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# DATA VISUALIZATION OF AVERAGE WORKING HOURS IN A WEEK ACCORDING TO OECD

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## DATA

All the dataset has been collected from the OECD database: <http://stats.oecd.org/>

We extracted it by a query on the website under the "Labor Force Statistics" section:



The data as we present it is over 41 (or 42) countries, 35 of them are official members of the OECD - Organization for Economic Co-operation and Development, which is known for measuring well-being and progress of the world's countries.

The comparison is by the average weekly working hours for each country for 5 years, between 2010 and 2014.

The data can be filtered by various choices such as:

- Gender of the worker
- Year
- Independent worker or employee
- Is it a full time or a part time job
- The age of the worker

➔ Which means that each filter gives us a set of 41 (or 42 in some years) items (e.g. 41 or 42 countries) with 5 different attributes which can be ordered by the value key which is the average working hours per week.

The values (e.g. total average weekly hours) are in the range between 4 and 62.58 and widely vary between the different filters.

Example:

Average weekly working hours for Full-time (total employment) male workers between the ages of 25 and 54 in the year of 2010.

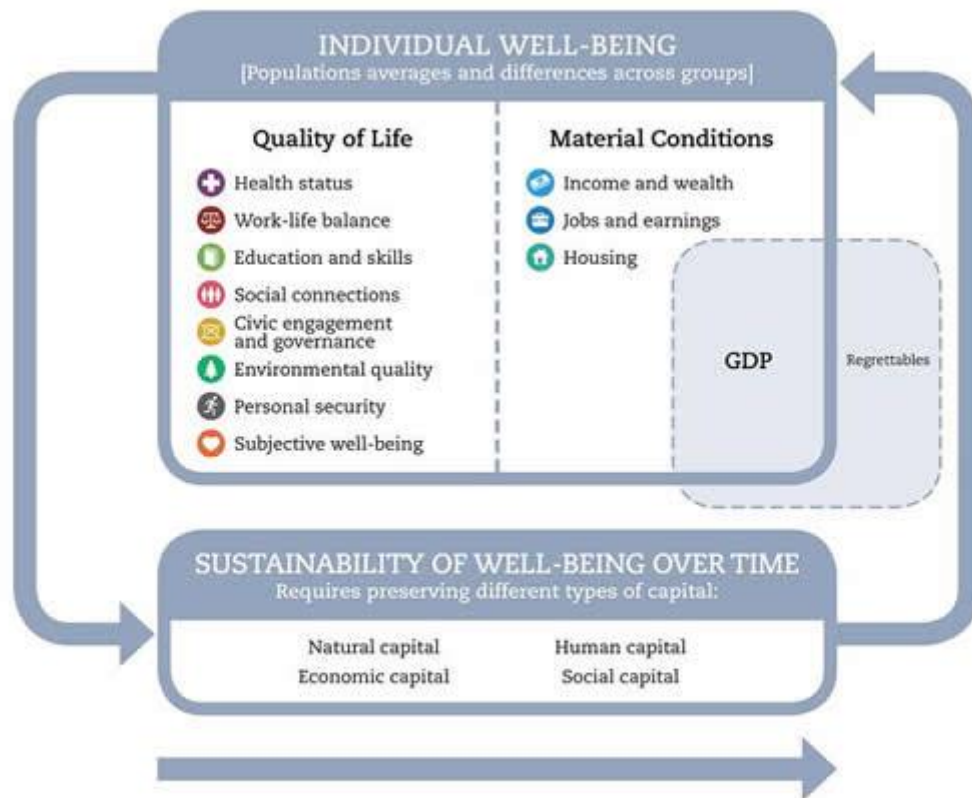
The sample here is the first 8 countries in descending order as we see it on the CSV file that was extracted from the OECD database.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	COUNTF	Country	SEX	Sex	AGE	Age	EMPS	Employment stat	JOBTYI	Job type	TIME	Time	Unit Coc	Unit	Value
197	CRI	Costa Rica	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		55.50025
647	TUR	Turkey	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		54.40706
1097	COL	Colombia	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		54.10744
1652	MEX	Mexico	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		51.00099
2222	KOR	Korea	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		50.25471
2672	ISR	Israel	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		47.79513
3122	ZAF	South Africa	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		47.68276
3572	ISL	Iceland	MEN	Men	2554	25 to 54	TE	Total employment	FT	Full-time e	2010	2010 HOUR	Hours		47.38526

Table1 Data Sample

### The User Task:

The comparison itself is part of a bigger comparison between the work force of the different countries involved, which is, among other measurements, can be applied (part of Quality of Life & Material Conditions) as a well-being of the specific country. For example - we can look at a country where people are working a lot of hours at the ages of 65+, a situation that could be interpreted as a lower life quality comparing to other countries where people at the ages of 65+ can retire.



Source: OECD, 2013

Such a measure could help decide whether to immigrate to a certain country based on a certain life-improvement will - such as picking a country where work hours are shorter than the current state (of course, this isn't

telling about the salaries, for that you can refer to the earning part at the OECD database ).

Note that the amount of hours displayed are the **average** working hours out of the working labor force - this does not say anything about the amount of people who actually work.

## VISUAL MAPPING:

The data originally comes as a flat table with options to choose filters.

Average usual weekly hours worked on the main job  : Average usual weekly hours worked on the main job

Customise Export Draw chart My Queries

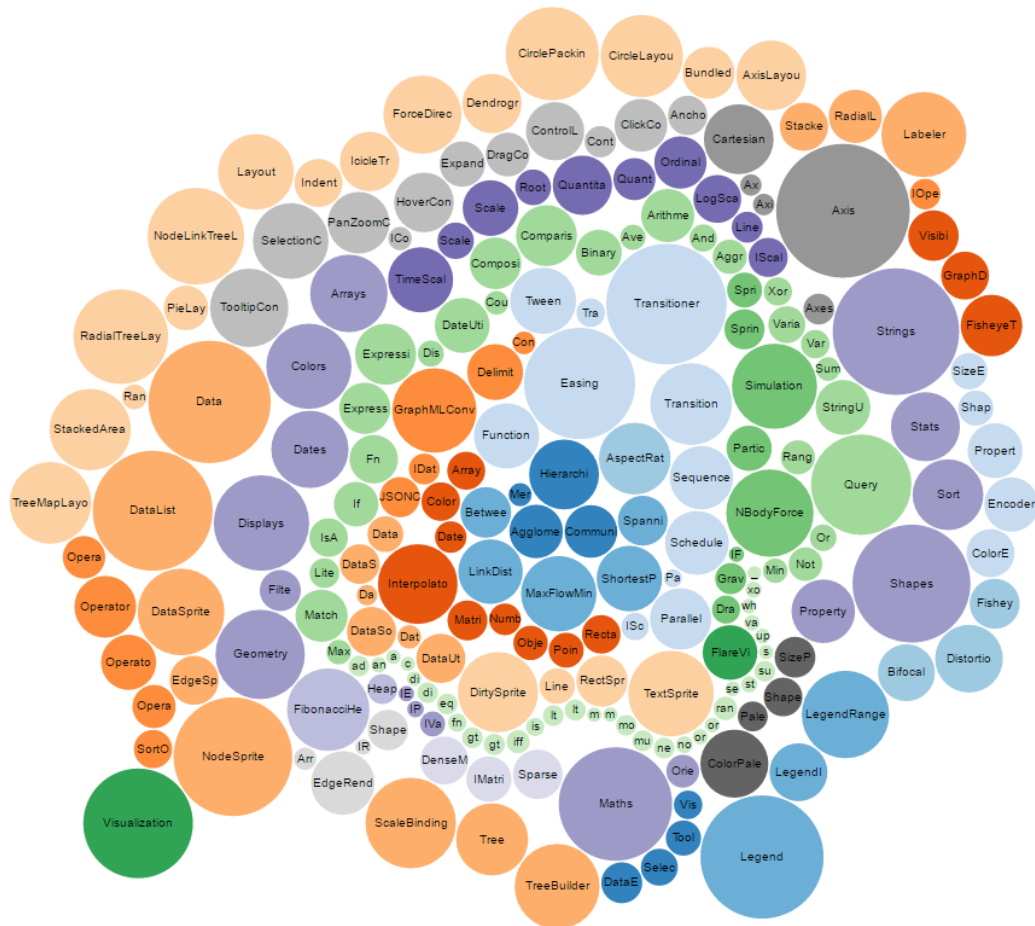
Sex	Men
Age	25 to 54
Employment status	Total employment
Job type	Full-time employment
Frequency	Annual
Unit	Hours
Time	2010 2011 2012 2013 2014
Country	
Australia	44.9 45.0 44.9 44.8 44.6
Austria	44.5 44.5 44.2 43.7 43.6
Belgium	42.0 42.2 42.1 42.5 42.3
Czech Republic	43.6 43.3 43.2 42.8 42.7
Denmark	39.6 39.8 39.6 39.6 39.4
Estonia 	41.5 41.4 41.4 41.3 41.3
Finland	41.7 41.7 41.6 41.4 41.4
France	42.5 42.6 42.5 42.0 41.7
Germany	42.4 42.5 42.5 42.3 42.1
Greece	45.4 45.2 45.4 45.7 45.9

Sorting the basic table by the values is possible but cannot give you a unique distinction among the different countries more than just who is first and who is last.

Since the data can be presented by various filters we started by trying the [Sun-Burst](#) and the [Tree-Map](#) visualizations. Both of them rely on hierarchical data but despite our data is splitting we do not have hierarchy and therefore both of the visualizations did not fit here without having to alter the layout.

The main goal is to compare the final value (average working hours) of the countries and the relative position of each country with respect to the others.

We chose the Bubble-Chart as we first saw it on [Mike Bostock's](#) work presentations ( <http://bl.ocks.org/mbostock/4063269> )



but the plain simple Bubble-Chart as we see in figure 1 was not good enough for our purposes:

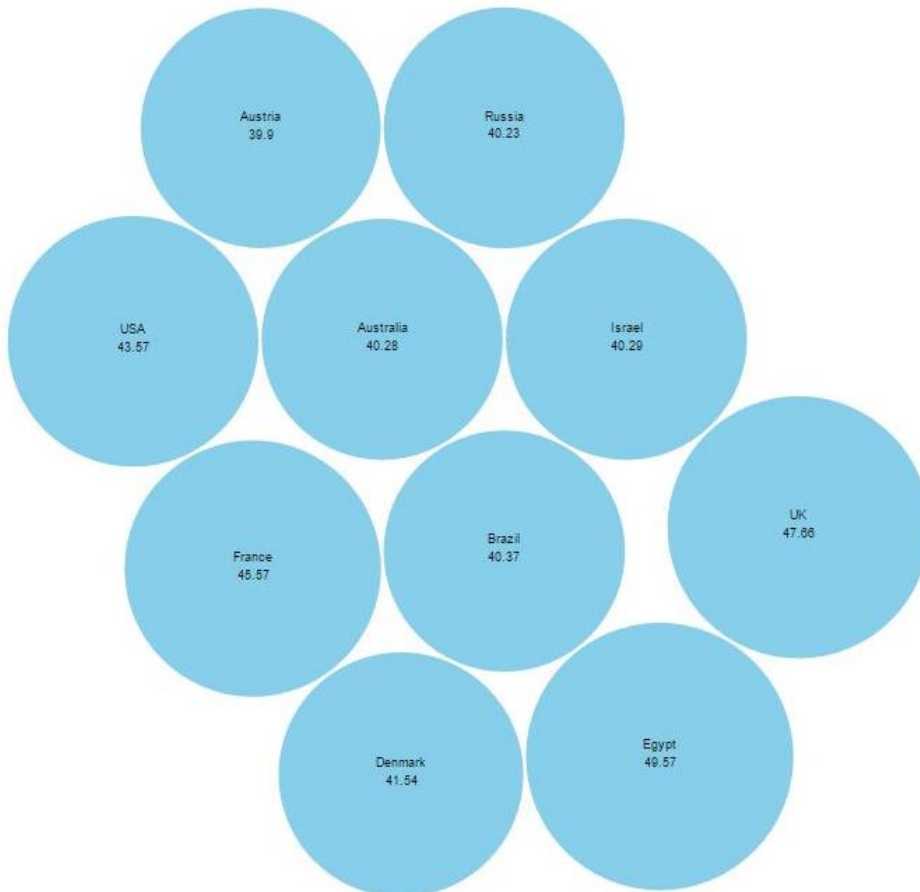
- There was no clear distinction between values - it only showed who's bigger than the other in an absolute way but there was no way to spot who is bigger when comparing 2 big bubbles - there was no **order** to help determine that.
- The order and the colors of the bubbles seemed random - as we can see in Figure 2 for example there is no correlation between the red bubbles and their position, nor the correlation between the color and their size.





## Design steps

1. Creation of plain bubbles - each bubble for a country while the name and the value are presented inside



There was still no easy way to decide for each two countries which has the highest and the lowest values.

2. For making the comparison easier we decided to base on some key aspects in data visualization - Color , Order & Location and Size.  
To do so we gave a color range between red (for the highest value) and light blue (for the lowest value).  
The color was mapped in the domain between the maximum value possible and the minimum value to

the range of the colors we decided .(See figure 8 for example how we used the scaling)

For ordering the countries we created an "imaginary clock".

The country with the highest values is in the middle while the other countries placed in circles around, when the highest valued country in each circle is at earlier hour than the other lower valued countries. To add one more important way of distinction we gave each bubble a different size by its value - the higher the value the bigger the bubble's radius.

As we can see in Figure 3 on the left side the bubbles are sorted clockwise

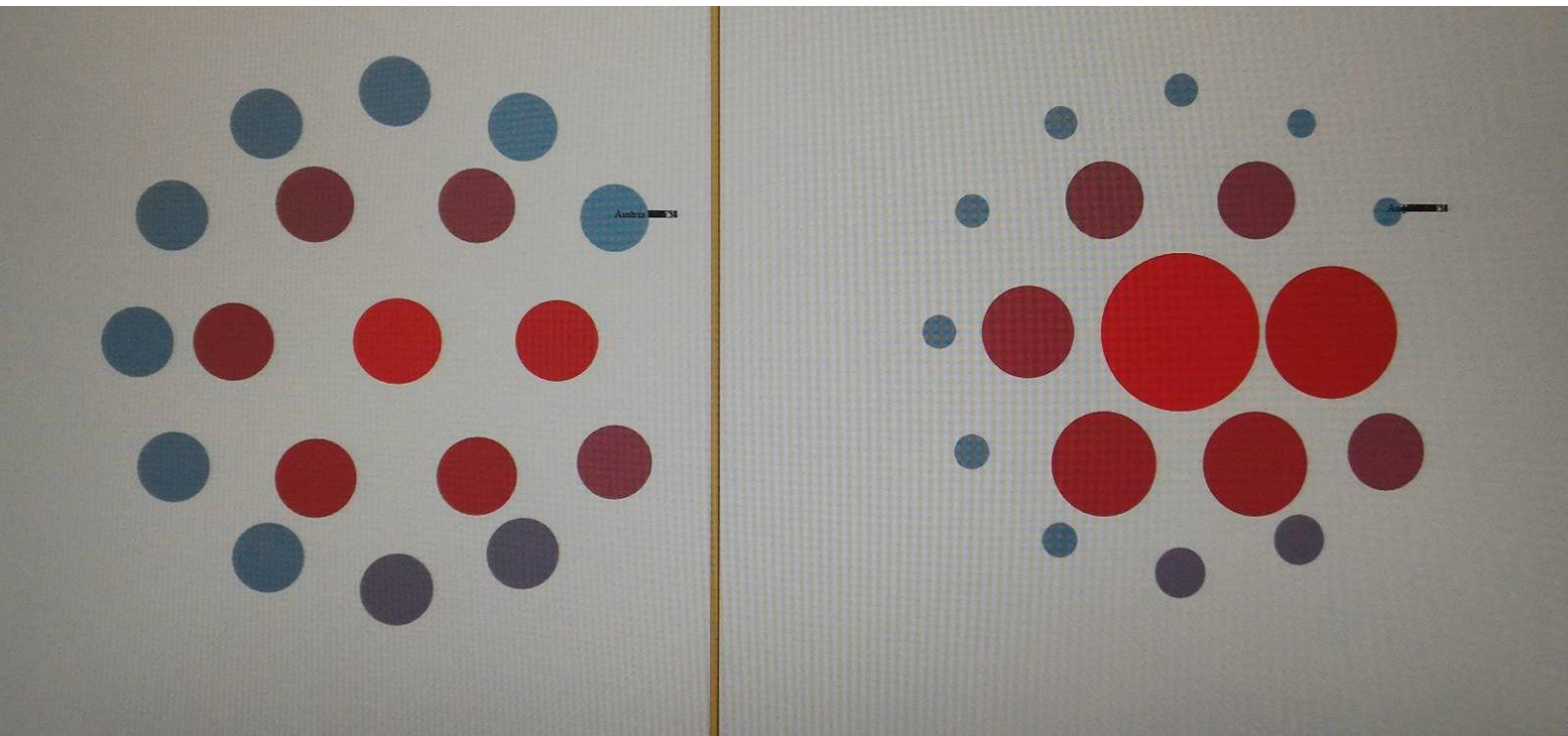
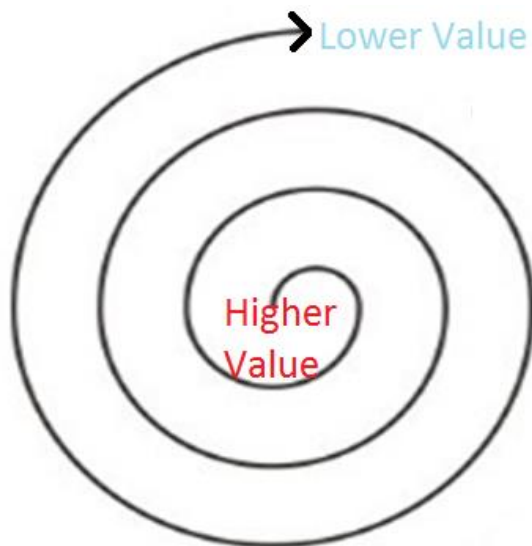


Figure 3 Before and after SIZE Scale



but a size factor needed to make the distinction more clear .

3. After creating the size scale we also applied a COLOR SCALE FOR EACH GROUP OF COUNTRIES, by dividing the bubble into 4 groups - each one is spread over a different imaginary circle and each group has an inner color scale - which means for example that in every circle , the bubble with the red color is the biggest bubble - the highest value, and the bubble with the light blue color is the one

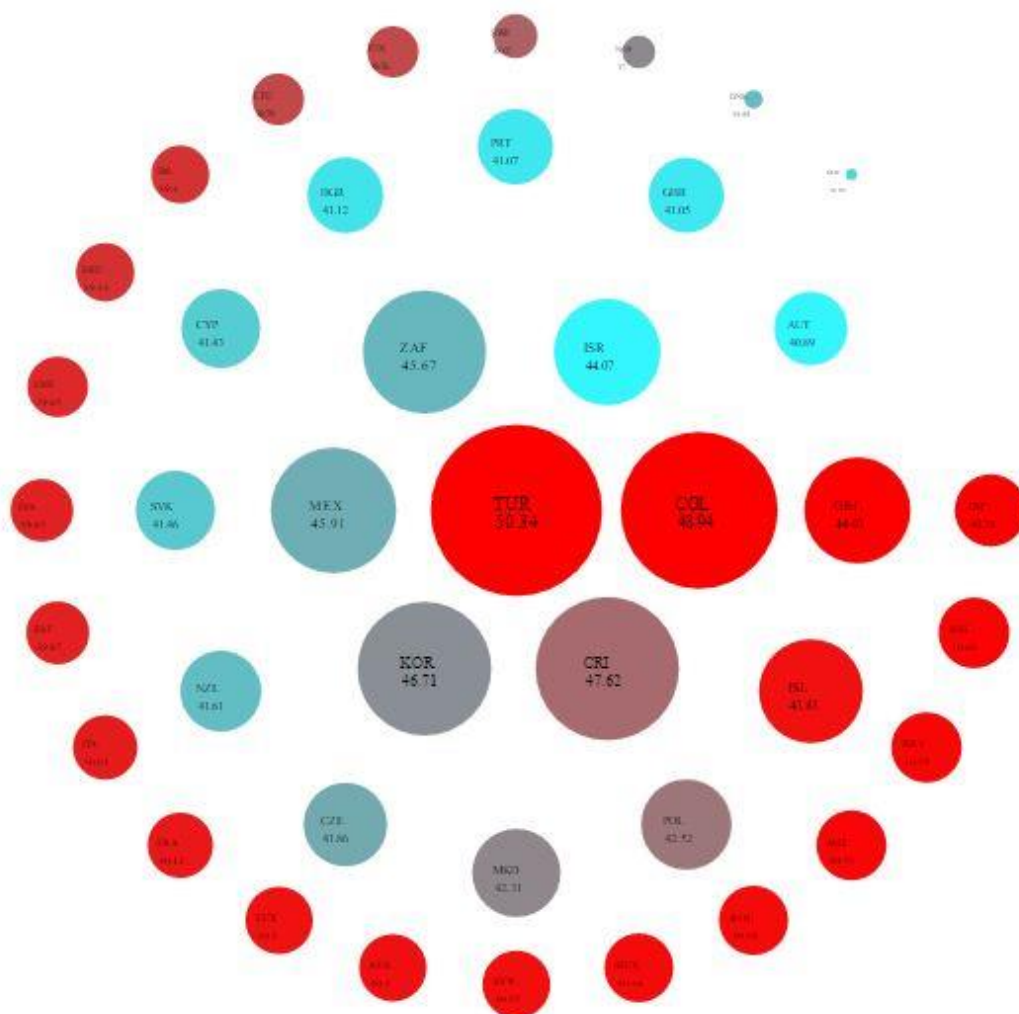


Figure 4

with the lowest value among that group . (See figure 7)

Figure 4 is an example for where we've got by that point. As you can see in figure 5, when we changed the data-filters (e.g. choose women instead of men) there was an overlap of the bubbles , and it made the chart less visually-readable.

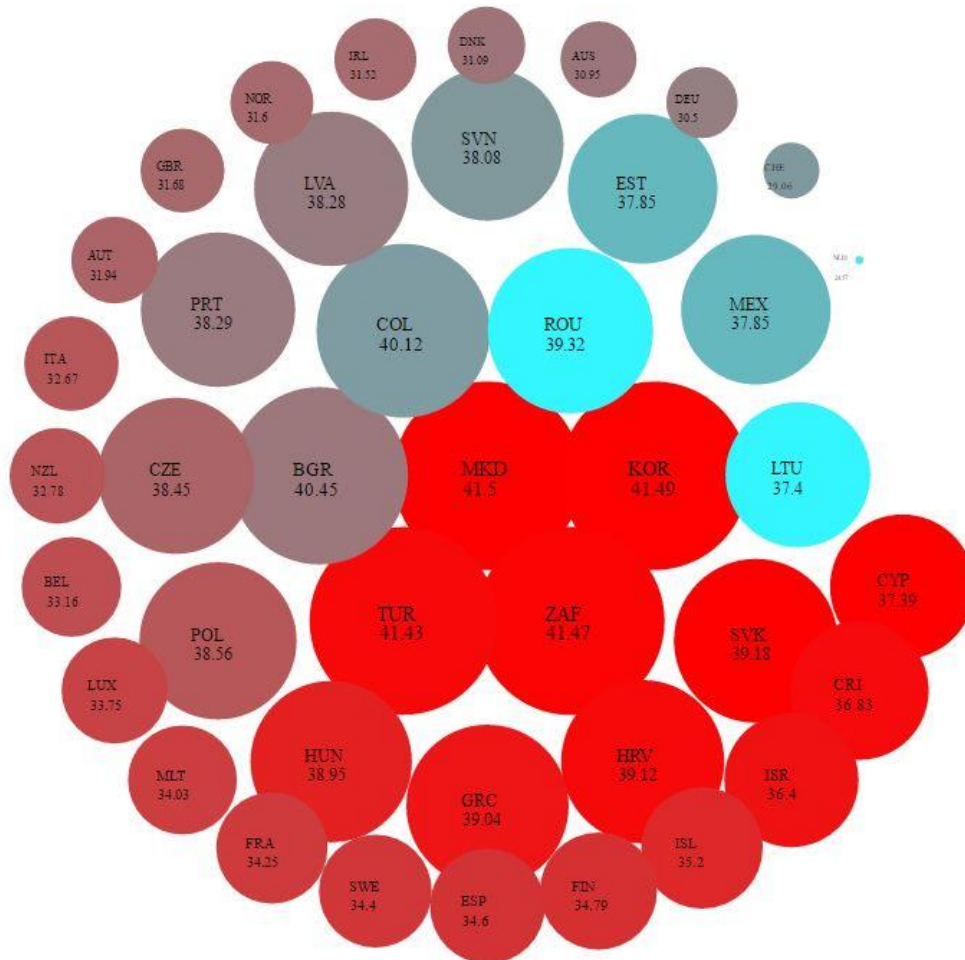


Figure 5

4. In order to fix the overlap we decided to give each circle a definite coordinates with enough space for the boundary case where all the circles are the biggest possible.



In this case when the filter change there won't be any more overlapping . The code snippet shown in figure 6 is made to determine the x coordinate of the center of each circle .

```
.attr("cx", function(d) {
  cx = xZero;
  if(placeInSort >= 1 && placeInSort < 7)
  {
    cx = parseInt(xZero + (2.2 * maxRadius + 20)*(Math.cos(Math.radians(firstArcXAngle))));
    firstArcXAngle += 60;
  }
  if(placeInSort >= 7 && placeInSort < 19)
  {
    cx = parseInt(xZero + (coefficientOfScale * 2.8 * maxRadius + 30)*(Math.cos(Math.radians(secondArcXAngle))));
    secondArcXAngle += 30;
  }
  if(placeInSort >= 19)
  {
    cx = parseInt(xZero + (6.7 * maxRadius + 30)*(Math.cos(Math.radians(thirdArcXAngle))));
    thirdArcXAngle += 15;
  }
  locationsX[placeInSort] = cx
  placeInSort += 1;
  return cx;
})
```

Figure 6

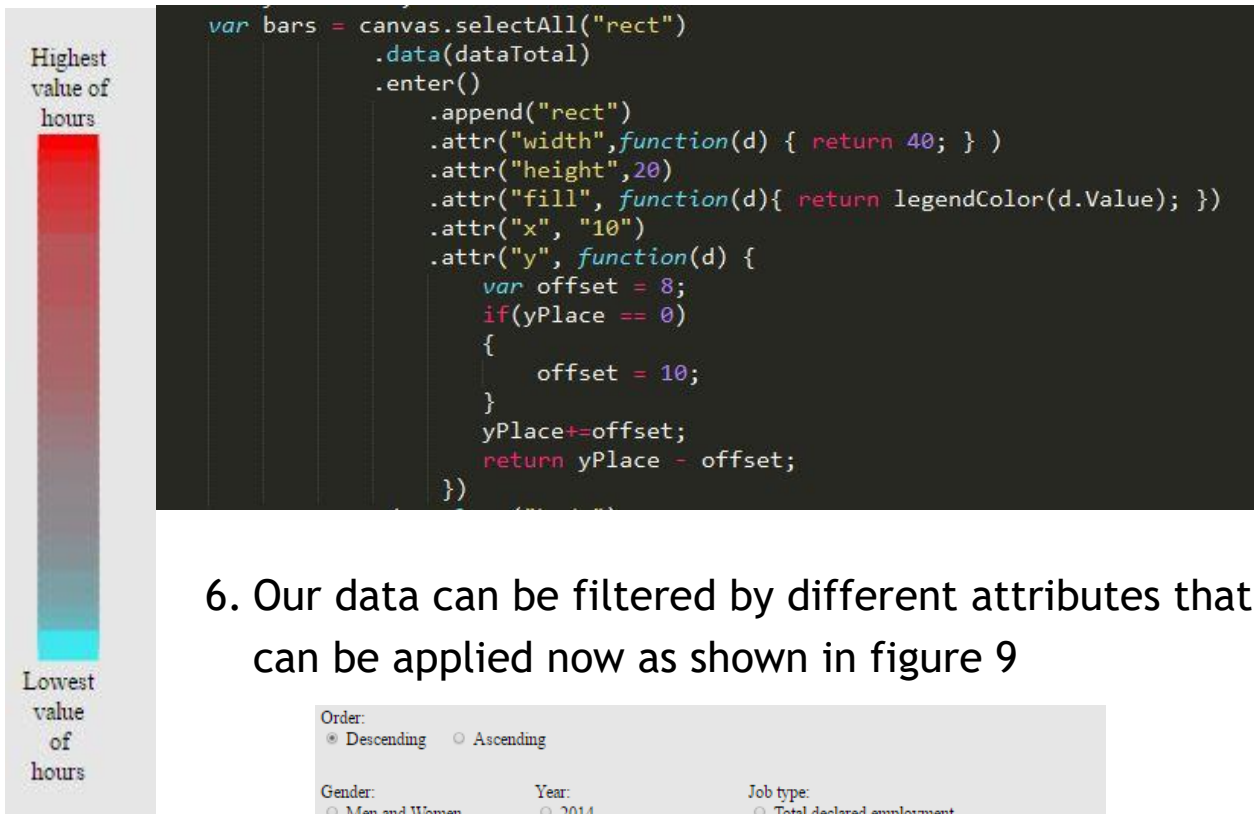
```
.attr("r", function(d, i) { return scale(d.Value); })
.style("fill", function(d) {
  if(placeInSort > 1 && placeInSort < 7)
  {
    placeInSort++;
    return colorFirstArcScale(d.Value);
  }
  if(placeInSort < 19)
  {
    placeInSort++;
    return colorSecondArcScale(d.Value);
  }
  if(placeInSort >= 19)
  {
    placeInSort++;
    return colorThirdArcScale(d.Value);
  }
});
```

Figure 7 Radius and Color scale

```
var legendColor = d3.scale.linear()
    .domain([minValueTotal, maxValueTotal])
    .range(["#33F6FF", "red"]);
```

Figure 8 Legend-Color Scale

5. Next we added the color legend , which was scaled as said above .



6. Our data can be filtered by different attributes that can be applied now as shown in figure 9

Order:  
☒ Descending   ☐ Ascending

Gender:  
☐ Men and Women  
☒ Men  
☐ Women

Year:  
☐ 2014  
☐ 2013  
☐ 2012  
☐ 2011  
☒ 2010

Job type:  
☐ Total declared employment  
☒ Full-time  
☐ Part-time

Age:  
☐ Total  
☐ 15 - 24  
☒ 25 - 54  
☐ 55 - 64  
☐ 65 - 99

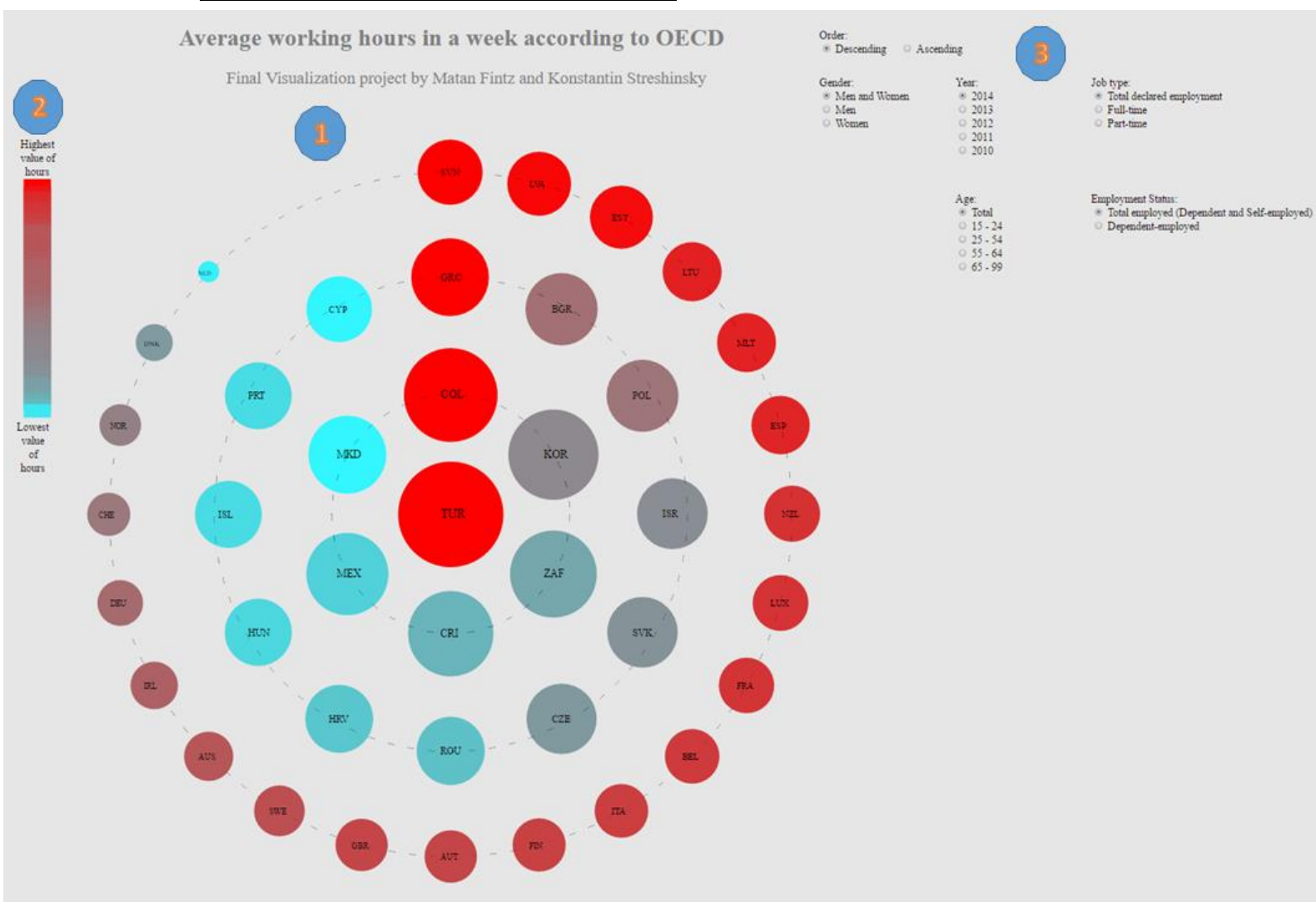
Employment Status:  
☒ Total employed (Dependent and Self-employed)  
☐ Dependent-employed

Figure 9

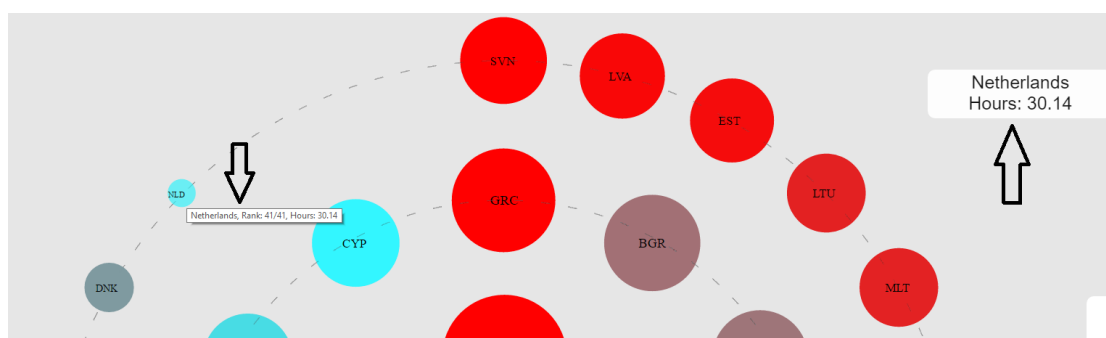


7. We changed bubbles placements so that the highest valued bubble in each group is place at the twelve hour of the clock in descending order (or the lowest in the group if you choose the Ascending order option).
8. Final , we added the hover option above each bubble so the country's information could be displayed easily.

## Final View and description :



1. The bubble chart: each bubble represent a country .  
 the text inside the bubble is the country's name  
 code. To see it's full detail,hover over it:



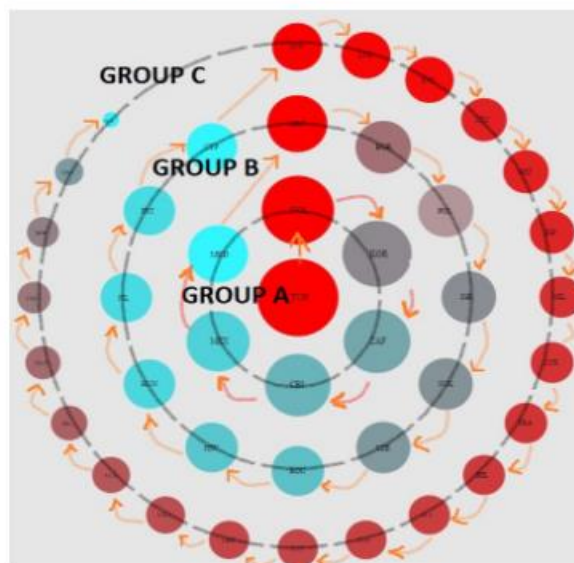
2. The legend: here to tell you the meaning of the bubble's color you are looking at.
3. Filters: choose the filters you'd like to apply on the data, and also choose if you want the order to be descending or ascending (keep in mind that the legend's values will be turned).

## How to read and use it?

### Read :

There are 3 key aspects to help you read the chart easily

- **Size:** if using the **Descending** order - the **bigger** the bubble -> the **higher** the value  
if using the **Ascending** order - the **bigger** the bubble -> the **lower** the value
- **Color:** use the legend on the left to know the bubble's size (which means-value) comparing to the others in the group.
- **Location:** as you can see the chart can be divided to 3 groups : places 2-7, 8-19 and 20-42 .
  - The middle bubble in is the one who ranked first, and the final bubble ranked last.
  - On every group (dotted cycle) if you go clockwise the bubble's rank is going down, starting at 12 O'clock.



Note that you can always hover over the bubble to see it's full details.  
Staying over a bubble will give the general rank too.

### Use :

Use the radio buttons on the top right of the page for your choices

- **Order:** Choose Descending or Ascending to order the bubbles as you prefer.
- **Explore:** There are 5 different attributes you can filter the data by, giving **450 different outcomes** !

## VALUE OF VISUALIZATION AND DISCUSSION

In the previous chapter we showed the progress of our visualization, while each step was to improve the value of visualization. This was mainly made by using the guiding Value formula we've learned in class:

$$\text{Value} = \text{T(ime)} + \text{I(insight)} + \text{E(ssence)} + \text{C(onfidence)}$$

It was clear that when we started with plain bubbles with no distinction of one from another none of the value aspects was in the chart -

**Time** : comparing 2 countries, or even finding the lowest and the highest valued countries could take a lot of time due to the lack of an attribute of distinction.

**Insight**: there was no order or any way to find patterns or relations between the values or between the different sets of filters (there weren't any...)

**Essence**: even when looking at the original design of the colored bubble-chart version (Mike Bostock's) when looking at the chart there was no clear way to show the bigger picture of the data or to give something new to the viewer.

**Confidence**: before there was a right scale between the domain and the range, most of the bubbles looked the same, even though there was a gap between their values. When there's a visual gap between what you see and what you've told, you will question the integrity of what's presented.

### **Self-review of the design:**

Our final design manages to answer the user task we presented earlier, and also achieves the visual goals we stated [at the beginning of the design](#) :

- The highest and lowest ranked (depending on the order that was chosen) bubbles (countries) can be found easily thanks to their position.
- Dividing the countries into groups gives another way for comparison and let the user compare between smaller groups of countries - for example compare 7 countries instead of 42.
- Placing the bubbles in a clockwise manner, giving bigger size for higher ranks and giving the red and blue colors accordingly makes the chart more intuitive to the common reader because all of that attributes are visual qualities we are used to see every day.
- Giving the scale we applied, both for size and color, some patterns can be found - for example, when switching the default view from men and women to Men vs. Women we can see that there's a lot more blue bubbles in the men's chart, which can show new relations.

There are some additional aspects that could be improved:

- We could add interactive feature that could take any imaginary circle and make comparison on all values that belongs to this circle. It could give better visual feelings of how the hours are distributed between those countries.
- Chose a different grouping view: the countries are group the way we decided, but could be maybe more beneficial if for example there was an option to group by continents (e.g. Europe vs South America).
- When changing the order from descending to ascending we only change the color legend. This might be a bit confusing and time consuming to adjust. This could be improved by also changing the size and positions accordingly.
- Choosing any 2 bubbles from the chart to present just them interactively and show all the data that is known about those 2 countries. By this the user can compare all attributes between those 2 and not only filtered features. The user could conclude by himself here what information is more important for him.
- Option that can exclude some countries from the chart, for example if the user not interested in the data from those countries, by that data will be shown with less bubbles on the chart.

All those suggestions can improve the user experience and provide better value to the visualization.