**CSE564: Visualization** **Professor: Klaus Mueller**
**Topic : Project Report(Final Review)** **Date : 5/15/2017**
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## Data Analysis:

Times Higher Education Data ranking (timesData) is in very nice format. Teaching, International students, Citations, Research, Income are given a percentage score out of 10. Apart from these, there are other interesting criteria such as number of students, student-staff ratio etc.
In our final review, we have plotted some interesting visualizations to determine how these parameters influence ranking across countries and within a country. We have also analyzed the trend in ranks and criteria over the years. In short, our tool will help any student to shortlist a university based on his preferred criteria.

## PART 1: ACROSS COUNTRY ANALYSIS

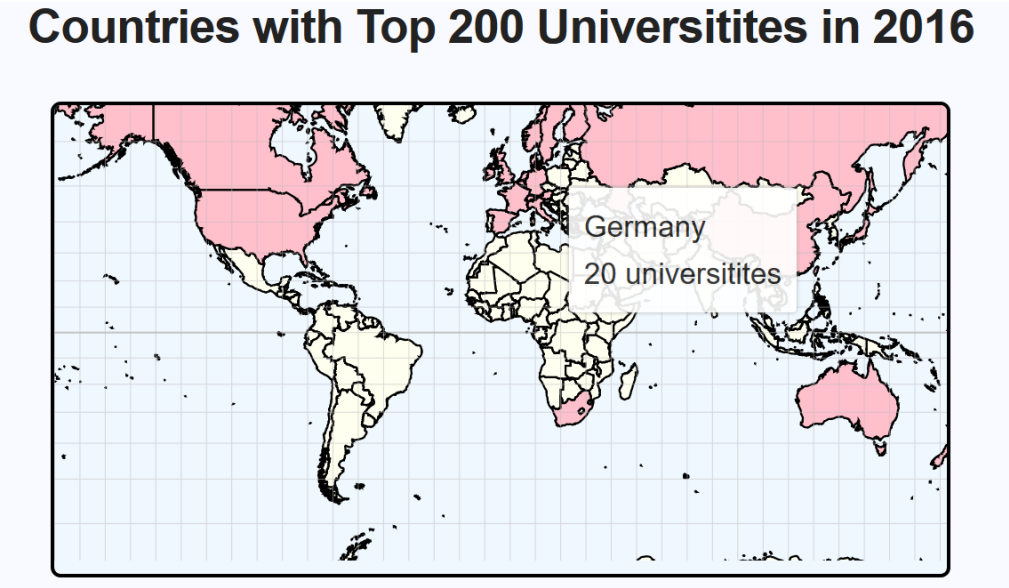
Let us assume you are a student searching for a university which meets your requirement.
Note: By default, the data is for 2016.

a. **MAP**

As a student, you go to the tool to see where are top 200 universities When you hover your mouse on each country, you get the country name and the number of universities in that country. As shown in figure, Germany has 20 universities in top 200 in year 2016. This is the main chart of the tool.

OBSERVATIONS:

- Most of the top 200 universities lie in Europe and United States.
- None of the universities in South America are in Top 200 and only one university from Africa is in top 200.



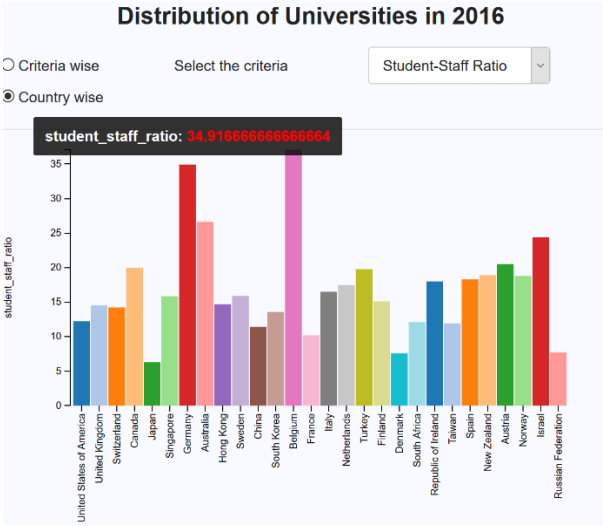
```
var country = g.selectAll(".country").data(topo);
country.enter().insert("path")
    .attr("class", "country")
    .attr("d", path)
    .attr("class", "boundary")
    .attr("id", function(d,i) { return d.id; })
    .attr("title", function(d,i) { return d.properties.name; })
    .style("fill", function(d, i) {
        if(uniqueCountries.indexOf(d.properties.name) > -1){
              return "pink";
        }else{
            return "#FFFFF0";
        }
   });
//offsets for tooltips
var offsetL = document.getElementById('container').offsetLeft+20;
var offsetT = document.getElementById('container').offsetTop+10;
//tooltips
country.on("mousemove", function(d,i) {
        var mouse = d3.mouse(svg.node()).map(
                        function(d) { return parseInt(d); } );
        if(typeof univCount[d.properties.name] == 'undefined'){
            count = 0;
        }else{
            count = univCount[d.properties.name];
        }

        tooltip.classed("hidden", false)
            .attr("style", "left:"+(mouse[0]+offsetL)+"px;
                            top:"+(mouse[1]+offsetT)+"px")
            .html(d.properties.name + " <br>" + count + " universitites");
        })
```

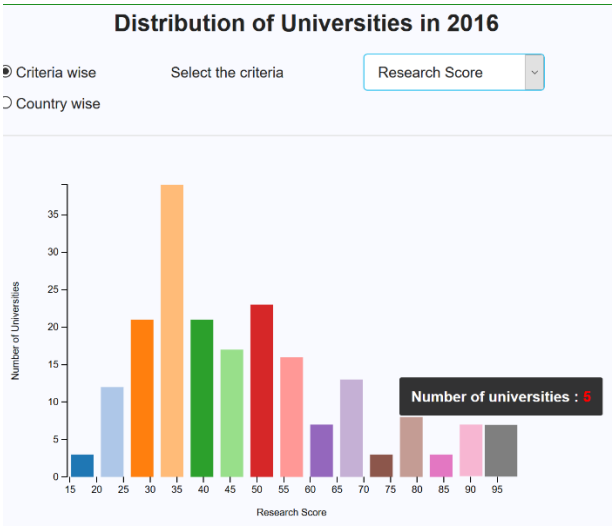
**b. <u>DISTRIBUTION OF UNIVERSITITES (HISTOGRAM, PIE CHARTS)</u>**

Now, you realize that top 200 universities are unevenly distributed. So, the dashboard provides you with histogram and pie chart visualizations. When you click on histogram, there is also a pie-chart visualization. There are two types of histograms.
First, to get a rough estimate how each criterion varies across country. For example, total number of students studying in Germany are 559304.

But you figure out that, restricting to a single country might limit your options to choose universities, so the second histogram provides you with a university count within a given range of criteria. For example, how many universities have industry income above 95%. Answer is 11 from histogram. Similarly, following are few interesting observations:
<u>OBSERVATIONS:</u>

- Only 5 of the total 200 universities have research score of 95% or above.
- There is only one university with more than 108,000 students. By checking the histogram plot across country, we figure out that it was the only university in South Africa, *University of South Africa*. After further research, figured out that this is a mega-university specialized on distance education.
- Germany and Belgium have very high student-staff ratio compared to other universities.



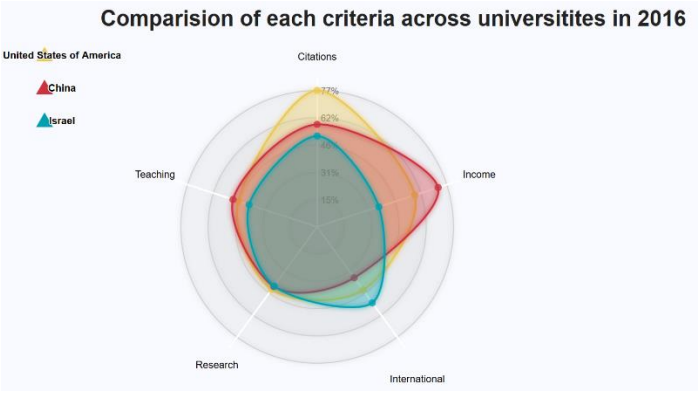




## c. COMPARISION OF EACH CRITERIA ACROSS COUNTRIES (RADAR CHART)

Till now, you have visualized the criteria individually across countries. You have basic idea which countries you are interested in. So, here is a radar chart visualization, where for chosen countries you have holistic visualization how different criteria vary for each country.

OBSERVATION:

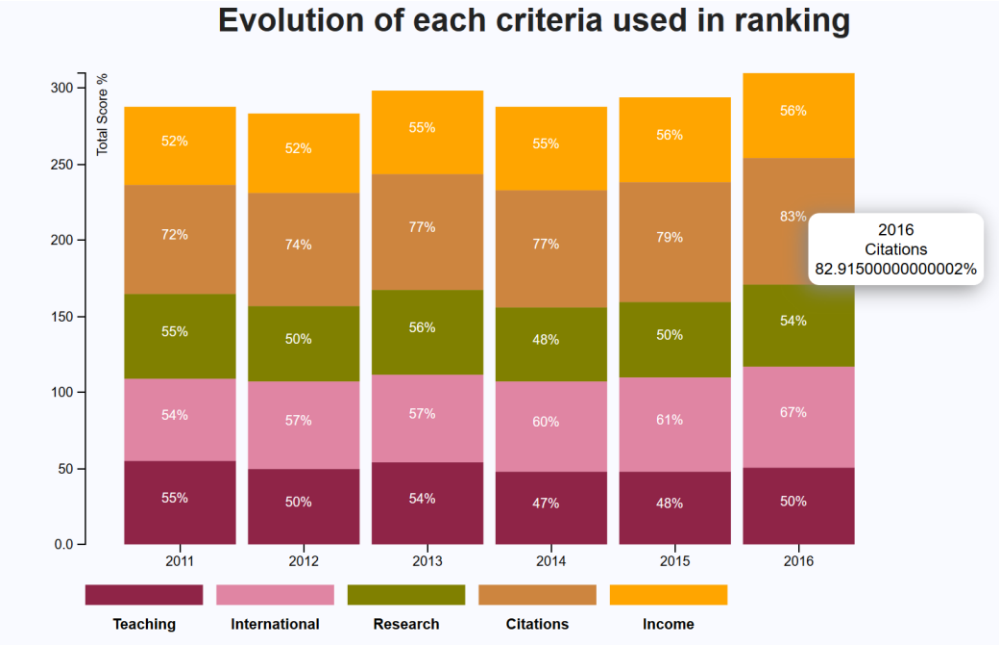
- From the below figure, it can be clearly seen that United States has very high citation score compared to China and Israel.



```
new_data = []
data.forEach(function(item){
    newSeries = {}
    newSeries.key = item.Country;
    newSeries.values = [];
    newSeries.values.push({"reason":"Citations","device":item.Country,"value":parseFloat(item.Citations)});
    newSeries.values.push({"reason":"Income","device":item.Country,"value":parseFloat(item.Income)});
    newSeries.values.push({"reason":"International","device":item.Country,"value":parseFloat(item.International
    newSeries.values.push({"reason":"Research","device":item.Country,"value":parseFloat(item.Research)});
    newSeries.values.push({"reason":"Teaching","device":item.Country,"value":parseFloat(item.Teaching)});
    new_data.push(newSeries);
})
RadarChart(".radarChart", new_data, radarChartOptions);
```

**d. <u>EVOLUTION OF EACH CRITERIA (STACK BAR CHART)</u>**

By now, you are almost sure, about the countries where your dream university lies in. Given that you have own criteria, like citations, teaching, research etc. to choose your university, you may want to check how is that criteria evolving over the years.




<u>OBSERVATION:</u>

- Teaching score seems to fluctuate but in general seems to decline over the years.
- International score has steadily increased over the years. This indicates that students are seeking for the best opportunities beyond their home country.
- Research seems to fluctuate the most i.e. Research is independent of time.
- Number of citations are increasing over time. This implies good quality research was performed which helped citations in future.
- Income score is almost constant over the years.

Hence, <u>while choosing a university, there are high chances that its international score, citations might improve while income might remain the same the next year.</u>

```
function average(data, year){
    var totalTeaching = 0;
    var totalInternational = 0;
    var totalResearch = 0;
    var totalCitations = 0;
    var totalIncome = 0;
    for(var i = 0; i < data.length; i++) {
        totalTeaching += parseFloat(data[i]['teaching']);
        totalInternational += parseFloat(data[i]['international']);
        totalResearch += parseFloat(data[i]['research']);
        totalCitations += parseFloat(data[i]['citations']);
        totalIncome += parseFloat(data[i]['income']);
    }
    var avgTeaching = totalTeaching / data.length;
    var avgInternational = totalInternational / data.length;
    var avgReseach = totalResearch / data.length;
    var avgCitations = totalCitations / data.length;
    var avgIncome = totalIncome / data.length;

    return {label:year, "Teaching":avgTeaching, "International":avgInternational, "Research": avgReseach,
                "Citations":avgCitations, "Income":avgIncome};
}
```

```
bar.on("mousemove", function(d){
        divTooltip.style("left", d3.event.pageX+10+"px");
        divTooltip.style("top", d3.event.pageY-25+"px");
        divTooltip.style("display", "inline-block");
        var elements = document.querySelectorAll(':hover');
        l = elements.length
        l = l-1
        element = elements[l].__data__
        value = element.y1 - element.y0
        divTooltip.html((d.label)+"<br>"+element.name+"<br>"+value+"%");
        });
    bar.on("mouseout", function(d){
        divTooltip.style("display", "none");
        });
    svg.append("g")
        .attr("class", "legendLinear")
        .attr("transform", "translate(0,"+(height+30)+")");
    var legend = d3.legend.color()
            .shapeWidth(height/4)
            .shapePadding(10)
            .orient('horizontal')
            .scale(color);
    svg.select(".legendLinear")
            .call(legend);
```

Here you realized which criteria fluctuates over the years and which remains the same. Finally let's go to PART 2:

## PART 2: WITHIN COUNTRY ANALYSIS:

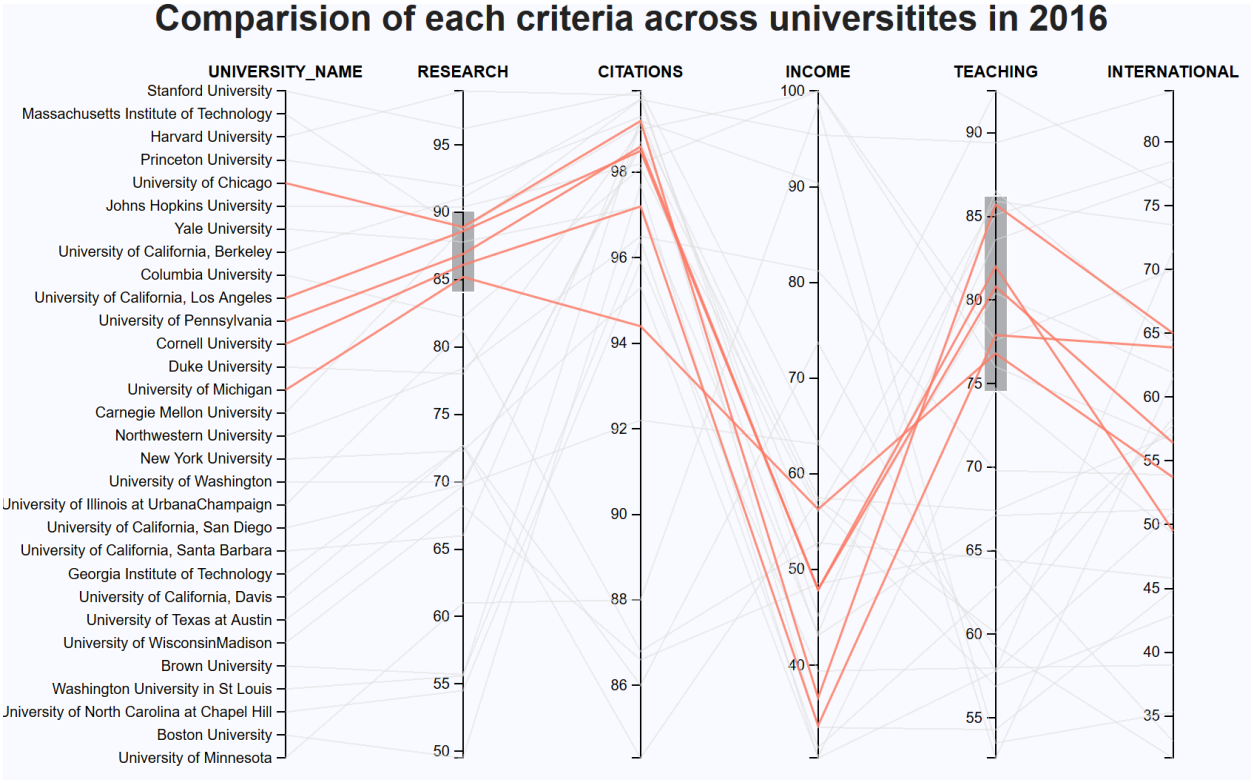
Now you click on your desired country in map. You get following two visualization to compare universities in that country.

a. **COMPARE CRITERIA OF EACH COUNTRY (PARALLEL COORDINATES)**

Now you chose United States to find your desired university. Here you wish to filter universities according to your preference. Suppose you want good research and moderate teaching then, accordingly you brush those axes to view your filtered universities.

OBSERVATIONS:

- United States distinctly had higher citations compared to other countries and other criteria.
- Germany had income on the higher end.
- United Kingdom has research and income are on the lower side.

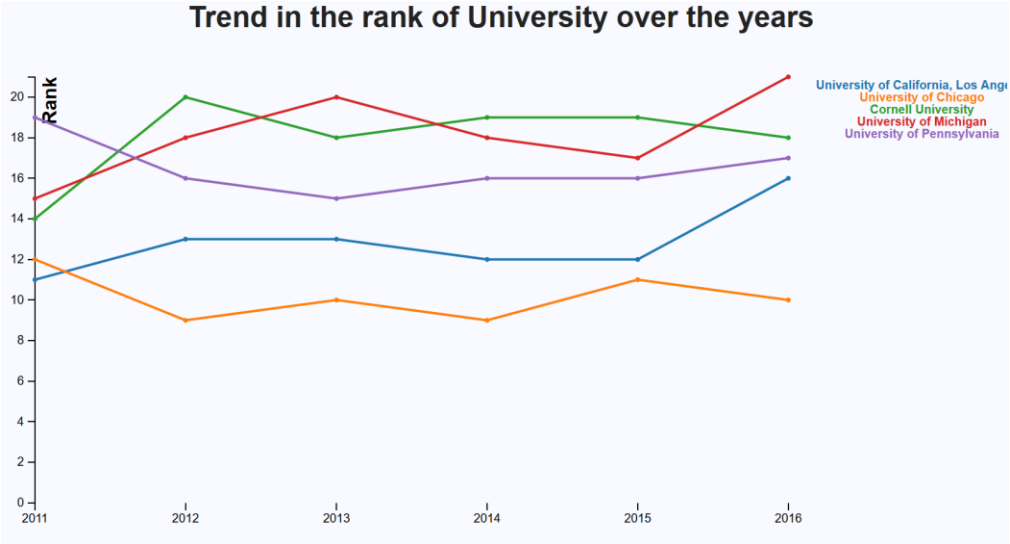



b. **TREND IN RANK OF UNIVERSITY (MULTI-LINE PLOT).**

After you finished brushing, you can click on "Update Line Plots" to get updated multi-line plot showing the trend in rank of those filtered universities.

OBSERVATIONS:

- Most of the college rankings fluctuate a lot as their total scores are very similar. For example, 5 universities in United States have a total score as 87.
- Also, each college may bias their ranking depending on a criterion in abnormal proportion. For example, University of South Africa which we discussed was ranked high because of the huge number of students.

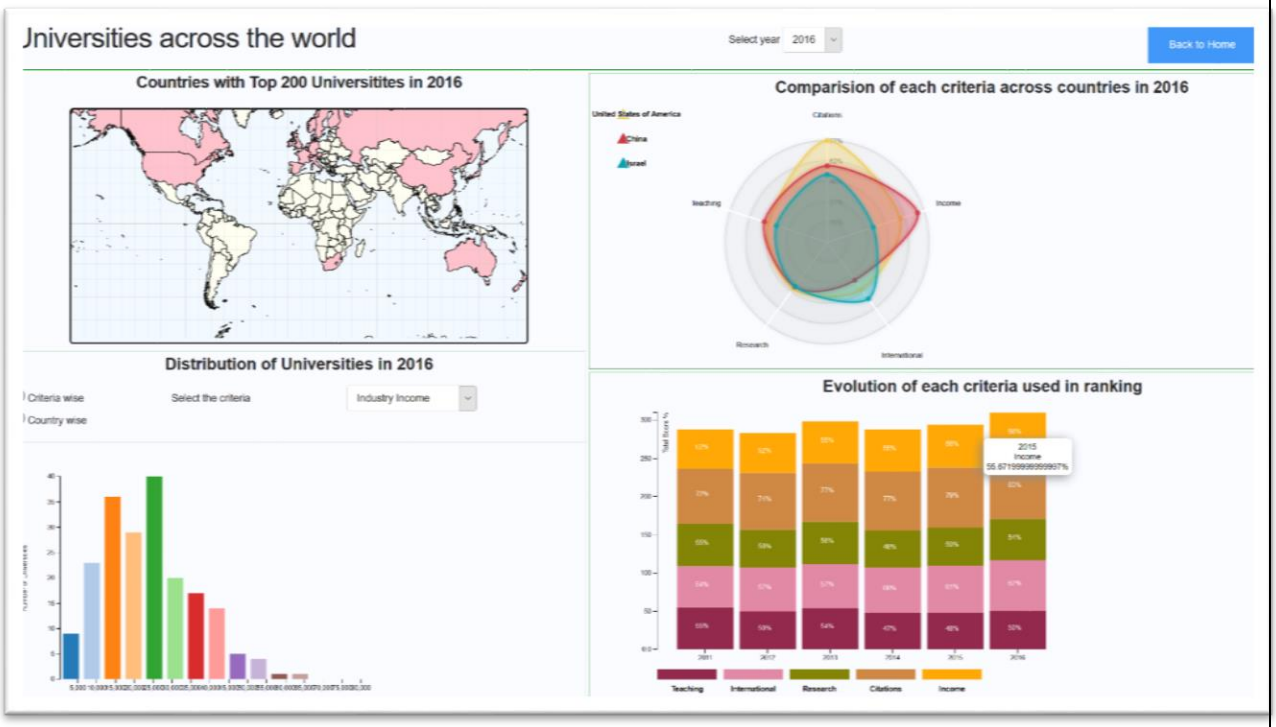


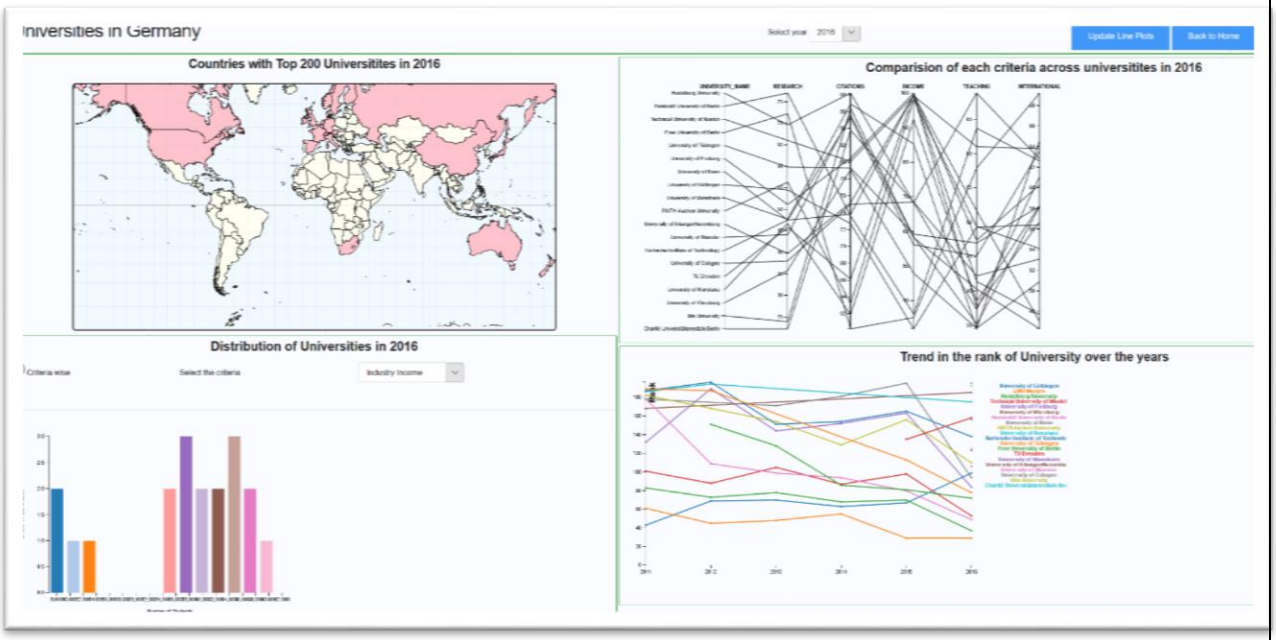

```
univRankTrend = [];
for(var i=0; i<g_timesData_2011.length; i++){
    for(var j=0; j<universities.length; j++){
        if(g_timesData_2011[i].university_name === universities[j]){
            jsonTemp = {};
            jsonTemp["university"] = universities[j];
            jsonTemp["date"] = 2011;
            jsonTemp["rank"] = g_timesData_2011[i].world_rank;
            univRankTrend.push(jsonTemp);
            break;
        }
    }
}
```

```
data.forEach(function(d) {
    d.date = new Date(+d.date,0,1);
    d.rank = +d.rank;
});
// Nest the entries by university
var dNest = d3.nest()
    .key(function(d) {return d.university;})
    .entries(data);
// set the colour scale
var color = d3.scale.category10();
// Scale the range of the data
x.domain(d3.extent(data, function(d) { return d.date; }));
y.domain([0, d3.max(data, function(d) { return d.rank; })]);

// Loop through each university / key
svg.selectAll("path.line")
    .data(dNest)
        .enter().append('path')
    .attr("class", "line")
    .style("stroke", function(d) { // Add the colours dynamically
        return color(d.key);
    })
    .attr("id", function(d) {
        return 'tag'+d.key.replace(/\s+/g, ''); // assign ID
    })
    .attr("stroke-width", 2)
    .attr("fill","none")
    .attr("d", function (d) {
        return dataline(d.values);
    });
```

**PART 3: DASHBOARD**

- The data changes with year and criteria selected.
- Get country related data on choosing a country.
- Filter brushed data from parallel coordinates plot and plot multi-line plot.
- Seamless interaction to go back and forth country-wise data and world data.




## OBSERVATIONS AND CONCLUSION:

1. This is a useful dashboard to shortlist universities based on different criteria like teaching, research, international score, income, and citations. The dashboard has two different components to compare universities across the world and universities within a country.

2. On an average only 5 of the total 200 universities have an average score of 95% and above.
3. University of South Africa is an outlier which is a mega university for distance education.
4. United States has a distinctly high citation score compared to other countries. Germany had income on the higher end. United Kingdom has research and income are on the lower side.
5. International and citation score tends to improve over the years while the income score remained steady with time.
6. Most of the college rankings fluctuate a lot as their total scores are very similar. For example, 5 universities in United States have a total score as 87.

**This project provides an interactive dashboard to find new insights about top universities across the world. The above dashboard is targeted towards students applying for universities across the world.**