FORSCHUNGSGRUPPE
KARTOGRAPHIE
Research Group Cartography

Programming Cartographic Tasks 2015

Lecture 6: Visualizing Data with D3.js, Part 2

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Part 6.1:

INTERACTION & ANIMATIONS

Adding Interaction: Elements

```
<svg class="map" id="map1" viewBox="0 0 800 400">
<g class="geometry"></g>
</svg>

<!-- add some buttons to trigger interaction -->
<button id="populationButton">Population</button>
<button id="areaButton">Area</button>

<script src="d3.js"></script>
```

Adding Interaction: Event Handlers

```
// old version
d3.csv('places-AT-cleaned.csv', draw_map);
```

Adding Interaction: Event Handlers

```
// new version
d3.csv('places-AT-cleaned.csv', function(data) {
    d3.select('#populationButton').on('click', function() {
        // draw population map
        console.log("population");
    });

    d3.select('#areaButton').on('click', function() {
        // draw area map
        console.log("area");
    });

});
```


… so we want to draw two different kinds of maps
how can we set this up?

Let's look at the draw_map function from last time…

Adding Interaction: Event Handlers

```
function draw_map(data) {
    var selection = d3.select('.map')
        .selectAll('circle')
        .data(data);

    selection.enter()
        .append('circle')
        .attr({
            'fill-opacity': 0.5,
            cx: function(d) {return projection([d.lon, d.lat])[0]},
            cy: function(d) {return projection([d.lon, d.lat])[1]},
            r: function(d) {
                return Math.sqrt(parseFloat(d.population)/500);
            }
         });
}
```

This is the code from last time

What line of code makes it draw a *population map*, specifically?

Adding Interaction: Event Handlers

```
function draw_map(data, radiusFunction) {
    var selection = d3.select('.map')
        .selectAll('circle')
        .data(data);

    selection.enter()
        .append('circle')
        .attr({
            'fill-opacity': 0.5,
            cx: function(d) {return projection([d.lon, d.lat])[0]},
            cy: function(d) {return projection([d.lon, d.lat])[1]},
            r: radiusFunction
         });
}
```

Adding Interaction: Event Handlers

```
var populationRadius = function(d) {
    return Math.sqrt(parseFloat(d.population)/500);
};
var areaRadius = function(d) {
    return Math.sqrt(parseFloat(d.area)/10);
};
d3.csv('places-AT-cleaned.csv', function(data) {
    d3.select('#populationButton').on('click', function() {
        draw_map(data, populationRadius);
    });
    d3.select('#areaButton').on('click', function() {
        draw_map(data, areaRadius);
    });
});
```


If we run this, it works only the first time we click on a button…

Adding Interaction: Event Handlers

```
function draw_map(data, radiusFunction) {
    var selection = d3.select('.map')
        .selectAll('circle')
        .data(data);

    selection.enter()
        .append('circle')
        .attr({
            'fill-opacity': 0.5,
            cx: function(d) {return projection([d.lon, d.lat])[0]},
            cy: function(d) {return projection([d.lon, d.lat])[1]},
            r: radiusFunction
         });
}
```

This is our current version of the code…

D3 Selections Revisited

```
var selection = d3.selectAll('circle');
```

- Selection: Array of (groups of) elements

```
selection.data(arrayOfData);
```

- `selection.data()` joins elements to an array of data
  - matchmaking by Array position (index) or key function
  - placeholders are created for non-existing elements

- After join: 3 parts
  - `selection`: updated elements
  - `selection.enter()`: placeholders for missing elements
  - `selection.exit()`: elements without matching data items

D3 Selections Revisited

```
var selection = d3.select('.map')
    .selectAll('circle')
    .data(data);

selection.enter()
    .append('circle')
    .attr({
        'fill-opacity': 0.5,
        cx: function(d) {return projection([d.lon, d.lat])[0]},
        cy: function(d) {return projection([d.lon, d.lat])[1]},
        r: radiusFunction
    });
```

The enter() part is never executed for existing elements!

D3 Selections Revisited

```
var selection = d3.select('.map')
    .selectAll('circle')
    .data(data);
// what to do with NEW elements
selection.enter()
    .append('circle')
    .attr({
        'fill-opacity': 0.5,
        cx: function(d) {return projection([d.lon, d.lat])[0]},
        cy: function(d) {return projection([d.lon, d.lat])[1]}
    });
// what to do with ALL elements
selection.attr({
    r: radiusFunction
});
```

(d3places_03.html)

Two things are missing:
- we don't have a map initially
- maybe we want to add animations

Drawing the Initial Map

```
d3.csv('places-AT-cleaned.csv', function(data) {
    d3.select('#populationButton').on('click', function() {
        draw_map(data, populationRadius);
    });
    d3.select('#areaButton').on('click', function() {
        draw_map(data, areaRadius);
    });

    draw_map(data, populationRadius);
});
```

Animating Transitions

```
// in draw_map()
// ...
// what to do with ALL elements
selection.attr({
    r: radiusFunction
});
```

Animating Transitions

```
// in draw_map()
// ...
// what to do with ALL elements
selection.transition()
    .duration(800)
    .attr({
        r: radiusFunction
    });
```

duration… duration in milliseconds

(d3places_04.html)

Part 6.2:

SCALES

Scales

```
var populationRadius = function(d) {
    return Math.sqrt(parseFloat(d.population)/500);
};
```

Scales

```
// var populationRadius = function(d) {
//     return Math.sqrt(parseFloat(d.population)/500);
// };

// we can create the same functionality using scales

var populationScale = d3.scale.sqrt()
    .domain([0,2000000])          // range of input values
    .range([0,60])                // range of output values
;
var populationRadius = function(d) {
   return populationScale(d.population);
};
```

Scales

```
// var areaRadius = function(d) {
//     return Math.sqrt(parseFloat(d.area)/10);
// };

var areaScale = d3.scale.sqrt()
    .domain([0,500])
    .range([0,10])
;
var areaRadius = function(d) {
   return areaScale(d.area);
};
```

More Scale Examples

```
var colorScale = d3.scale.linear()
    .domain([0,100])
    .range(['#e0ecf4','#8856a7'])
;
var thresholdColors = d3.scale.quantize()
    .domain([0,100])
    .range(['#edf8fb','#b3cde3','#8c96c6','#8856a7','#810f7c'])
;
var ordinalColors = d3.scale.ordinal()
    .domain(['rural','mixed','urban'])
    .range(['#99d8c9','#bdbdbd','#636363'])
;
```

Part 6.3:

SETTING UP THE PROJECTION

Setting up the Projection

```
// so far, we set up our projection like this:
var projection = d3.geo.mercator()
    .translate([-950, 5710])
    .scale(5800);
;
```


Can we calculate these numbers?

Setting up the Projection

```
function setup_projection(projection, geometry) {
    // reset projection
    projection.scale(1).translate([0,0]);

    // TODO: calculate projection parameters from geometry
    var scale = ???
    var translate = ???

    // apply the new parameters
    projection
       .scale(scale)
       .translate(translate);
}
```


This is the overall idea.

… how can we calculate the projection parameters from our geometry? …

Setting up the Projection

```
// we use a path generator to convert geometry into pixels
var pathGenerator = d3.geo.path().projection(projection);
var bounds = pathGenerator.bounds(geometry);

// bounds will now contain projected coordinates:
// [[left, top], [right, bottom]]

// TODO: set up projection parameters
var scale = ???
var translate = ???
```

Setting up the Projection

```
// bounds: [[left, top], [right, bottom]]

// TODO: set up projection parameters
var scale = 0.95 / Math.max(
    (bounds[1][0] - bounds[0][0]) / width,
    (bounds[1][1] - bounds[0][1]) / height
);

var translate = [
    (width / 2 - (bounds[0][0] + bounds[1][0]) / 2 * scale),
    (height / 2 - (bounds[0][1] + bounds[1][1]) / 2 * scale)
];
```


We need to add the
global variables
width and height!

Setting up the Projection

```
function setup_projection(projection, geometry) {

    projection.translate([0,0]).scale(1);
    var bounds = d3.geo.path().projection(projection).bounds(geometry);

    var scale = 0.95 / Math.max((bounds[1][0] - bounds[0][0]) / width,
        (bounds[1][1] - bounds[0][1]) / height);
    var translate = [
        (width / 2 - (bounds[0][0] + bounds[1][0]) / 2 * scale),
        (height / 2 - (bounds[0][1] + bounds[1][1]) / 2 * scale)
    ];
    projection
       .scale(scale)
       .translate(translate);
}
```

Setting up the Projection

```
d3.json('bezirke.geojson', function(error, geometry) {

    // set up the projection as soon as geometry has loaded
    setup_projection(projection, geometry);

    // ...
});
```


(d3places_06.html)

There is one problem remaining:
we set up the projection after the geometry has loaded, but the dots may have been rendered earlier!

Setting up the Projection

```
d3.csv('places-AT-cleaned.csv', function(data) {
    // PROBLEM: projection may not have been set up!
    // ...
});

d3.json('bezirke.geojson', function(error, geometry) {

    // set up the projection as soon as geometry has loaded
    setup_projection(projection, geometry);

    // ...
});
```

Setting up the Projection

```
d3.json('bezirke.geojson', function(error, geometry) {

    // set up the projection as soon as geometry has loaded
    setup_projection(projection, geometry);

    // ...

    d3.csv('places-AT-cleaned.csv', function(data) {
        // SOLUTION: load csv data after geometry has loaded
        // ...
    });
});
```

Assignment 3

- Create an interactive choropleth map of Austria
  - Use D3.js to create a SVG map from geodata
  - Visualize income data of Austrian districts, available as fields of the `properties` of each GeoJSON feature
    - `income_med` Overall median income
    - `income_med_m` Median income of male workers
    - `income_med_f` Median income of female workers
  - Provide 3 buttons to switch the visualization between these values
  - Use a single color scale to set the fill color of each district, depending on the selected value.
    - Choose a suitable domain for the color scale
    - Choose a range of color values from colorbrewer2.org

Assignment 3

- Bonus Points
  - Create a legend for the map using D3.js, using the *color values as data* to create the legend entries
  - Add a `'click'` event handler to the district geometries that shows information (Name, data values) next to the map

- Due date: May 22

Next Week

No lecture, only (final) programming tutorial (at 3PM)