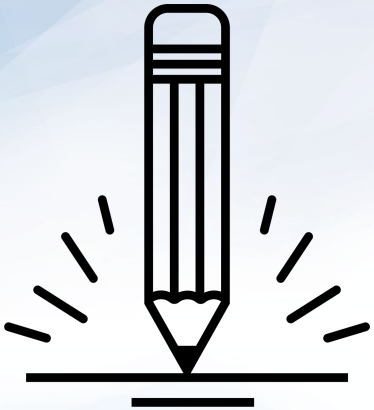

```
Elements  Console  Sources  Network  Performance  »
top  Filter  Default levels
```

```
var dataArray = [1, 2, 3];
var dataCategories = ["one", "two", "three"];

var svgHeight = 400;
var svgWidth = 1000;

var margin = {
  top: 50,
  right: 50,
  bottom: 50,
  left: 50
};

var chartHeight = svgHeight - margin.top - margin.bottom;
var chartWidth = svgWidth - margin.left - margin.right;

var svg = d3.select("#svg-area").append("svg")
  .attr("height", svgHeight)
  .attr("width", svgWidth);

var chartGroup = svg.append("g")
  .attr("transform", `translate(${margin.left}, ${margin.top})`);

var yScale = d3.scaleLinear()
  .domain([0, d3.max(dataArray)])
  .range([chartHeight, 0]);

var xScale = d3.scaleBand()
  .domain(dataCategories)
  .range([0, chartWidth])
  .padding(0.05);

var yAxis = d3.axisLeft(yScale);
var xAxis = d3.axisBottom(xScale);

chartGroup.append("g")
  .attr("transform", `translate(0, ${chartHeight})`)
  .call(xAxis);

chartGroup.append("g")
  .call(yAxis);

chartGroup.selectAll(".bar")
  .data(dataArray)
  .enter()
  .append("rect")
  .classed("bar", true)
  .attr("x", (d, i) => xScale(dataCategories[i]))
  .attr("y", d => yScale(d))
  .attr("width", xScale.bandwidth())
  .attr("height", d => chartHeight - yScale(d));
```

Countdown timer

15:00

(with alarm)



Activity: Complete Bar Chart

In this activity, you will create a bar chart from CSV data complete with axes. It will require a combination of skills from today and mostly build on the solution from the previous activity.

Suggested Time:
15 Minutes

Activity: Complete Bar Chart

Instructions:

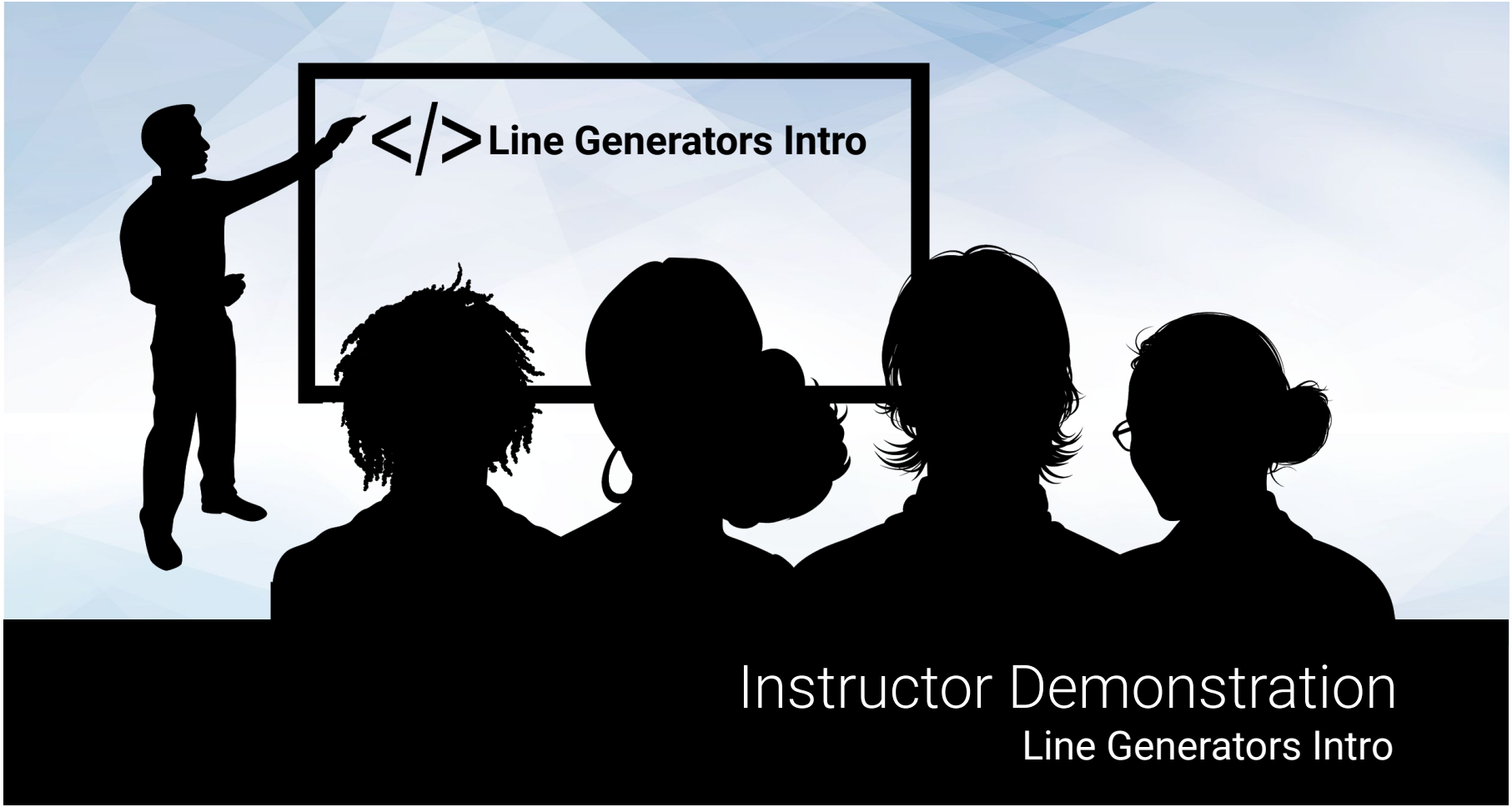
- From the command line, start a Python server to serve the csv and web files: `python -m http.server`.
- Load the data from the `hours-of-tv-watched.csv` using `d3.csv`.

Within the `d3.csv` method callback, do the following:

- Cast the hours as numbers.
- Create scale functions for your x and y values.
- Create functions to generate your x and y axes.
- Render your axes to the page.
- Render rectangles to the page to create your bar chart and give them hover effects.
- **Hints:**

  - Use prior activities for reference.
  - Checkout your slack for this reference material on D3 Scales.
  - See this example of create D3 Band Scales & Bottom Axes. Remember that the domain and range must both be arrays.
  - For assistance with axis creation with D3, see the d3-axis documentation.

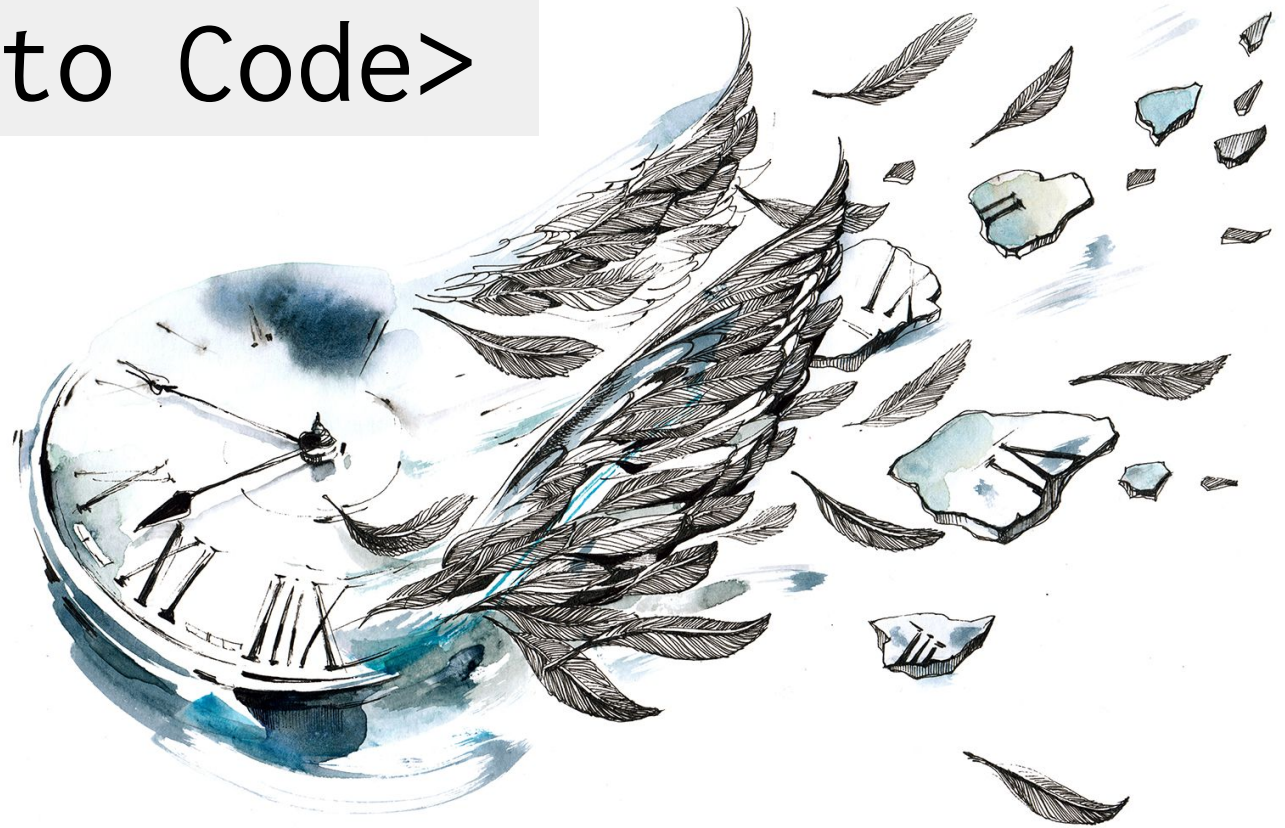
Time’s Up! Let’s Review.

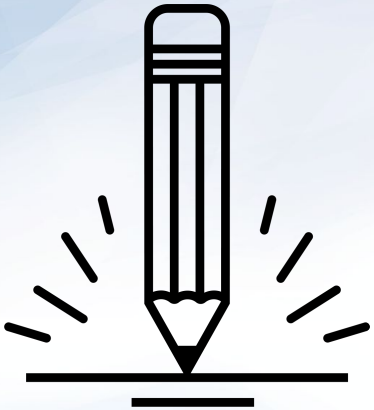


Instructor Demonstration

Line Generators Intro

<Time to Code>





Activity: Generating Lines

In this activity, you will generate a line chart using life expectancy data from CSV data.

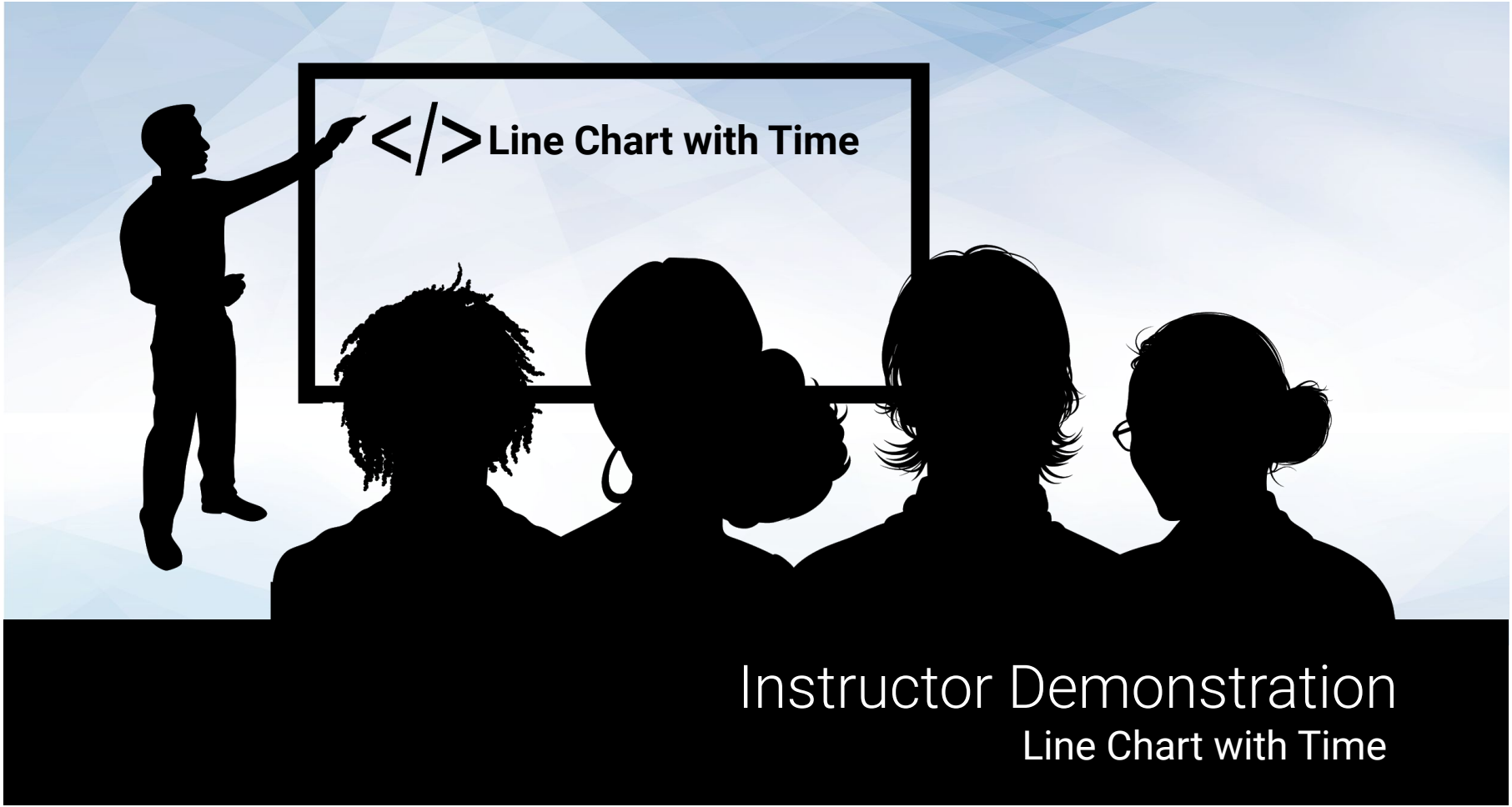
Suggested Time:
10 Minutes

Activity: Generating Lines

Instructions:

- First, take a few minutes to review the code.
- Note that we cast `year` as a number here. This is for demonstration purposes and will normally be cast as a date object. You will see this in the next activity.
- Create scales for x and y so that your line fits the SVG properly.
- Create and store a line generator function using the scale functions for x and y.
- Append a path element to the SVG using the line generator and add styling attributes.
- Test your code by running a server and viewing in the browser. Refine as needed.
- Hints:
  - 
  - Check out D3 in Depth - Line Generator.

Time’s Up! Let’s Review.

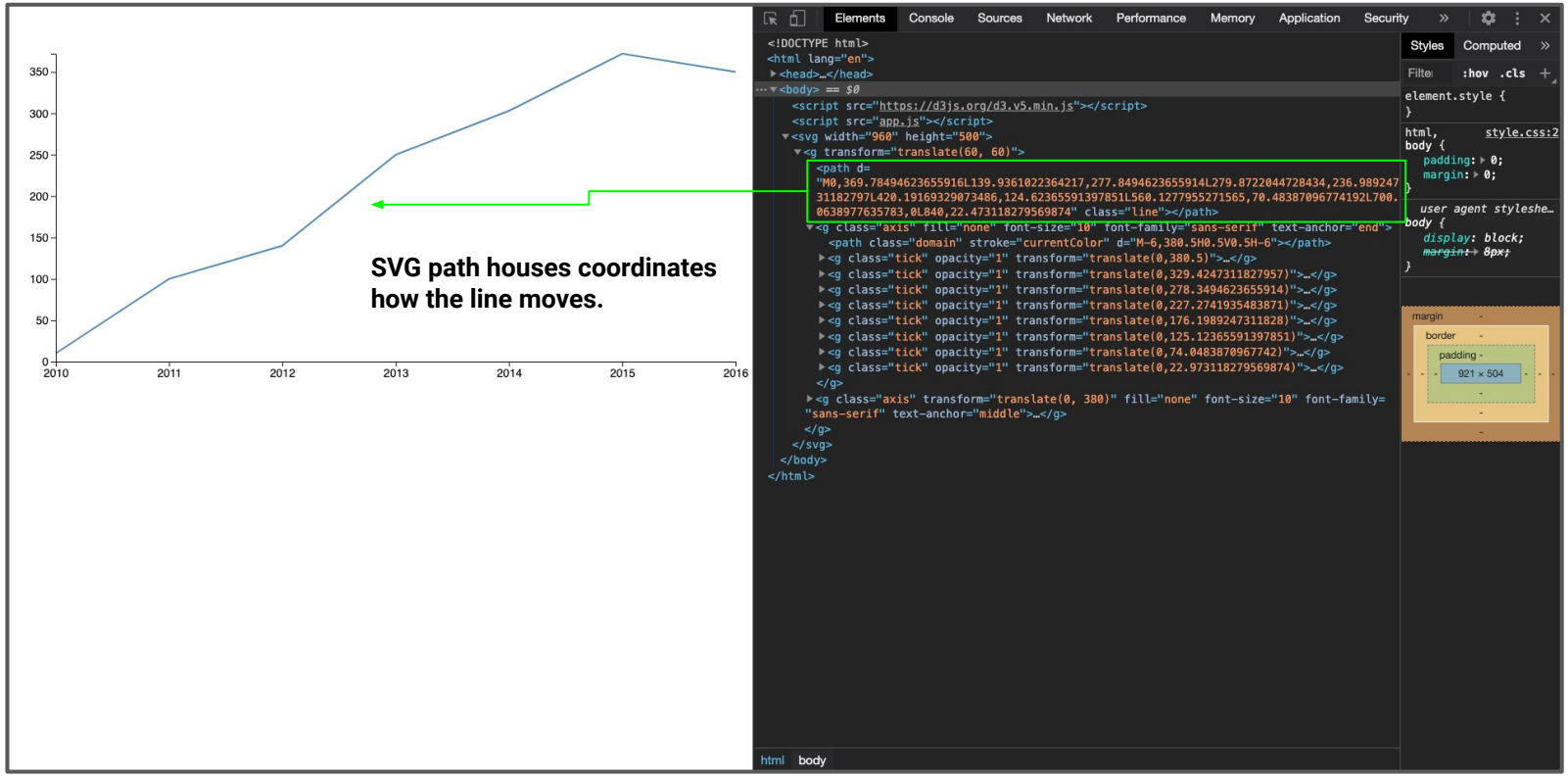


Instructor Demonstration

Line Chart with Time

Line Chart with Time

- `<path>`



Line Chart with Time

- app.js

```
var svgWidth = 960;
var svgHeight = 500;
```

➔ Sets the height and the width of the SVG container.

```
var margin = {
 top: 60,
 right: 60,
 bottom: 60,
 left: 60
};
```

➔ Sets margins for the chart.

```
var chartWidth = svgWidth - margin.left - margin.right;
var chartHeight = svgHeight - margin.top - margin.bottom;
```

➔ Sets the height and the width for the chart area.

```
var svg = d3.select("body")
 .append("svg")
 .attr("width", svgWidth)
 .attr("height", svgHeight);
```

➔ Appends a SVG container to the body with the svgWidth and the svgHeight.

```
var chartGroup = svg.append("g")
 .attr("transform", `translate(${margin.left}, ${margin.top})`);
```

➔ Appends a group area and set its margins.

```
var parseTime = d3.timeParse("%Y");
```

➔ Configures the function to return a new date object in a string.

```
d3.csv("forcepoint.csv").then(function(forceData) {
  console.log(forceData);
```

➔ Loads data from the file.

Line Chart with Time

```
 forceData.forEach(function(data) {
   data.date = parseTime(data.date);
   data.force = +data.force;
});
```

➔ Formats the date and converts the force value to an integer.

```
var xTimeScale = d3.scaleTime()
  .domain(d3.extent(forceData, data => data.date))
  .range([0, chartHeight]);
```

➔ Configures the time scale.

```
var yLinearScale = d3.scaleLinear()
  .domain([0, d3.max(forceData, data => data.force)])
  .range([chartHeight, 0]);
```

➔ Configures the linear scale .

```
var bottomAxis = d3.axisBottom(xTimeScale);
var leftAxis = d3.axisLeft(yLinearScale);
```

➔ Configures two functions to create the chart axes passing the scales as arguments.

```
var drawLine = d3.line()
  .x(data => xTimeScale(data.date))
  .y(data => yLinearScale(data.force));
```

➔ Configures a line function to plot the x and y coordinates using the scales.

```
chartGroup.append("path")
  .attr("d", drawLine(forceData))
  .classed("line", true);
```

➔ Function returns the instructions to create the line for the forceData.

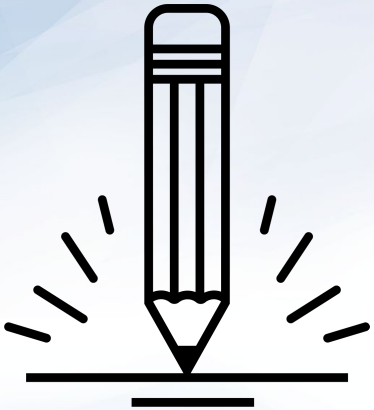
➔ Configures the time scale.

```
chartGroup.append("g")
  .classed("axis", true)
  .call(leftAxis);
```

➔ Appends an SVG group element. Creates the left axis inside.

```
chartGroup.append("g")
   .classed("axis", true)
   .attr("transform",
   `translate(0, ${chartHeight})`)
   .call(bottomAxis);
}).catch(function(error) {
 console.log(error);
});
```

➔ Appends an SVG Group. Creates inner bottom axis translating it to the bottom of the page.



Activity: Line Chart

In this activity, you will create a line chart using a new data set. In the line chart demonstrate the number of miles per month the user of a fitness application has walked since they started using the app.

Suggested Time:
10 Minutes

Activity: Line Chart

Instructions:

- Take a moment to study the new data set `miles-walked-this-month.csv`.
- Define the dimensions for chartWidth and chartHeight.
- Append an SVG to the body, and then append a group element to it and translate it to adhere to the margins.
- Load the data from the CSV. Remember that you will need to run a server to check your page.
- Use the `d3.timeParse` method in order to create a new function to parse the month from the CSV data and save the function to a variable. You will need to pass the `%B` token as an argument into the `d3.timeParse` method in order to properly configure the new function to create a `Date` object from a string month.
- Run a `forEach` loop on the `milesData`. Cast the `miles` property of each element in the `milesData` array to a number. Use the time parser function created in the last step to convert the `month` for each element into a `Date` object.
- Configure your x and y scales as `xTimeScale` and `yLinearScale`.
- Create your axes generator functions.
- Run the `d3.line` method to create and save a new line generator function. Configure this function to plot the x-axis using `xTimeScale` function, passing in the `date` value for each element in the data set. Then, configure this function to plot the y-axis using the `yLinearScale` function, passing in the `miles` property for each element in the data set.
- Append an SVG `path` to the SVG group element. Set the `d` attribute of the new SVG `path` using the line generator function created in the last step. Pass `milesData` into the line generator as an argument. Give this element a class of "line".
- Append two `<g>` elements and use the axes generator functions you created in step 7 to append an axis to each. Make sure to place these elements to correctly display your axes.

Activity: Line Chart

Instructions:

- **Hints:**

  - See D3 documentation for local.parse to better understand the d3.timeParse method.
  - See D3 documentation for local.format to better understand the tokens used with the d3.timeParse method.
  - See D3 documentation for d3.line to better understand the steps for creating a line generator function.
  - Check out a basic line chart example made by D3 creator, Mike Bostock.
  - Check the browser often, print any values you're unsure about to the console.

Time’s Up! Let’s Review.


The End