Geomapping

Projections, Resolution, Resolution, and Mapping

Overview

- Projections
- Resolution of Data Sets
- Data Formats (Json, GeoJson, Topojson)
- GeoMapping Examples
  - Geomapping Introduction by Scott Murray (Chapter 14)
  - US Chloropleth Map by Mike Bostock
  - California Population Density by Mike Bostock

Projections

Earth is round. Screen is flat. One needs to figure out how to project a round object on a flat surface. Navigators and cartographers have invented several projection techniques over centuries. AlbersUsa used by Scott Murray in Chapter 12 is only one of the projection system. Other popular projections include Mercator, EqualArea type, EquiDistant type, Conformal (or EquiAngle type), EquiRectangular etc.

D3 supports many different types of projections:
https://bl.ocks.org/mbostock/3711652 demonstrates *Projection Transitions (D3 V3 Version)*. This example also has support for a *pull-down menu* that you may want to use for final project.

An updated D3 V4 version has been created by Alex Macy:
https://bl.ocks.org/alexmacy/6700d44240d2b6d3ec9767a5a5854e42

The full reference is available at:
https://github.com/d3/d3/blob/master/API.md#geographies-d3-geo

Resolution or Scale of DataSets

Earth is much bigger than the flat screen. Data Formats come in different resolutions. All the data formats we discuss are vector files (points and lines) rather than bitmap (or pixels). Some typical resolutions are 1:10M (*1M = 1 million inches = 15.8 miles*), 1:50M, and 1:110M. Please note that 1:10M is the highest resolution and 1;110M is the coarsest among these. When you see a file named us-10m.json, it is likely that the underlying resolution is 1:10M.

1:110m resolution may suffice for world maps. 1:10M will be much better for a specific country. If mapping a much smaller region, such as a specific city or a neighborhood, then you will need much better resolution. These high resolution GeoJSON data sets are unlikely to be available

online unless some brave soul has attempted to visualize this geographic region before you and have provided this data for free online! Most likely, you will have to create these high resolution data sets starting from the data provided by local government agencies. Since the standard data format for geographic data has been shapefiles for several decades, it is most likely that you will get this data in shapefile which then you will have to convert to GeoJSON or TopoJSON data formats described later in Part II of this handout.

US Census provide a high resolution boundary data sets for US census tracts that are freely available. The distance between two points in this data set is roughly 25 feet! High resolution data sets are often needed for gaining better insight into urban issues. For further description, http://gis.stackexchange.com/questions/74155/what-meter-resolution-are-us-census-block-shapes

It's all about GeoJSON/TopoJSON Data Formats

JSON

JSON = **J**ava**S**cript **O**bject **N**otation Data Format
It is introduced in Scott Murray's book on Page 39.
JSON data files are read similar to csv files a described below (Page 75 of Scott Murray's book).

```
d3.json("us.json", function(json) {
        Console.log(json); // output to javascript console
});
```

http://adobe.github.io/Spry/samples/data_region/JSONDataSetSample.html
This website presents 10 examples of Json data (not related to GeoJSON data)

In this class, we are interested only in GeoJSON or TopoJSON data, discussed next.

GeoJSON

GeoJSON data files are json files that encode geographic information. This data format is introduced in Scott Murray's book on page 40 and then discussed in further detail in Chapter 12. One of the main things to note is that GeoJSON data sets are encoded in long/lat (longitude/latitude) order rather than lat/long.

TopoJSON

TopoJSON is an extension of GeoJSON that encodes "topology", that is, connectivity information between adjacent polygons, thereby (and using additional techniques) reducing storage requirements significantly, and thus enhances efficiency. Like GeoJSON, TopoJSON is also a json data format.

https://github.com/mbostock/topojson/wiki

This web link provides an excellent introduction to TopoJSON data format. In addition, it presents a gallery of examples of maps created using TopoJSON data.

1. GeoMapping (Introduction by Scott Murray)
For rendering GeoJSON data files, we will follow the example described in Chapter 14 of Scott Murray. Pay special attention to (i) quantization of scales while generating chloropleth maps, and (ii) adding cities by extracting longitude/latitude coordinates and adding them to csv files.

2. **Chloropleth Map**
http://bl.ocks.org/mbostock/4060606
makes a chloropleth map on US Counties

3. **California Population Density** (by Mike Bostock)
https://bl.ocks.org/mbostock/5562380

https://medium.com/@mbostock/command-line-cartography-part-1-897aa8f8ca2c
This 4-part tutorial on Command-Line Cartography teaches how to create a thematic map from command line using d3-geo, Topojson, and ndjosn-cli.

Some Simple Examples of US mapping
(with states, counties and their variations including layered example)
U.S. States TopoJSON
http://bl.ocks.org/mbostock/4090848
U.S. Counties TopoJSON
http://bl.ocks.org/mbostock/4122298
U.S. Land TopoJson
http://bl.ocks.org/mbostock/4134057
U.S. TopoJSON
http://bl.ocks.org/mbostock/4108203
Another U.S. TopoJSON with outer glow
http://bl.ocks.org/mbostock/4136647
U.S. Counties TopoJSON Mesh
http://bl.ocks.org/mbostock/4090870

Mapping Gems by Mike Bostock
Raster+Vector Pan+Zoom
http://bl.ocks.org/mbostock/5342063

U.S. State Capitals with Pan+Zoom
http://bl.ocks.org/mbostock/9535021

And, if you really want to bend your mind, view the example gallery by Mike Bostock:
http://bost.ocks.org/mike/example/

Older examples that work with d3 v3:

Projections
http://bl.ocks.org/mbostock/3709000 demonstrates *Map Projection Distortions*.
https://bl.ocks.org/syntagmatic/ba569633d51ebec6ec6e presents yet another example of *Comparing Map Projections*.

http://www.d3noob.org/2013/03/a-simple-d3js-map-explained.html
provides a simple introduction to creating a map in D3 describing the role of center, scale, rotate, zooming, and panning the map, and placing city dots on the map.

http://www.jasondavies.com provides support for now support essentially every obscure projection you could imagine using D3's geoprojections plug-ins.

TopoJSON data format allows additional mapping techniques that will be very difficult using only GeoJSON data format (that does not have connectivity information). Examples:
1. Topology-preserving *Line Simplification* http://bost.ocks.org/mike/simplify/
2. Cartograms http://prag.ma/code/d3-cartogram/
3. Automatic map coloring
http://bl.ocks.org/jasondavies/4188334
http://bl.ocks.org/mbostock/4180634

Let's make a Bubble Map
http://bost.ocks.org/mike/bubble-map/
makes a bubble map on Us Counties

See-Through Globe
http://bl.ocks.org/mbostock/6746848
http://bl.ocks.org/mbostock/6747043

Lets Make a map Tutorial (by Mike Bostock) This is outdated but used to be the best.
Let's make a Map Tutorial by Mike Bostock: https://bost.ocks.org/mike/map/
This map shows United Kingdom with many cities.

Adding parallax to illustrate different layers
http://bl.ocks.org/mbostock/5707610 (really cool!)