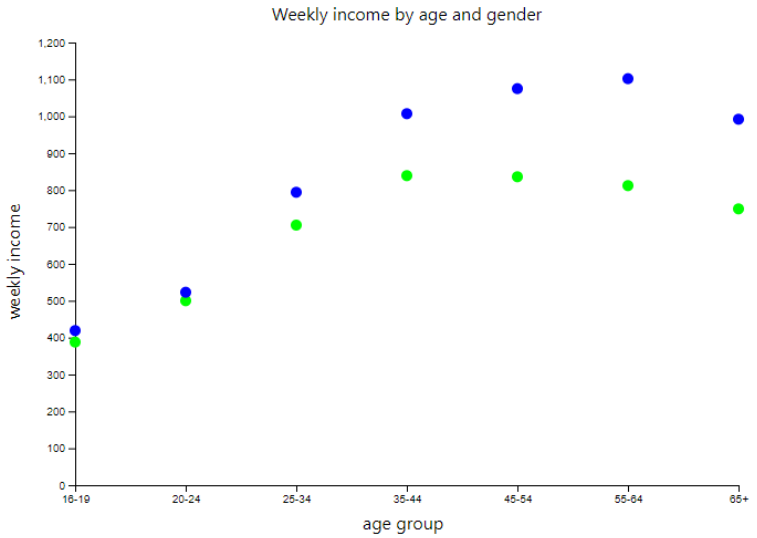
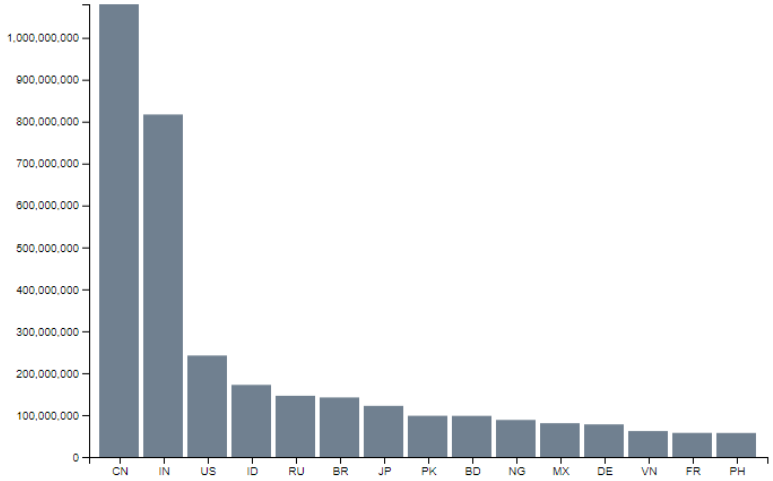
Today: Drawing with generator functions

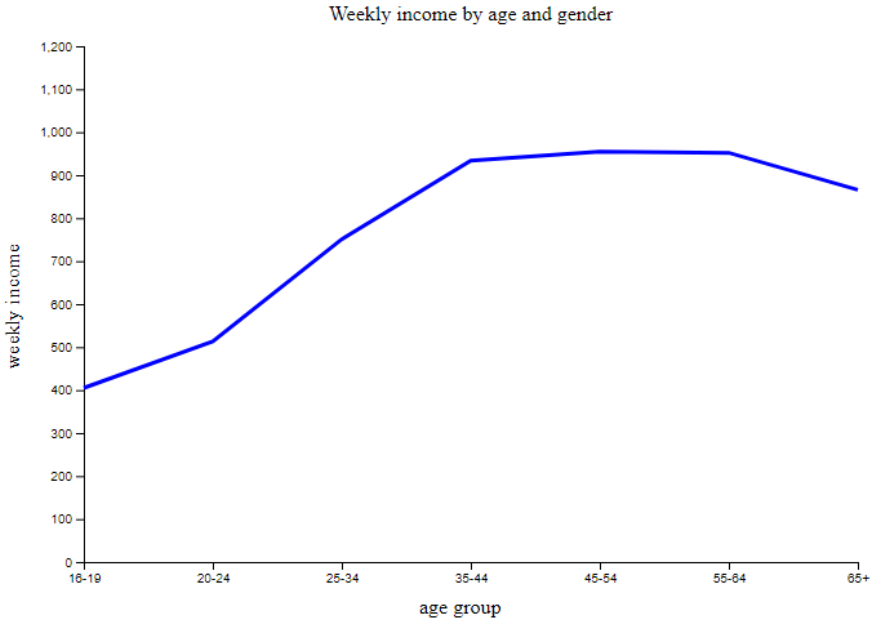
So far, we've worked with visualizations that create one object for each item in a data set.





Drawing with generator functions

What happens when you need to use a bunch of points in your data set to make a single shape?



Now, d3 needs to go through all of the points in your dataset, and use them as points for a path object. To do this, we need a generator function.

Generator functions

A generator function is a function that tells d3 what to do with a set of points. It is called from the d3 .append code, just like we did before for adding points to a scatterplot.

At the top of your file (before d3.csv), add the following:

```
var makeLine = d3 .line ( )
   .x ( function ( d )  {  return scaleX ( d.age ); } )
   .y ( function ( d )  {  return scaleY ( d.total ); } );
```

Notice:

- This function d3.line( ) is stored in a variable (similar to what we did with d3.nest).
- It contains information about how to turn data into values using scale functions.
- We've written the function, but we haven't called it yet, so right now it doesn't *do* anything.

Today: Drawing with generator functions

In the drawing code, remove .selectAll() and .enter()

```
// Add the path
   svg .append ( "path“ )
      .dat um ( dataIn )        // datum (not data!) tells d3 that all of the data
                                // belongs to a single line
      .attr ( "class“ ,  "line“ )
      .attr ( "d“ , makeLine )   // the "d" attribute is just part of how the path
                                 // element is defined, like "cx" or "cy" for a circle.
                                 // it calls the makeLine function above, and hands
                                 //it sets of points that the path should contain.
      .attr ( 'fill‘ , 'none‘ )
      .attr( 'stroke‘ , 'blue‘ )
      .attr( 'stroke-width‘ , 3 );
```

From Line to Area

To draw an area chart instead, we just adjust the generator function.

```
var makeArea = d3 .area ( )                                    //area instead of line
    .x ( function ( d )  { return scaleX ( d.age );  } )
   .y0( scaleY(0))                                             //sets the baseline
    .y1( function ( d )  { return scaleY ( d.total ); } );  //y1 instead of y
```

Change the function call in the data drawing:

```
 svg.append("path")
      .datum(dataIn)
      .attr("class", "area")
      .attr("d", makeArea )
```

And update styling (usually give it a fill, turn off stroke)

Next week: maps

Use generator functions and geographic projections to draw map outlines using d3. To do this, we will use a special kind of function called a geoJSON file (more on this next week)

This week, think about what kind of data that you might want to show on a map, and create a list of latitude and longitude points for the data. (Stick to things inside the US for now.)

	A	B	C	D
1	name	lat	long	
2	Harold Parker State Fo	42.6103	-71.0904	
3	Campus Life - Northea	42.3398	-71.0892	
4	Ground Zero	42.50793	-71.1048	
5	Just Between Neighb	28.0781	-82.7637	
6	Raccoon Race	41.9211	-87.8092	
7	Climbing Tree	41.8781	-87.6398	
8	At the Bottom of Miss	42.36115	-71.0571	

Intro to map data

geoJSON is a special format of data used for maps. Census bureau has a good collection of US maps:
https://www.census.gov/geo/maps-data/data/tiger-cart-boundary.html

Natural Earth has a good collection of world maps:
http://www.naturalearthdata.com/

Often, you will find maps as SHP files rather than geoJSON. Mapshaper is a handy tool for converting the files :
http://mapshaper.org/

Download US States file from Census, unzip. Load both .shp and .dbf files into mapshaper, export geoJSON.

Also possibly useful:
http://geojson.io

Inside a geoJSON

Feature collection
→ Features
→ Geometry
→ Coordinates
→ Properties


```
{"type":"FeatureCollection", "features": [
{"type":"Feature","geometry":{"type":"MultiPolygon","coordinates":[[[[-68.92401,43.885407],[-68.87478399999999,
.904714999999996],[-68.849009,43.849841],[-68.888483,43.803781],[-68.944433,43.835325999999995],[-68.92401,43.
[[[-71.083924,45.305451],[-71.03820999999999,45.311921999999996],[-71.012757,45.34476],[-70.949365,45.331536],
.912111,45.296197],[-70.892822,45.239171999999996],[-70.84443,45.234513],[-70.8340195374401,45.2717944023968],
45.286941],[-70.808613,45.311606],[-70.819471,45.341435],[-70.80624399999999,45.376557999999996],[-70.8256119
.400304999999996],[-70.781471,45.431159],[-70.755567,45.428360999999995],[-70.729972,45.399359],[-70.677995,45
[-70.634661,45.383607999999995],[-70.635498,45.427817],[-70.674903,45.452399],[-70.723396,45.510394],[-70.6882
.563981],[-70.64957799999999,45.598147],[-70.591275,45.630551],[-70.55282390337851,45.6678060578851],[-70.5527
.667836],[-70.44690299999999,45.704043999999996],[-70.383552,45.734868999999996],[-70.415684,45.786158],[-70.3
.808485999999995],[-70.329748,45.853795],[-70.259117,45.890755],[-70.252526,45.933175999999996],[-70.26541,45.
[-70.31296999999999,45.961856],[-70.303034,45.998976],[-70.317629,46.019079999999995],[-70.30673399999999,46.0
.26634899999999,46.100992999999995],[-70.239566,46.142762],[-70.290896,46.185838],[-70.255492,46.246444],[-70.
.284428],[-70.205719,46.299865],[-70.207415,46.331316],[-70.161337,46.360983999999995],[-70.118597,46.38423299
[-70.080292,46.410531],[-70.053748,46.429235999999996],[-70.02301978705619,46.573486472517295],[-69.997086,46.
.695229999999995],[-69.818552,46.875029999999995],[-69.566383,47.125032],[-69.43919799999999,47.25003299999999
.219996,47.457159],[-69.156074,47.451035],[-69.108215,47.435831],[-69.039301,47.42217],[-69.053885,47.37787799
[-69.0402,47.2451],[-68.966433,47.212711999999996],[-68.90098499999999,47.178518999999994],[-68.80353699999999
.216032999999996],[-68.675913,47.242626],[-68.60481899999999,47.249418],[-68.588725,47.281721],[-68.507432,47.
[-68.460064,47.286065],[-68.375615,47.292268],[-68.384281,47.326943],[-68.361559,47.355605],[-68.26971,47.3537
.204263,47.339729999999996],[-68.153509,47.314038],[-68.08289599999999,47.271921],[-67.998171,47.217842],[-67.
.196141999999995],[-67.889155,47.118772],[-67.789761,47.065743999999995],[-67.789799,46.794868],[-67.788406,46
```

Making our first map: setup

Load map data into the browser using d3.json, and console.log it to look at its structure.

Before we do any more with it, first a little cleanup, because we want to be able to use the svg size to adjust the map:

 around svg with class svgBox
<svg> width and height set to 100%, add an id="svg"

CSS style the containing div to take up the whole window:

```
.svgBox  {
      width:  100vw ;
      height:  100vh ;
}
```

Making our first map: setup

Check that the width and height are set properly:

```
var  width = document .getElementById ( 'svg1‘ ) .clientWidth ;
var  height = document .getElementById ( ‘svg1‘ ) .clientHeight ;
```

Set margins to zero for now.

Drawing map outlines: projections and generator functions

Before we can draw the map, we need to identify a projection to convert the latitude and longitude values in the data into points on our screen.

https://bl.ocks.org/mbostock/29cddc0006f8b98eff12e60dd08f59a7

We want to use the Albers projection, centered on the United States.

```
var albersProjection = d3 .geoAlbersUsa ( )
   .scale ( 700 )
   .translate ( [ (width/2) ,  (height/2) ] );
```

Next, set up a path generator, and tell it to use the projection:

```
path = d3 .geoPath ( )
   .projection ( albersProjection );
```

Actually drawing the map

```
svg.selectAll ( "path“ )
        .data ( dataIn .features )
        .enter ( )
        .append ( "path“ )
        .attr ( "d“ , path )
        .attr ( "class“ ,  “state “ )
        .attr ( 'fill‘ , 'gainsboro‘ )
        .attr ( 'stroke‘ , 'white‘ )
        .attr ( 'stroke-width‘ , .2 );
```

Drawing points on the map

```
svg .selectAll ( 'circle' )
      .data (  [  { long: -71.0589,  lat: 42.3601}   ] )
      .enter( )
      .append ( 'circle' )
      .attr ( 'cx' ,  function ( d ) {
            return albersProjection (  [ d.long,  d.lat ]  ) [ 0 ]
      } )
      .attr ( 'cy' ,  function ( d ) {
          return albersProjection (  [ d.long,  d.lat ]  ) [ 1 ]
      } )
      .attr ( 'r' , 10 )
      .attr(  'fill' , 'purple' )
```

Chloropleth: Graphing a variable using state fill color

First, we need to load the data that we want to plot on the map (stored in a separate .csv file)

Then, we need to figure out how to connect it to the map data

Finally, we need to use the .csv data when we draw the map.

Loading multiple data files at once

Queue.js is a library that helps us to load more than one data file into the browser at once.

Add it to the HTML:

```
<script src =" ./queue.min.js" ></script>
```

From JS, the following replaces d3.json:

```
queue ( )
   .defer ( d3 .json , " . / cb_2016_us_state_20m .json "  )
   .defer ( d3.csv , " . / statePop .csv" )
   .await ( function ( err , mapData, populationData ) {

   //put your map drawing code here, update to .data( mapData )

}
```

Connecting map and .csv data

To connect the data, we want to make a "lookup table", or dictionary, that we can use to look up the data value for a particular state when we draw the map.

Unfortunately, the function that we use to do this is called array .map( ), which is confusing because it has nothing to do with geographic maps.

First, we make an empty dictionary at the top of the document:

```
var stateLookup = d3 .map ( ) ;
```

Then, we connect it to the .csv data by setting the dictionary values:

```
populationData .forEach ( function ( d ) {
      stateLookup .set ( d.name, d.population ) ;
});
```

Using an array.map( ) function to look up values

Now that we have our dictionary set up, we want to be able to use it to set the colors for different states in our map.

First, set up a color scale for the data:

```
var colorScale = d3 .scaleLinear ( ) .range ( [ 'white' , 'blue' ] );

colorScale .domain (
    [ 0, d3.max(
            populationData .map( function ( d ) {
                    return +d.population
            } ) )
     ] );
```

And apply it to the map drawing:

```
.attr ( 'fill' , function ( d ) {
        return  colorScale ( stateLookup .get ( d .properties .NAME ) );
})
```