Making Graphs

Scales

Scales are functions that map from an input domain to an output range

Linear Scales

Linear scales have equal division for equal values. We input a svg to grid and scale it down to fit the demensions so it doesn't run off the screen. Consider the following:

```
const y = d3.scaleLinear()
	.domain([0, 828])
    .range([0, 400])

console.log(y(100)) // 48.3
console.log(y(828)) // 400
console.log(y(414)) // 200

console.log(y.invert(48.3)) // 100
console.log(y.invert(400)) // 414
console.log(y.invert(200)) // 428
```

One of the most common types of linear scales is a time scale. The input is a JS Date Object and the output is a number. Keep in mind months are indexed starting at 0.

```
const x = d3.scaleTime()
	.domain([
    		new Date(2000,0,1),
            new Date(2001, 0, 1)
            ])
            .range([0, 400])
```

```
console.log(x(new Date(2000, 7, 1)) // 199


console.log(x.invert(199)) // Tue Aug 01 2000
```

Logaritmic Scales for Diverging Data

Often data sets that grow over time will grow exponentially, such as population. In these cases we would need to use a log scale.

Performing a log scale on a dataset will change the difference between points in a data set to be even (linear).

Remember: You cannot take the log of 0. So never use log on a dataset where the domain passes through 0.

Consider the following:

```
const y = d3.scaleLog()
	.domain([300, 1500000])
		.range([0, 400])
		.base(10)


console.log(y(500)) // 32.9
console.log(y(5000)) // 181.1
console.log(y(50000)) // 329.3


console.log(y.invert(32.9)) // 500
console.log(y.invert(181.1)) // 5000
console.log(y.invert(329.3)) // 50000
```

Ordinal Scales

For assigning color schemes to categorical data. If there are more items in the domain than the range then the array loops back around from the start. There are also pre-build color schemes.

d3.schemeCategory10 <>

d3.schemeCategory20 <>

d3.schemeCategory20b <>

d3.schemeCategory20c <>

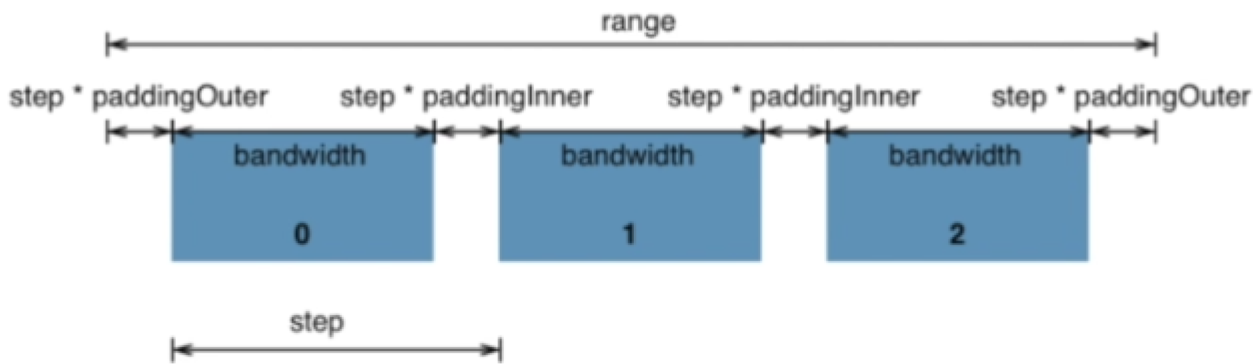
```
const color = d3.scaleOrdinal()
.domain([
    "AFRICA", "ASIA"
    ])

    .range([
    "RED", "BLUE", "GREEN"
    ])
    // Alternatively
    //.range(d3.schemeCategory10)



console.log("AFRICA") // "RED"
console.log("ASIA") // "BLUE"
console.log("EUROPE") // "GREEN"
console.log("PANGEA") // "RED"
```

It is not possible to take the invert of a ordinal scale.

Band Scales

Discrete Domain, Continous Range Band scale are almost exlusively used to space out different categories in a bar chart. The scale splits up the range into bands of equal length based on the

number of elements in the array.



We give the scale an array of categories as a domain and a min and max values for the range. Also a ratio between 0 and 1 for the inner and outer padding needs to be provided, which defines how thick the bars should be. A padding ratio of 0 means no spacing between bars.

If we call a value that doesn't exist in the domain the scale returns undefined.

```
const x = d3.scaleBand()
.domain([
    "AFRICA", "N. AMERICA",
        "EUROPE", "S. AMERICA",
        "ASIA", "AUSTRALIA"
 ])
     .range([0, 400])
     .paddingInner(0.3)
     .paddingOuter(0.2)

console.log(x("S. AMERICA")) // 209
console.log(x("AUSTRALASIA")) // 341
console.log(x("AFRICA")) // 13.1

console.log(x.bandwidth()) // 45.9
```

Determine Min and Max

Rather than defining range and domain as static values, D3 has a few functions to determine these automatically; min, max and extent. They all work generally the same, they take an array of data and an access function as arguments. The accessor function loops over every item in an array.

```
const data = [
{ grade: "A", value: 4 },
    { grade: "C" , value: 1}
]

const min = d3.min(data, d => d.value) // 1
const max = d3.max(data, d => d.value) // 4
const extent = d3.extent(data, d => d.value) // [1, 4]
const grades = data.map(d => d.grade) // ["A", "C"]
```

Margins and Groups

We usually define a margin to surround the visualization using D3 axis generators to add padding to the top, left, bottom, or right. Also we can tweak the dimensions of our visualizations directly from within our javaScript.

This is done by attaching everything to an SVG Group Element, which we can translate anywhere on the canvas. SVG group elements are containers for different SVG shapes. Basically we can bundle many shapes together and translate and transform each using ES6 functions.

```
const MARGIN = { LEFT: 100, RIGHT: 10, TOP: 10, BOTTOM: 130 }

// The example canvas below is 600x400
// but we deduct the margins
const WIDTH = 600 - MARGIN.LEFT - MARGIN.RIGHT
const HEIGHT = 400 - MARGIN.TOP - MARGIN.BOTTOM

const svg = d3.select("#chart-area").append("svg")
  .attr("width", WIDTH + MARGIN.LEFT + MARGIN.RIGHT)
  .attr("height", HEIGHT + MARGIN.TOP + MARGIN.BOTTOM)

// From here we can append shapes to group element g
const g = svg.append("g")
  .attr("transform", `translate(${MARGIN.LEFT}, ${MARGIN.TOP})`)

const rectangles = g.selectAll("rect")
 .append("rect")
 ...
```

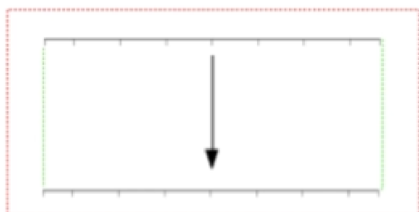
Axes and Labels

Axis are generated from the origin point, meaning axises not on the left or top need to be attached to a group and translated.

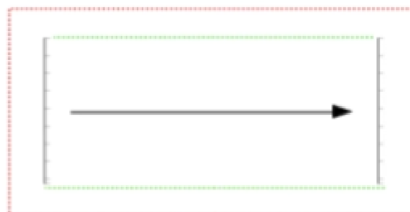
```
const leftAxis = d3.axisLeft(yScale)
g.append("g")
    .attr("class", "left axis")
    .call(leftAxis)
```

```
const topAxis = d3.axisTop(xScale)
g.append("g")
    .attr("class", "top axis")
    .call(topAxis)
```

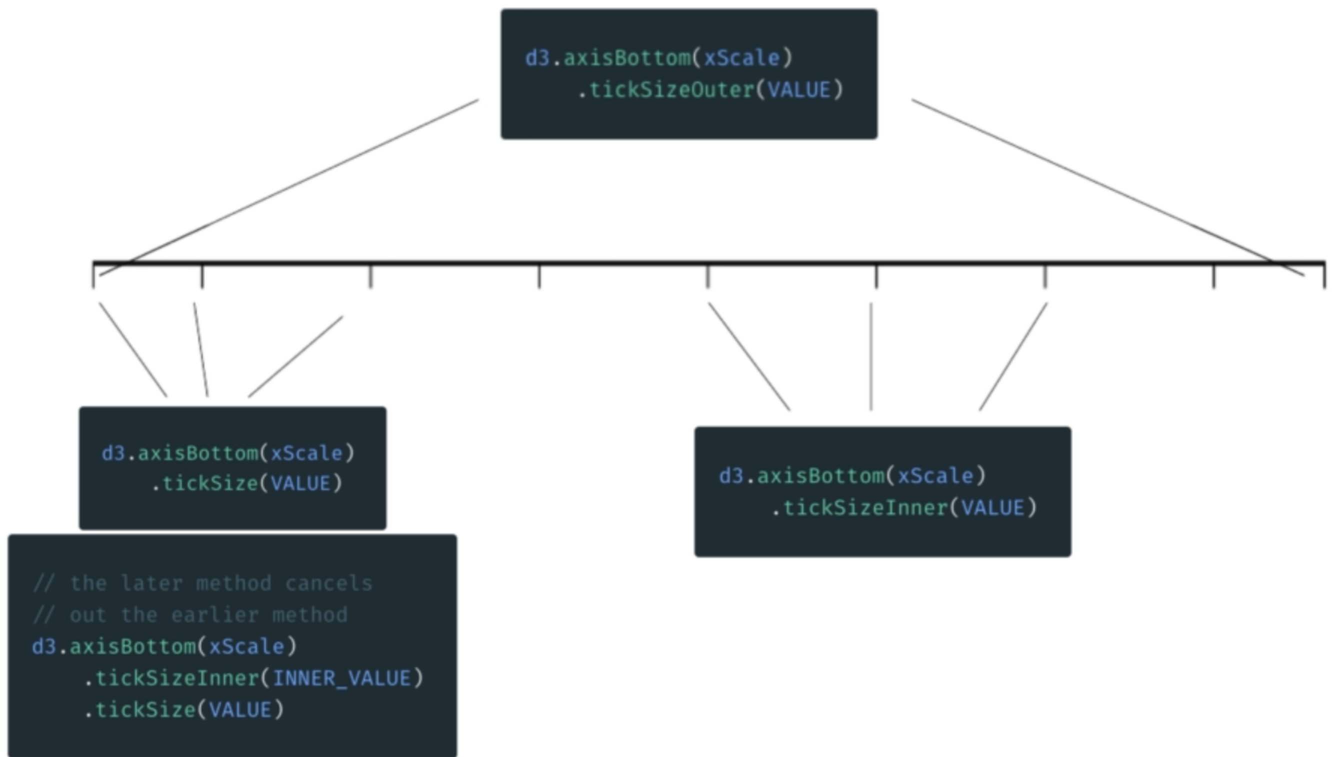
```
const bottomAxis = d3.axisBottom(xScale)
g.append("g")
    .attr("class", "bottom axis")
    .attr("transform", `translate(0, ${HEIGHT})`
    .call(bottomAxis)
```



```
const rightAxis = d3.axisRight(yScale)
g.append("g")
    .attr("class", "right axis")
    .attr("transform", `translate(${WIDTH}, 0)`
    .call(rightAxis)
```



We can change the distance between ticks using the following methods:



tickSizeOuter only changes outermost ticks, tickSizeInner only changes inner ticks, tickSize effects all of them equally. Using tickSize along with the inner or outer adjuster will make the last one called count.

```
// How Many?
d3.axisBottom(xScale)
	.ticks(10)

// Text format
d3.axisBottom(xScale)
	.ticketFormat(d3.format(",.0f")

// Explicit Values
d3.axisBottom(xScale)
	.tickVlues([1, 2, 5, 6])
```

Line Graphs

Recall how svg paths work from the previous section, how we provide a list of coordinates to the path tag in HTML to create a line. D3 comes with path generators that we can use to create lines.

```
// line path generator
const line = d3.line()
    .x(d => x(d.year))
    .y(d => y(d.value))

// add line to chart
g.append("path")
    .attr("class", "line")
    .attr("fill", "none")
    .attr("stroke", "grey")
    .attr("stroke-width", "3px")
    .attr("d", line(data))
```

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