CS 3300 Project 2

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Description of Data

Throughout this project we worked with three data sets. The first is the satellites dataset and the second is the gdp dataset. It was important for us to parse these datasets so that the data we need will be well organized, and easy to access. In addition it was important for us to parse the data in a way where the integration between the two sets will be as straightforward as possible. There was plenty of data in the USC satellite dataset, but we were very intentional about selecting the data which we thought would be the most understandable, interesting and relatable to a viewer. We ended up using the following statistics from the dataset: (1) Name of satellite, (2) Country of Operator/Owner, (3) Users, (4) Altitude (calculated from Perigee/Apogee), (5) Orbits per day (calculated from Period), (6) Launch mass, (7) Date of launch, and (8) Country of Contractor.

Parsing the GDP Dataset:

When parsing the GDP data, we had in mind our main idea for the project. Our satellite data is from 1960-2017, so we extracted GDP data from within this year range. In addition, we wanted to access the GDP for each country and not by each year, so when parsing the data we created a dictionary for each country where the keys are the years and the values are the GDPs for the corresponding years.

Integration of the flag data:

Adding the flag icons to our tooltips was also a process of data integration. We obtained the flag icons from GitHub, and had to convert the 3 letter country code from the GDP dataset into a 2 letter country code to match the flag names. We created a JSON, using a code reference table found online (cited below), to help us with this conversion.

Interactivity:

In order to fully integrate the slider, we re-rendered the satellite shapes and country bars each time a slider input was detected. To increase efficiency, we extracted the code for drawing the bars and shapes into two separate functions outside of the original callback function. This allowed us to only parse the data once from each file, and then extract the data we needed to accomodate interactive features. When implementing the interactivity of the check boxes, we ensures that only the “checked” shapes were being drawn to the svg, and when a certain was “unchecked” we had to remove all occurrences of that specific shape from the page. Finally, while our data is represented very visually, we also added axis labels, headers, and tooltip descriptions to provide users with more information.

Mapping of Data to Visual Elements

Color scheme:

At any point in time, a maximum of ten countries are represented in our visual. Each of the ten (or fewer) countries is assigned a distinct color, and all satellites operated by that country are

shown in the same color. The bars also correlate to the specified country colors, and the ten colors are predefined in an array in our code.
The color sequence remains consistent and in coherent visual sequence (not hopping about) in order to help the viewer identify, without having to look at a legend, (1) how many countries have satellites represented, and (2) which satellites belong to the same country.
The identity of the country is easily identified, then, visually, by the flag that appears within the tooltip when the user hovers over a data point.

The background gradient subtly evokes the context of space, and also helps the viewer to recognise his/her vertical position on the page as the background darkens. This aids in maintaining a sense of orientation along a relatively long visualization.

Satellites:
Satellites are represented by different shapes according to use category. The area of each satellite icon is relative to its launch mass. The heights correspond to the satellite altitudes, which we calculated by averaging each satellite's perigee and apogee value from the dataset we found. In order to account for the spread of data among different altitudes, we divided the altitude into about fifteen different increments (0km to 300km, 30000km to 40000km, etc), gave each increment an individual height value, and then generated a custom linear y scale for each increment. This helped us spread out the data visually, as some altitudes have high concentrations of satellites. The x scale we used was also linear within the horizontal area of the bar each satellite's operating country corresponded with. However, we generated the x values randomly before inputting them into the x scale in order to spread out our data points.

Bar Graph:
The bar graph depicts a couple different variables. First, each bar represents one of the top ten countries in the year selected with the slider. Next, the width of each bar is determined by the proportion of total satellites among the top ten countries each country has in space from 1978 to the selected year. Finally, the height of each bar represents the GDP of that country in the selected year. All scales used for this representation were linear, but we did add 50px to each bar's final height value to account for any countries with relatively small GDPs.

Overall:
We were also very intentional about ensuring that the visualization would scale to any browser size, as this meant the viewer would be able to look at the overall trend (visualization) by reducing the browser width, or zoom into detail by enlarging it. This makes our visualization flexible/adaptable and able to communicate at different levels of detail/interest without having to generate an alternative "overview" representation. This also capitalizes on the function of "scalable vector graphics".

Legend & Checkboxes:

We wanted to integrate the legend and checkboxes in order to maximise visual communication. It is helpful for the viewer to recognize the relationship between the category he/she is (de)selecting, and the change in icons on the graphic.

Story

We wanted to show how various countries have invested in space exploration through satellite launches over time. The visualization shows:

1. An increase in the number of countries investing in satellites, from one leader (USA) in 1974 to two in 1992, and at least ten countries by 1997. Our representation stops at the top 10 countries, in order to display the detail of their satellite ownership over time.
2. We also see that there are a few common resting altitudes for satellites in space. Mainly, the 35,000 km mark and the 20,000 km mark both have a great concentration of satellites. On a similar note, it was also interesting to observe that first satellites were launched at very high altitudes (>30,000 km), and it was only around 1994 that countries began launching satellites into space at lower altitudes.
3. The comparison with GDP highlights countries' satellite investment (as a proportion of global total). While the USA is the dominant investor with consistently the highest GDP and highest number of satellites, there are prominent outliers in the other top ten countries. One standout case is Luxembourg, which starts investing in satellites in 1994 and remains a prominent investor (within the top 5 countries) despite its relatively small GDP until 2007, when it is overtaken by Japan. It remains within the top 10 even today.
4. From the icons, being able to select between the various uses, it appears that satellites, in recent years especially, are predominantly commercial. Satellite technology has been a boon to the communications industry, with telecommunications companies launching entire constellations of satellites that are visually prominent in clusters.
5. The USA's dominance in satellite ownership through history is both inspiring and ominous. Its ownership has dropped below 50% only in 2015 (49.3%). The proliferation of satellites over time is both promising in terms of scientific progress and concerning for questions of surveillance and privacy.

Resources Used

Country code conversion adapted from:
http://www.nationsonline.org/oneworld/country_code_list.htm
Satellite data was obtained from:
https://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.WtVk6YjwZm9
GDP data was obtained from:
https://data.worldbank.org/indicator/NY.GDP.MKTP.CD
Satellite icon was taken from:
https://thenounproject.com/andrei.manolache7/
Flag icons were taken from:
https://github.com/lipis/flag-icon-css