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UNVEILING PATTERNS: PROCESS BOOK

TEAM DATA VIZARES

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Introduction

The Global Terrorism Database is an open-source database maintained by the START consortium which contains information on terrorist events around the world from 1970 through 2020. Sifting through the available open-source databases online we happened upon the GTD, and we were inspired to build our website around this dataset, with visualizations that could help emphasize patterns in terrorist acts around the world. We of course immediately agreed to be very careful during this process, and limit our work to visualizing the data, without drawing any conclusions.

Dataset

Immediately as we started working, we wanted to put all the necessary data for our website on the GitHub page so that we could start work on the site and the visualizations. This is where we encountered our first issue: the dataset was too big to maintain on the GitHub of our page, and it would have been extremely time-consuming to filter out the data necessary for each visualization from this dataset every time. We tried to have the data load through git LFS, but quickly abandoned that idea over a much simpler one: we filtered the data and created specific csv files for each of the visualization ideas we had in mind.

In terms of the dataset, after peering through it using python, we quickly concluded that it was fairly well made, as in not much data wrangling was needed, and it seemed to be fairly complete, i.e. we did not need to combine it with any other dataset.

Initial Concepts

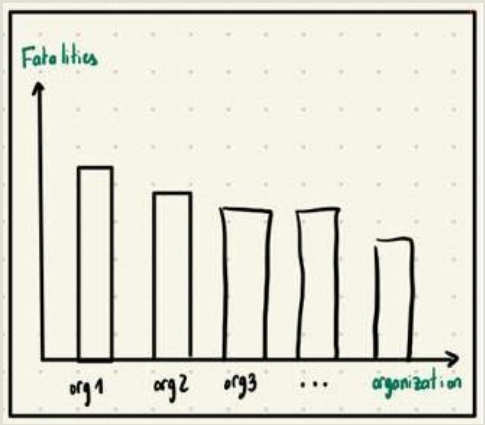
Having picked a database and looked at the data contained within by making multiple visuals through python and reading the accompanying guidebook, we started brainstorming concepts for what visuals we wanted to make and how to show them. A very large part of the original ideas ended up making it into the site, and they are explained in further detail in the following section, along with sketches on how they looked initially and how they look now. One idea that didn't make it off the cutting room floor was what we called the "Arrow map". We wanted to create a visual based on the country in which a

terrorist organisation was based, and show which countries were included in their attacks. This proved impossible however, as the database did not contain a "country of origin" for the terrorist groups. In retrospect, we understand why the START decided to not include this information, and feel that it is for the best that we did not include this visual.

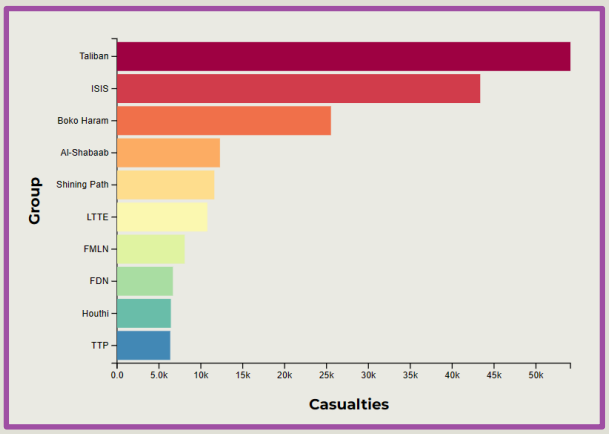
The 5 ideas that stuck

The following 5 are the initial ideas that were fully implemented and are currently fully functional in the site.

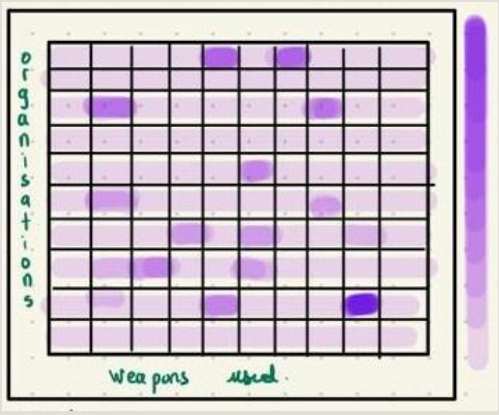
Group Profiles: Insights on terrorist groups, through two visualizations, one bar chart on the number of casualties caused by terrorist groups, showing the top 10 terrorist groups with the most caused casualties, and one heatmap showing the top 10 terrorist groups against the top 10 most used attack methods.



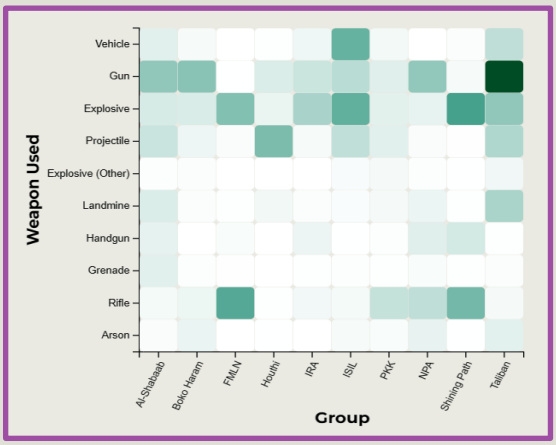
Initial sketch of the "Casualties" bar chart



Final version of the "Casualties" bar chart on the site

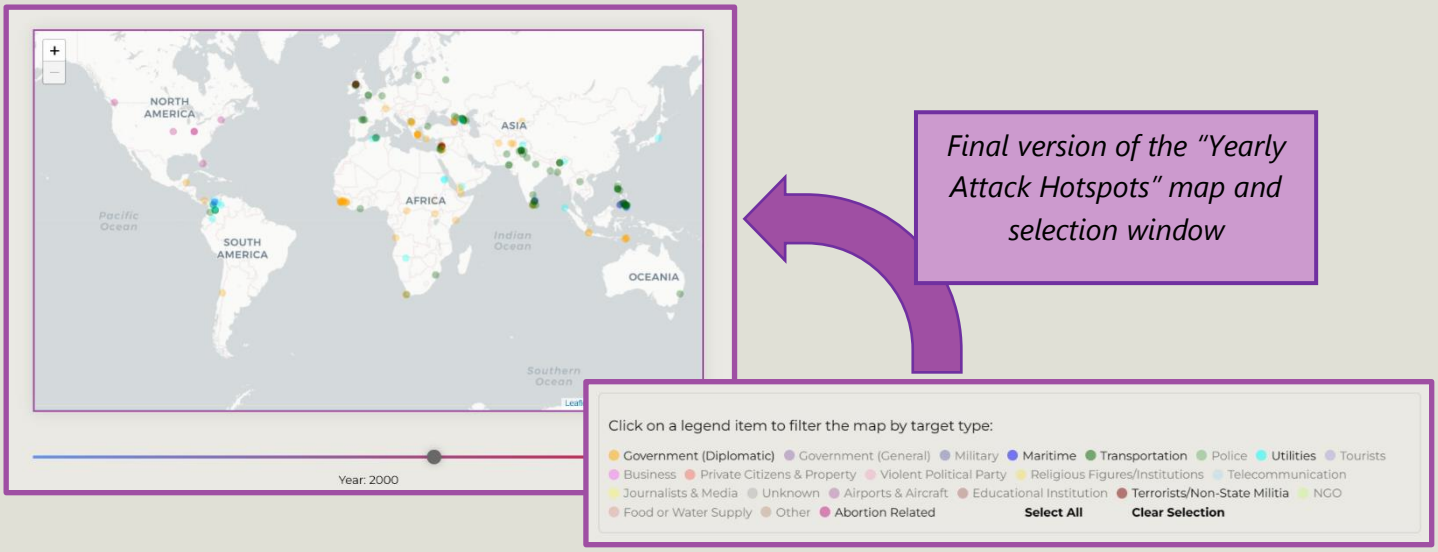


Initial sketch of the "Terrorist groups – Attack Methods" scatterplot



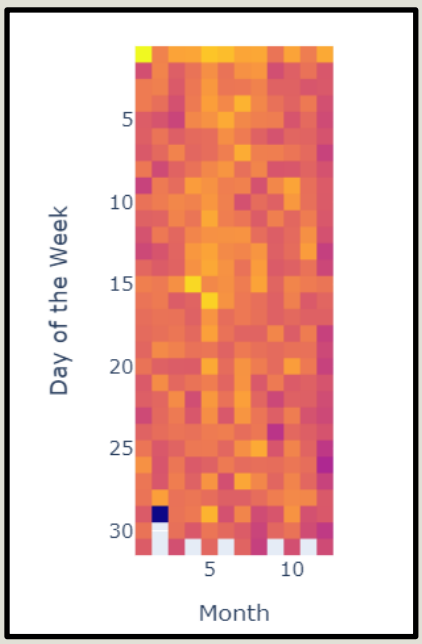
Final version of the "Terrorist groups – Attack Methods" scatterplot on the site

Yearly Attack Hotspots: A map showing terrorist attacks through the years, with an increment of one year, colour coded based on the target type of the attack. Users should be able to pick which target types they want to look at, with multiple choices possible. Clicking on an attack plotted on the map should show a popup with more information on the attack, such as info on the perpetrator, the attack type, total number of casualties, and the summary contained in the database.

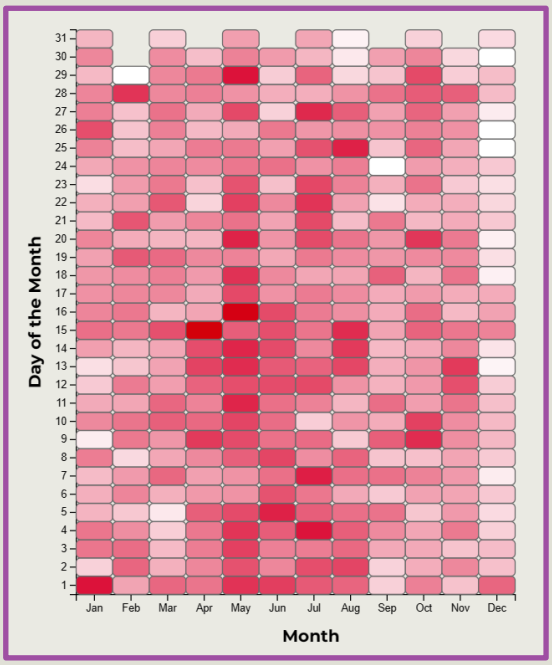


Final version of the "Yearly Attack Hotspots" map and selection window

Temporal Patterns: A heatmap of frequency of terrorist attacks throughout all the years contained in the GTD, grouped by which day of the year they were committed on.

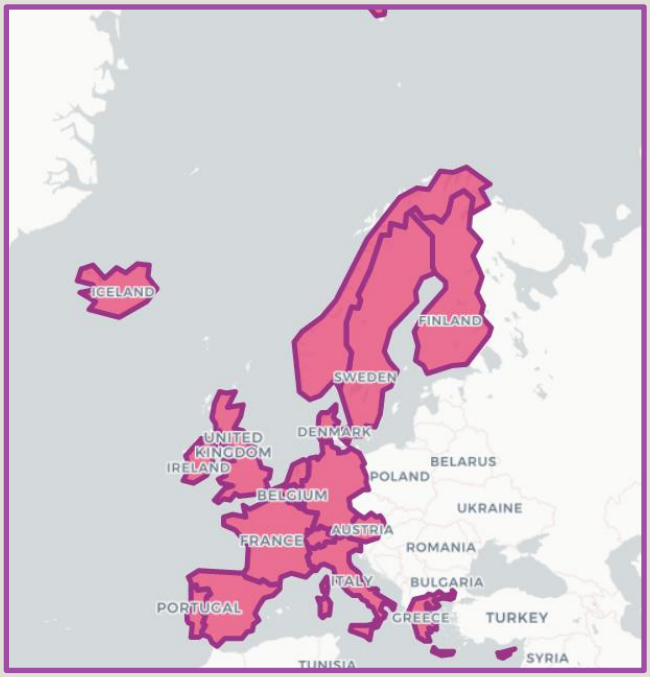


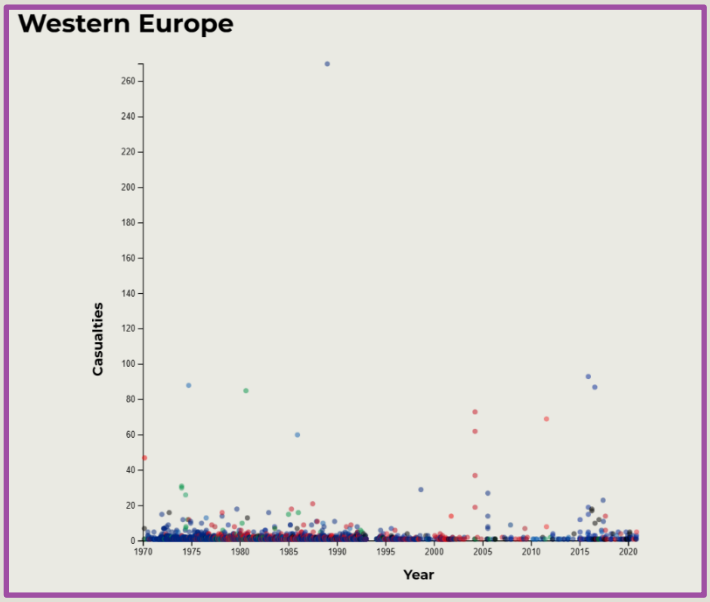
Initial python output for the "Temporal Patterns" heatmap



Final version of the "Temporal Patterns" heatmap on the site

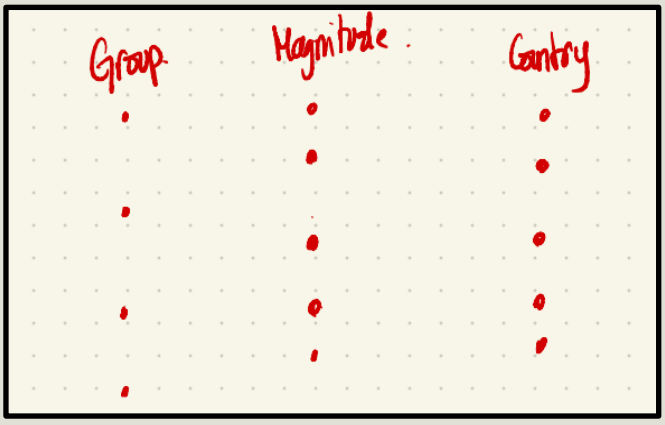
Regional Impact: A scatterplot showing terrorist attack casualties throughout the years for different regions, with the attacks colour coded by the specific country they were committed in. Noticing trends early on when plotting the data, we also decided that extra info should be provided on historical events for the chosen region in an attempt to explain to the user why certain trends appear.





Final version of the "Regional Impact" scatterplot and map on the site

Country-Specific Analysis: A streamgraph for each country showing the spread of terrorist casualties through the months, for each year that there were casualties in that country.



Initial sketch of the "Country-Specific Analysis" streamgraph

Final version of the "Country-Specific Analysis" streamgraph on the site

As an extra idea: In terms of the UI, we decided fairly early on to add a help button to our site, where we would explain what each page shows and how to use the interactive visuals.

First steps, baby steps

The first steps in building our site were fairly rocky. One of the first issues we encountered was the map not displaying or in general working properly. We thankfully solved this fairly quickly through debugging our code (at that point a mere skeleton of a site) and it did not pose a problem later.

The second big issue came up when we tried implementing the heatmaps. Though we managed to load the data into the heatmap element, the display would not show the values in the heatmap, and instead filled only one of the 100 boxes we had. After looking through the code and cross-referencing with examples from the course, we figured out that the problem was how the variables were assigned to the heatmap axes, so by moving things around a bit we managed to make the display work as intended. We then moved on to make the heatmap look cleaner, and added extra info that would display when the user hovered over one of the cells.

A fairly recurring theme in this initial stage, was that we did not know how to structure our site, where to place things in a page so they would fit nicely together. Through working on improving the site however we managed to overcome this.

Further steps, further challenges...

The more we kept on adding features, the more issues we encountered. A prime example of such an issue was the highlighting of groups of countries in the map, used in the “Regional Impact” for the regions, or in the “Country-Specific Analysis” for current countries that belonged to certain groups in the past (for example the Soviet Union). The problem was that every time we wanted to change the highlighted group of countries, the countries that were already highlighted would not deselect properly, i.e. they remained highlighted even when the countries in the new group were selected. This was fixed by using a list

of layers for the leaflet.js visualizations and iterating over the list containing the layers, instead of using one layer.

The second big issue at this stage appeared when putting the finishing touches on the "Regional Impact" tab. We had decided at this point to use an animation for the scatterplot, which caused an issue with regions containing countries with a lot of data of terrorist attacks. We had set the maximal time for this animation to 200ms, and the time it took for the plot to fill in was well above that number. Since this plot was based on the number of casualties and not on the number of attacks, we decided to remove the attacks with zero casualties from the data of this visualization. This ended up helping to reduce the loading time for the plots, however the time it takes to load some of the data is still fairly large, with some visualizations taking up to about 2,5 minutes to fill in completely. We have not managed to get the time under 200ms on these plots as of yet.

On a positive note, at this point we also started adding in the text for each page, a process which went off without a hitch, since we already had implemented the text boxes in each page, with placeholder text in them.

The final big issue came up when deciding what to do with the home page of our site. Since we did not want to greet the user with a block of text, we decided to add something representative of the dataset we used, so we added a map with every single terrorist event contained in the GTD. This, however, turned the map into a clunky mess, with horrible response times when we interacted with it and the data points lagging behind the moving map. To solve this we decided to exclude from this map all terrorist events with less than 10 casualties, which unfortunately made this map incomplete.

User feedback and modifications

Having finished a big part of the visualizations and of our site, we asked several of our peers for feedback on the site. We asked them to test the site to try and find any bugs that we might have missed, and to also tell us what they liked/disliked in terms of the visuals. In terms of bugs, we found the following from user feedback:

1. **Resetting targets in "Yearly Attack Hotspots":** When manually selecting some attack targets and resetting the page, the selections would not reset.

If for example, one selected two target types, switched to another page, and then came back to the "Yearly Attack Hotspots" page, the box with all the options reset, showing every option as selected, when in reality only the two target types were selected. This was thanks to the map, which followed the actual selected types, and not the visual, and thus showed only the attacks for the specific target types. This was promptly fixed by having the target selection properly reset whenever the user switched to another page.

2. **Dropdown menus:** A user discovered that when hovering over the dropdown menus the cursor did not turn into a hand that shows that the option is clickable. This was corrected.
3. **Slider in "Yearly Attack Hotspots":** When using the slider if a user decided to move fast through the years, every year between the position the user started sliding from, to the position they ended on, would be displayed on the map. This not only caused lagging issues, but there were also several spots on the map from some of the years that would not reset/disappear when the year was changed. This was fixed by adding a delay of 50ms to the visualization of the map compared to the slider, i.e. the site now waits to see the slider stop moving for 50ms before starting to load the data for the visual.

In terms of what the users mainly disliked about the visual aspects of the site, we received the following feedback:

1. **The dropdown menus** had no arrows to indicate they were a dropdown menu, which some users found confusing. Wanting our site's visuals to be as intuitive as possible, we decided to add these.
2. **We had multiple colours** in our site, different colours for the buttons (light blue) and different for the title and team logo (light red). We wanted to find a different colouring scheme but were fairly hesitant to start looking at palettes, so it helped a lot that we got feedback on this aspect. We decided to go with only one colour (light purple) for the buttons, title, and logo for our site (as well as the border of the map), and different shades of greyish-white for the background in order to give the site a uniform look.
3. **The map had a quirk** where zooming out enough would cause multiple copies of the map to show next to each other, which confused users a lot. We fixed that so the view remains locked to the common Mercator projection.

Final touch-ups

After most of the visualization work was done, we focused on putting some final touch-ups to make the site more visually pleasing. Some of those were:

1. **Changing the highlight colours** in the “Regional Impact” and “Country Specific Analysis” tabs to a pinkish-purple in order to match the rest of the website and thus improve the uniform look.
2. **For the “Country-Specific Analysis”** when a country is chosen we decided to have its flag show up next to its name.
3. **Adjusting the heatmap colour ranges** for both heatmaps so the differences in values are sharper and the gradient is bigger.
4. **Adding the colour coding** mentioned earlier for the “Regional Impacts” as well as the hover-over popups, with the popups being colour-coded based on the primary and secondary colours in the country’s flag (primary colour is the textbox fill and secondary colour is the text box border)

Peer Assessment

We did the initial brainstorming of concepts as a group, and we wrote all the Milestones together. Apart from these, the work was split as follows:

- **Alex** was in charge of creating the initial structure of the website, including the map using Leaflet.js. His work involved developing features such as country highlighting on the map used in 'Regional Impacts' and 'Country Specific Analysis'. He implemented the heatmap in the 'Group Profiles' section and developed the 'Yearly Attacks Hotspots' density map with a slider animation. Additionally, Alex created drop-down menus for the 'Regional Impact' and 'Country-Specific Analysis' sections and worked on the 'Temporal Patterns' heatmap.
- **Aristo** contributed to the project through a range of roles including text creation for the website, data processing, and data compatibility adjustments with GeoJson. He was responsible for data selection and formatting for the visualizations, the creation of the 'Casualties Density Map' on the homepage, and the integration of a help button. Aristo also contributed to the development of the 'Regional Impacts Scatterplot' and its interactive features. He implemented the target type filtering into the 'Yearly Attacks Hotspots' and worked on the website's footer. Additionally,

Aristo was responsible for creating all the tooltips used across the site to provide additional information for users.

- **Konstantinos**'s main contribution to the project was in the area of visualizations and design elements. He worked on the development of the bar chart for 'Group Profiles' and the creation of the streamgraph visualization. He also took charge of the styling of the website and the visual elements of the heatmap. Konstantinos was also responsible for the initial selection of visualizations based on the data and the creation of the SVG logo for the website.