DATA VISUALIZATION

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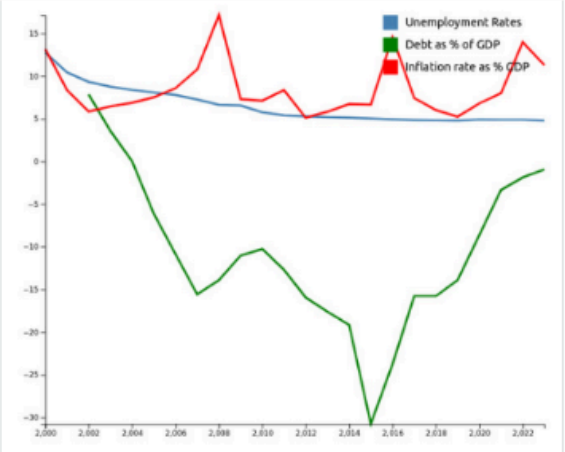

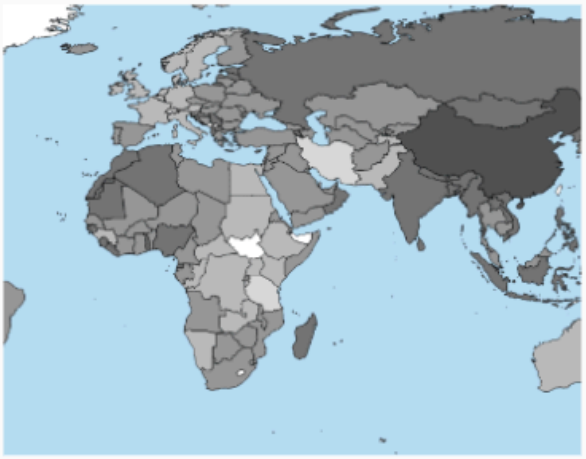

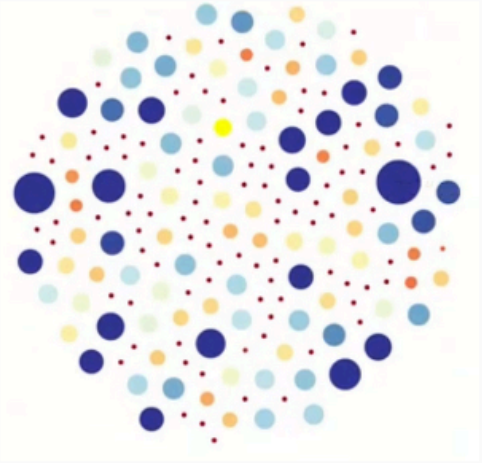

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HYDERABAD

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Our Aim

We **aimed** to show how the economic statistics of a country varied over the years as the number of refugees changed for the country.

- This project deals with **two** major factors, and their correlation. **Migration of refugees to asylum countries** and the **corresponding aftermath on the countries economics.**

- We choose the datasets available on UN websites and draw out visualizations to show the movement of refugees such as their origin and the asylum they are taking shelter in.

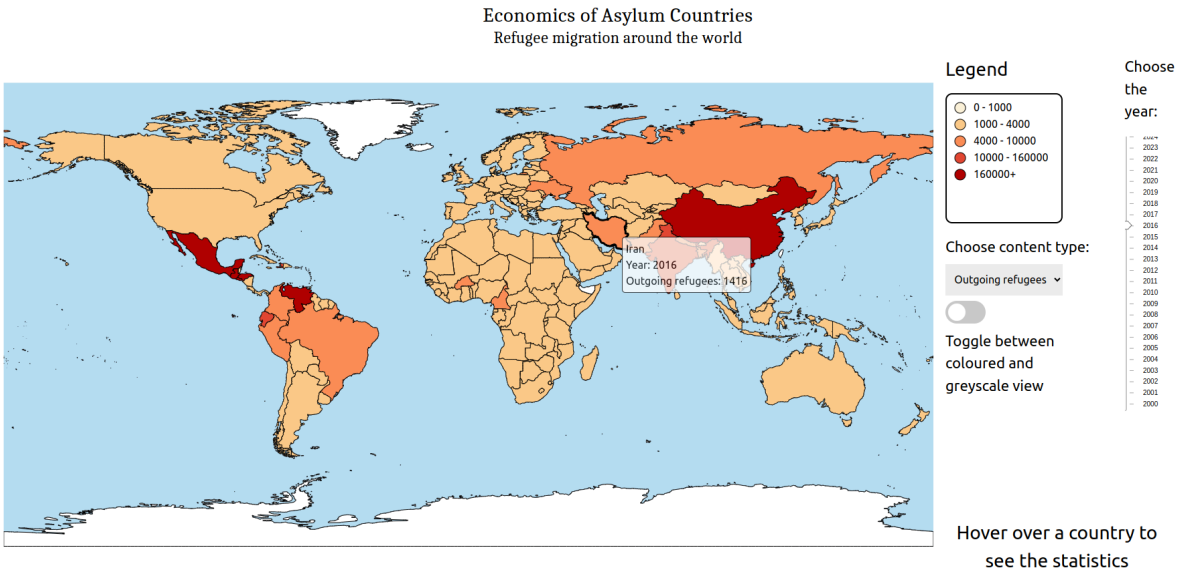
- We then want to use economic datasets to see if we can find a correlation between countries affected and the economics of that country. We aim to answer as these **questions**:
  1) Which years had most refugees and from where overtime
  2) What were the economics of the country before/after displacement

Our Progress for Phase 2

In **Phase 2,** we deployed with the following visuals, each helping us achieve our goal in the following manner

1. The Geo-Map/Choropleth Map

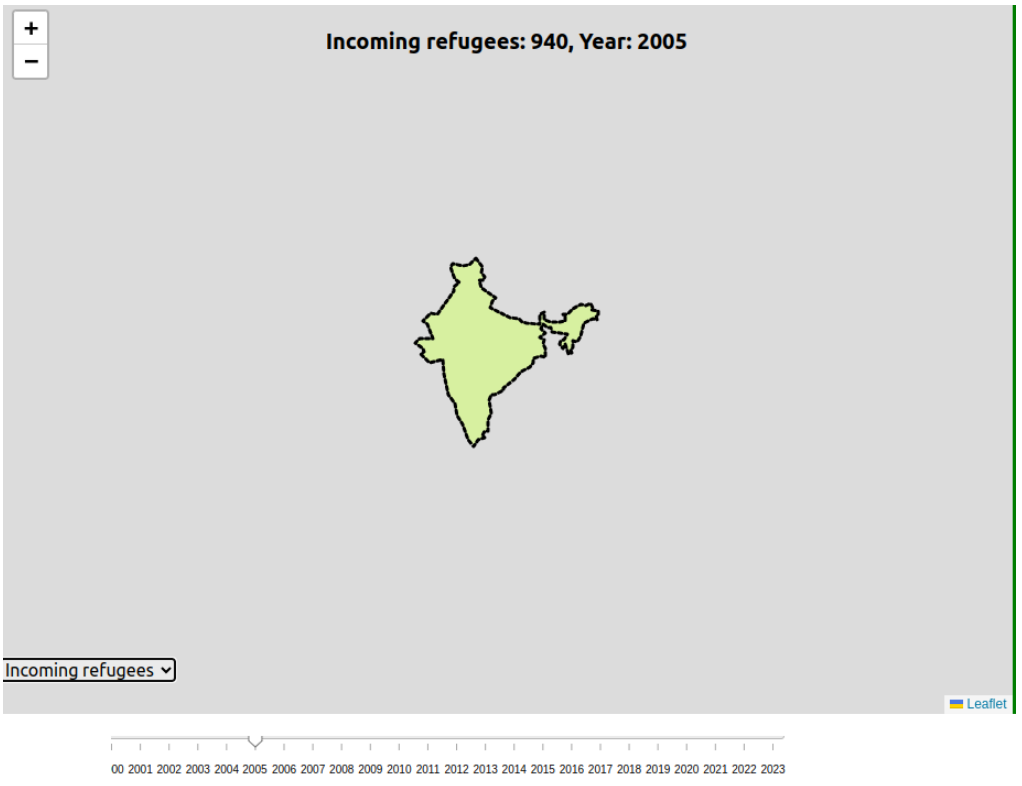
The choropleth visualization of the world shows three different data for each country - number of incoming refugees, number of outgoing refugees, and the net difference in population due to it. The marks used in this visualization are the SVGs for each country, and the channel used is the saturation - darker implies more number of refugees. There is an option of shifting to gray-scale as well which uses luminance to show the same. A slider is provided to be able to choose the year for which one would want to see the data. This is useful as it can also be used to link these changes with major world conflicts. On hovering over a country, one can see the relevant statistics like country name, year, and the content type selected



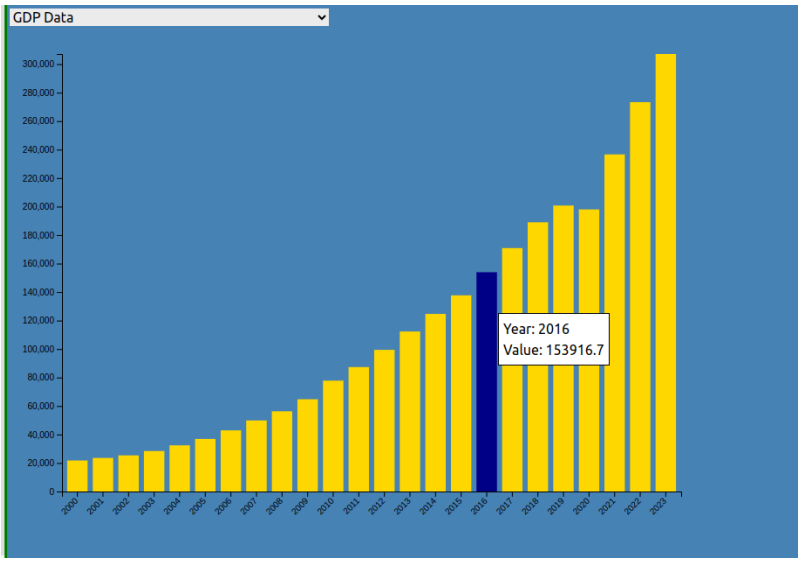
2. The Country Page

The country page offers a regional view specific to the country chosen from the GeoMap.

i. <u>Country Map</u> - A map of the <u>country</u> chosen (the mark) which uses channels like <u>color saturation</u> to show the data like number of incoming refugees, outgoing refugees and net difference in population from it. This visualization also uses a drop down menu to choose the type of data and a slider to choose the year.



ii. Bar Chart - A bar chart, where the bars are the marks and the channels are the horizontal position to show year and length of bar to show value of the data selected. The drop down menu allows the user to choose the economic aspect to visualize like GDP, per capita income for current prices, etc. Hovering over a bar enables a tooltip to show the exact value.



iii. Line Chart - A line chart with three types of data shown simultaneously, unemployment rate, inflation rate, and debt as percentage of GDP. The marks for the line graph is the point corresponding to each data point and the line joining them. The channels used are color as categorical channels to identify which line is for which data, x position to show the year for the datapoint, and y position to show the value of the datapoint.

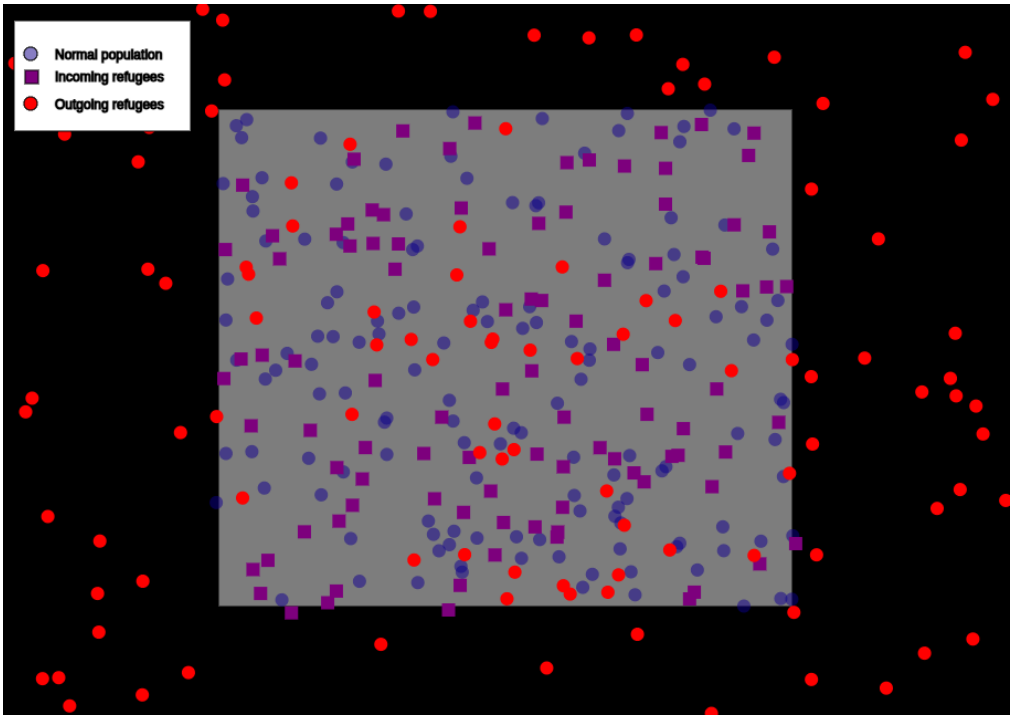
Our Submission for Phase 3

Since Phase 2, we have made some changes on how we show our data, based on recommendations by our instructors, we have also **added** some new visuals which enhance the use cases of our visualization. In particular we have added/modified a few visualizations and below we discuss how it helps us achieve what we want to achieve (and why we used it).

1) Country Map

We felt that coming from the home page, that is the choropleth map, we show the same kind of data for the country map when it comes to the refugees, by using the same saturation and the same visualization for that country and an awkwardly placed number title on the map. But **now**, we have changed the visualization to help better understand how the situation of the country evolved over time.

We decided to use particles as our marks this time with a motion effect. The channel here is the shape and the color of these particles. Based on the statistics, that is, the population, the number of incoming and refugees and the year in selection. Now instead of having to select the type of data the user wants to see, they can have a well put together picture on what the refugee scenario is like on the visualization.

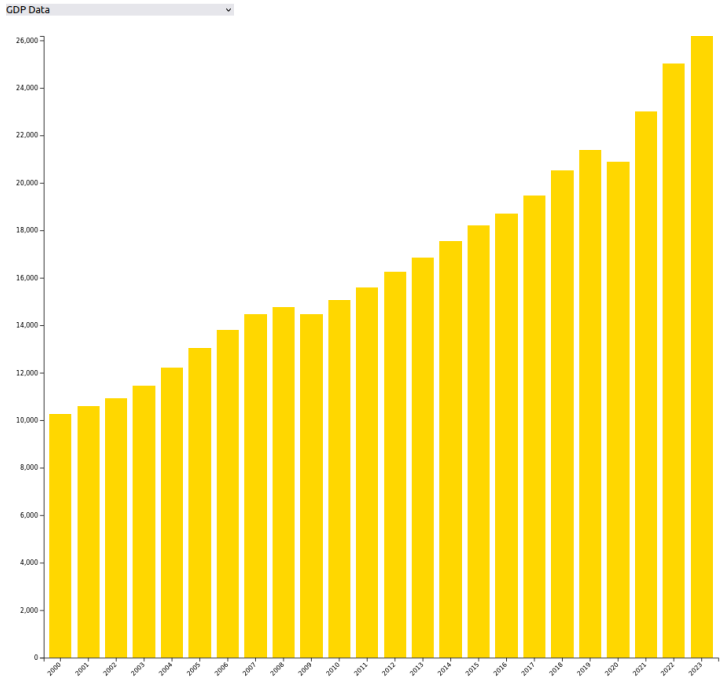


2) Bar Chart

i. Clear Comparison: Bar charts make it easy to compare values across different years. Each bar represents a distinct time period, allowing the users like economists, foreign affair enthusiasts etc to quickly identify trends, peaks, and troughs in the data.

ii. Suitability for Discrete Data: Since years are discrete data points, bar charts are well-suited for representing this type of data. Each bar corresponds to a specific year, and there are clear separations between adjacent bars.

iii. Emphasis on Individual Years: Bar charts emphasize the values of individual years, making it straightforward to see how a specific parameter of the economy has changed over time.



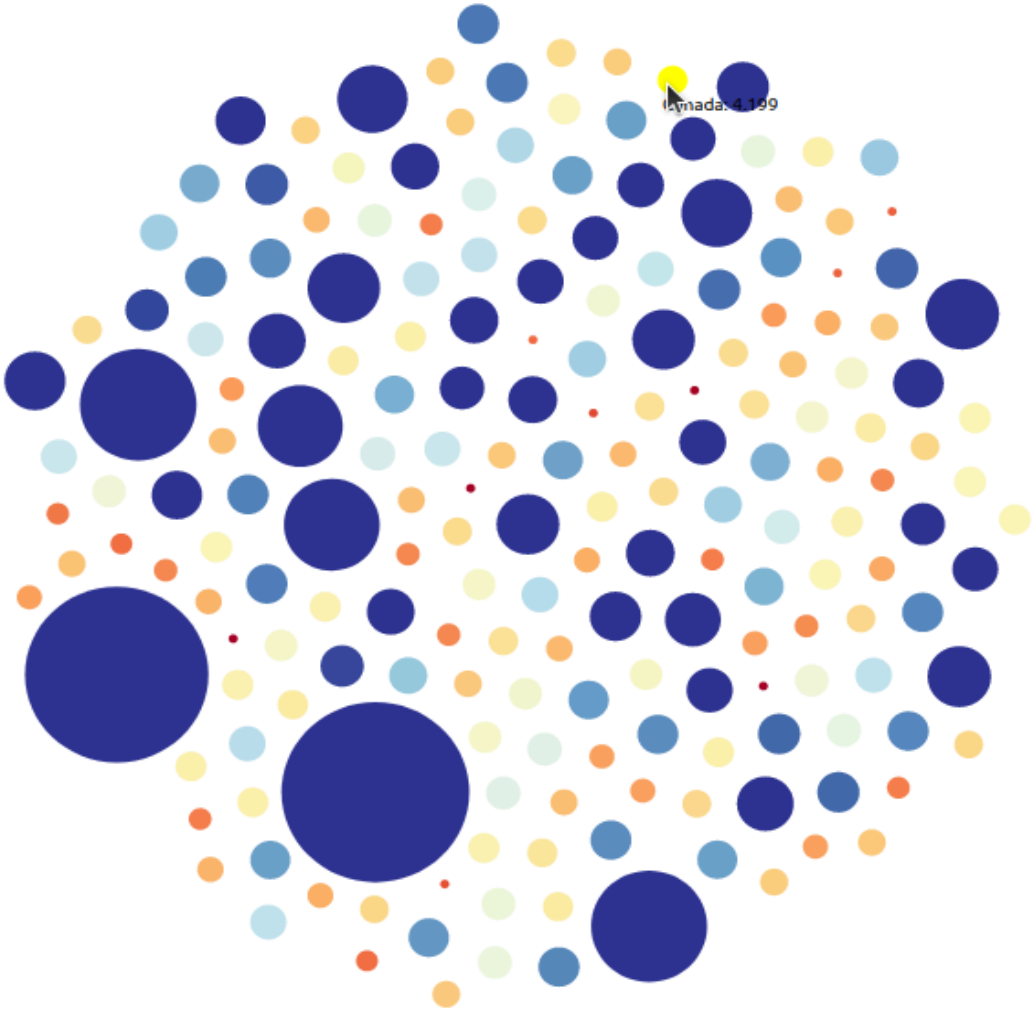
3) Line Chart

i. Comparative and Correlation Analysis: A line chart allows for easy comparison and correlations between multiple variables over time. By plotting all three indicators unemployment rates, inflation rate , debt as percentage of GDP on the same chart, economists, foreign affair enthusiasts etc can quickly see trends and patterns across different aspects of the economy changing over the years. Other visualizations such as bar charts or pie charts are less effective at comparing and correlating variables over time for multiple variables.

ii. Visual Clarity and Trend Identification: Line charts provide a clear visualization of trends and patterns over time. Each indicator can be represented by a different colored line, making it easy to distinguish between them. This clarity helps the user studying the visualization to understand the relationships and correlations between the variables.

iii. Contextual Understanding: Viewing multiple indicators together provides context for understanding economic conditions. For example, the economists, foreign affair enthusiasts etc can see how changes in unemployment rates correspond to changes in inflation or debt levels, providing a more comprehensive understanding of the economic landscape

3) Bubble Chart



i. Comparative Analysis: We have added a bubble chart where we show different countries on the same parameters (such as Unemployment rate, inflation rate) in the same year.

ii. Contextual Understanding: Following the theme of the above line graph, this comparison allows economists, foreign affair enthusiasts etc to see how changes in unemployment rates correspond to changes in inflation or debt levels, providing a more comprehensive understanding of the economic landscape globally.

4) Comparing Countries

- This is a newly added chart following our Phase-2 where we believe we can increase the use cases of our visualization by giving the user a feature to compare the economics of two countries.
- Here we have a selector to show which type of data we want to compare for both the **Line Chart** and **Bar Chart** discussed above, along with a selector for selecting the country we want to compare with.
- We modified our Bar Chart to a **Double Bar Chart** to achieve this comparison ground.
- This visualization is showed in a page of its own after selecting a particular country

Navigations

To navigate through our visualization, follow the steps below:

1) First, after going to the home page, hover over any country you are interested in to view its statistics, you may click on this country to be redirected to a regional-view of the selected country.
2) On this regional view we offer a variety of visualizations, including the particles, bar chart , line chart and the bubble chart. Except the bubble chart, all the visualizations are confined to the selected country.
3) The non-particle visualizations also have selectors to switch to the data the user wants to view, and hover functionality is added to all the graphs.
4) The Navbar allows the user to switch to a different view/page altogether, by allowing the user to compare the economy statistics with other countries via

a selector. This is done upon the clicking of the "**Compare Country**" option, do note that by default "**Single Country**" is selected.

Our Users

As discussed above our users may fall into the following classes and professions

1) **Economists:** Economists concerned with how the different countries' economies changed over time, and more importantly, who are seeking the answer to questions such as "How was country X affected when country Y at a particular time?" This time-period may be a time of refugee crisis, or a time of financial crisis, or just a normal analysis time frame.
2) **Historians:** Historians who want to see how the population shifted from one place to another during which year and time can view our visualization to get their questions answered as we show both the incoming and outgoing refugees. We also provide a compositional particle map where we show what the distribution of a population was like during a particular view which can explain how influenced was a country's population at a particular time by foreign involvement.
3) **Foreign Affair Enthusiasts:** We all are well aware of how the crisis affects relations between countries on a world-wide scale and not just any particular geo-political region . Our visualization can help interested users to explore how the refugee and economic situation molded a country's relations over a range of time and perhaps give answers to interesting deductions like "While country X was suffering from a refugee crisis, country Y and Z, not very far from X, were doing just fine." (Often a consequence of cold wars)

Limitations

While our visualization(s) cover a wide range of use cases, we still suffer from the following problems

1) Multiple Countries: Currently we only offer comparisons of one selected country with another country, and not more than two countries, this could also be useful if we wanted to cover a regional area of interest.
2) Data Constraint: Our visualization heavily relies on data, we had to set some scaling constraints for the particles, which may be improved and we could decide to nullify the values for countries for which the data was not

available. While this could be dealt with some Data Science - Techniques but we felt it was out of the scope of this project.

Datasets Used

To achieve what we wanted to visualize, we had to collect data, here are the links of all the relevant datasets used.

a) **Refugee Dataset** | **(Link)** : United Nations High Commissioner for Refugees (UNHCR) dataset consists of records documenting the refugees across the globe. It provides statistics of refugees including their country of origin, the country they seek asylum in, and the country they departed from along with the year. This dataset is maintained by the UNHCR to enable the monitoring, analysis,and management of refugee populations worldwide. For our analysis, we focus on examining the country of origin and the destination country where individuals seek asylum.

b) **Economy Dataset** | **(Link)** : The World Economic Outlook (WEO) Database serves as a valuable resource for assessing the economic conditions of countries. This database enables users to access a wide range of economic indicators, including Gross Domestic Product (GDP), employment and unemployment rates, and debt levels.

c) **Custom Datasets** : Using the above datasets, we had to manufacture and analyze the data we have, for example the legend values are made by analyzing the histograms of the different refugees, the break down of economy datasets into separate json files was also a significant task considering we want all of our data to be in the same format even though we are using different datasets. All the relevant code can be found in the “data” folder in our main repository, including the python notebooks used to extract and build our data.

Contributions

Everyone in our team had played a pivotal role to make this project possible, this includes brainstorming ideas overnight, discussion with the TAs on improvising, spending nights searching (and improving) the datasets we used, but here is what everyone brought to the final visualization visually (!)

1) Bassam Adnan: Worked on the previous leaflet country part, changed it to a different visualization later on, the particle component. Also added the bar chart and made the datasets work well with each other.

2) Bipasha Garg: Worked on the Line Graph and the Bubble chart components which are used in multiple pages, making sure they are compatible on comparison view.
3) Devika Bej: Worked the main home page , adding the choropleth map, the year slider which was used in different pages, and also on the comparison page.