

Alexander and the Gymnosophist



60 Years of "Peace"

"It took place, once, in 326 B.C. on the banks of a river called the Indus, now in Pakistan... Alexander, a young Macedonian, met there what he called a "gymnosophist," which means "the naked, wise man." We don't know who he was... Alexander asked, "What are you doing?" and the gymnosophist answered, "I'm experiencing nothingness." Then the gymnosophist asked, "What are you doing?" and Alexander said, "I am conquering the world." And they both laughed. Each one thought that the other was a fool. The gymnosophist said, "Why is he conquering the world? It's pointless."

[Devdutt Pattanaik](#)

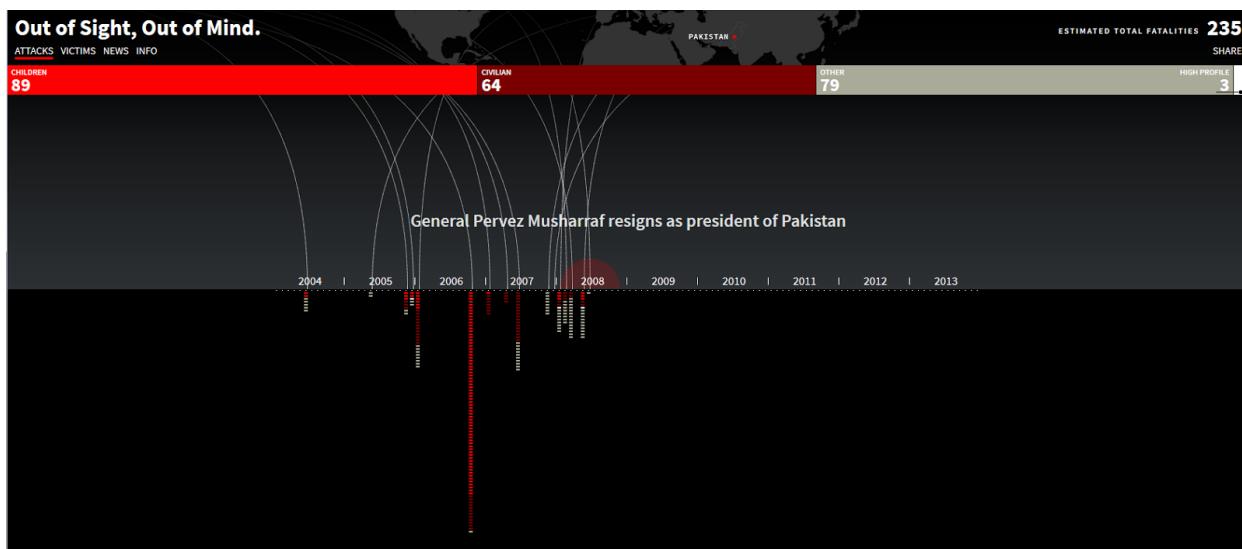
Motivation

Wars are not something people think about on a daily basis. We are confident that transforming the data about armed conflicts into knowledge and communicating this knowledge is a great application of the skills we learned in CS171. Our purpose is 2-fold: we want to communicate the price the Humanity pays for wars, and encourage people to look for patterns in the complicated relationships between warfare, economic power, political alliances and history.

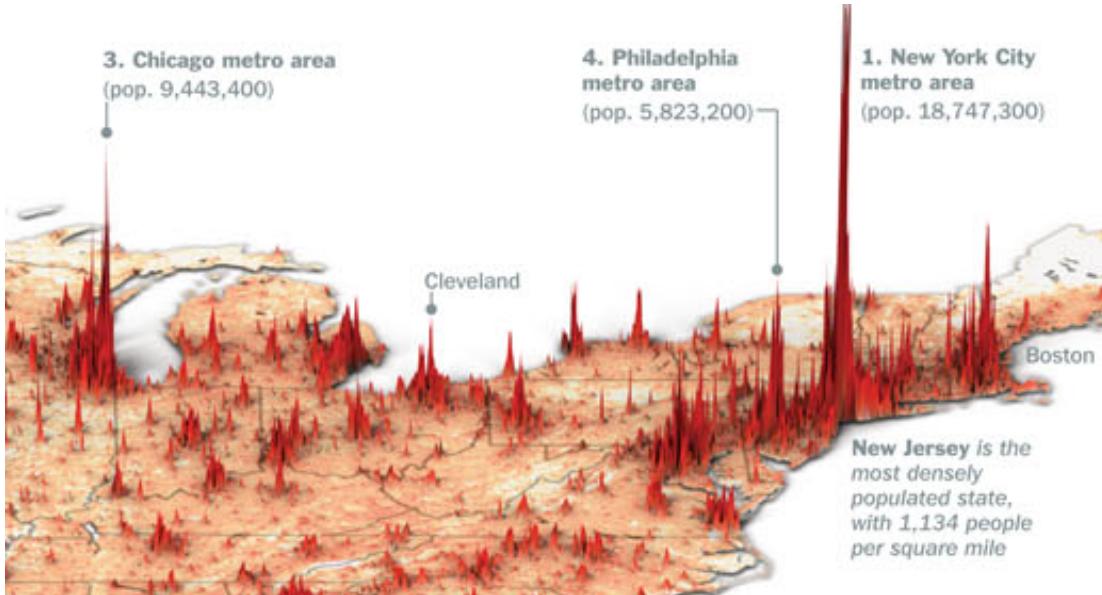
Skills: data analysis, statistical analysis, gamification, visualization

Inspiration

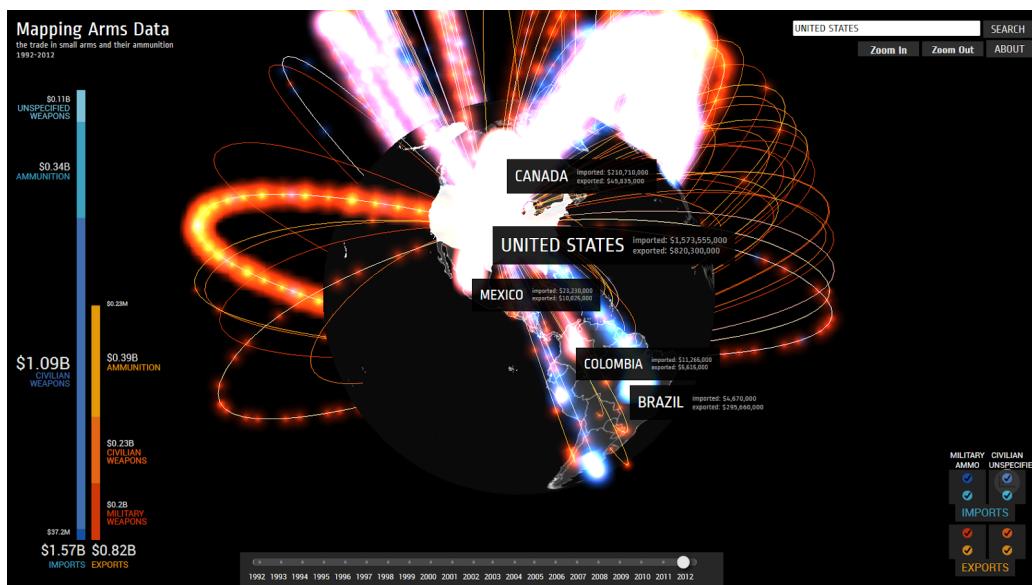
This [visualization](#) of US drone attacks in Pakistan appeals to us very much. We think it is a great example of the important message, which is communicated in a clear and beautiful way.



The [visualization](#) of US population density shown in the “Maps” lecture inspired some of the ideas for advanced features (which did not make it to the final version).



This [visualization](#) of arms transfer between countries over time, while not perfect, also seemed interesting.



Project Evolution

Evolution up to TF check-up

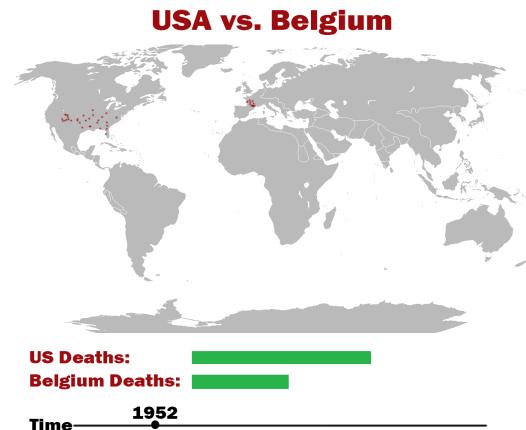
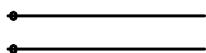
Our initial ideas was to construct a data-based game, where players could select 2 or more countries at a particular year and see the progression and the results of a hypothetical armed conflict between these countries and their allies. We put a lot of emphasis on building a good statistical model to predict the outcomes of wars based on the historical data about military power, economics and political alliances.

However, while we took a closer look at the data and tried testing simplest models to predict war outcomes, this task turned out to be very complicated: there seem to be a lot of variables at play, and we don't have data about most of them. Our optimistic assumptions about the relationships between military power and war victories turned out to be false, and the composition and changes in alliances (treaties, non-aggression pacts, defense alliances, etc.) turned out to be complicated and require a lot of research and wrangling to be ready for the use in a prediction model.

Our Teaching Fellow suggested that we limit the statistical part of the project and confine ourselves to a few features of the data that can be cleaned and used relatively easily, and instead focus our attention on the design of the most effective ways to communicate our message.

Because of this, we conducted the review of the interface of our game and realized that it was not very effective: we initially planned that the game would consist of 2 screens: one for the war setup, and the second for the demonstration of the course of

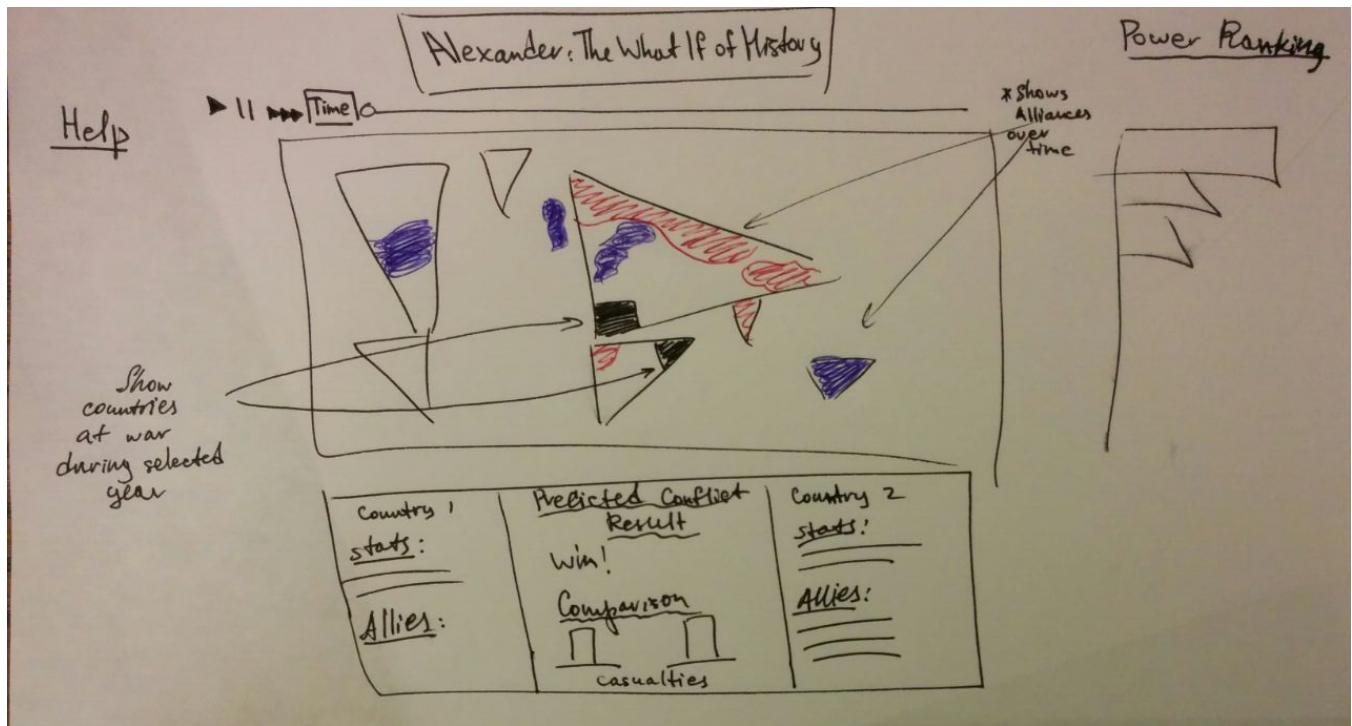
Alexander: The *What If?* of History



the war. Such a setup would not be fully utilizing the amazing opportunities for interaction provided by web-based visualization.

Because of this, we decided to make simulation an optional feature, and instead focus on visualizing complicated relationships between alliances, power metrics and war outcomes throughout history.

Through many sketches and discussions we came to the following basic multi-view layout, which we are currently implementing:



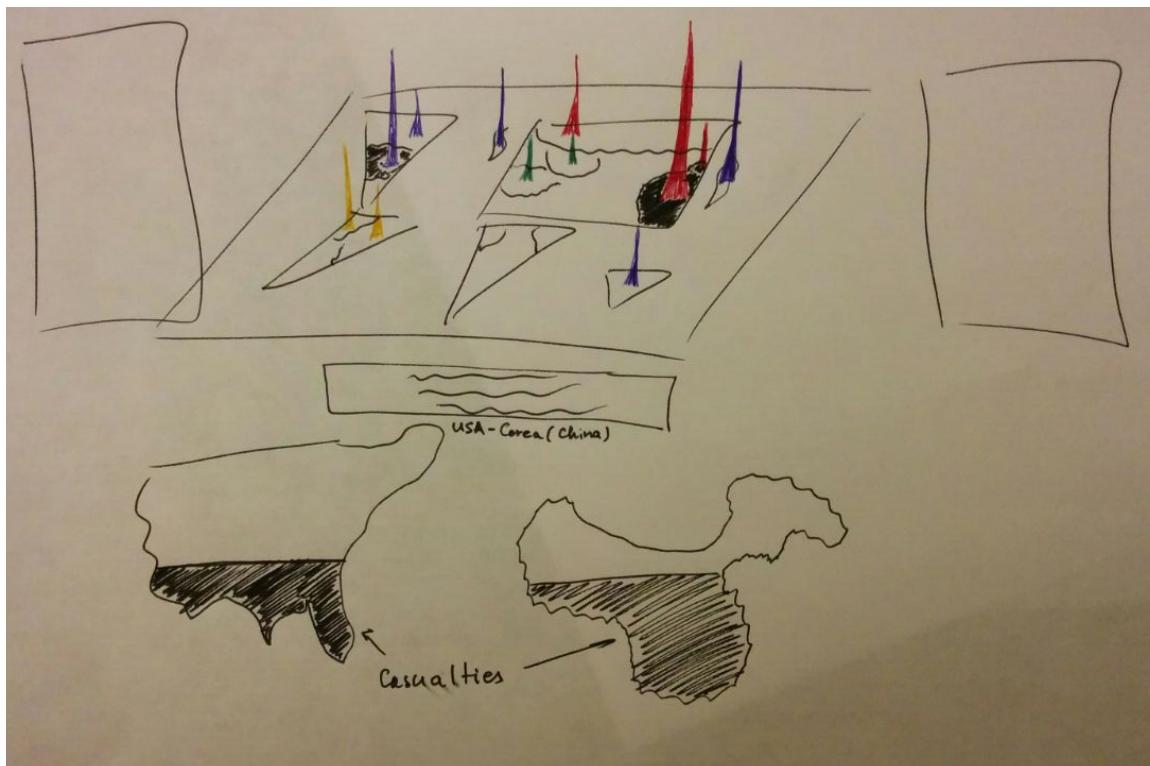
The must-have features now include:

- An interactive map, which allows the user to select countries
- A bottom panel which represents historical statistics about countries
- A bar chart of top-10 countries by National Power Index
- Highlighting the countries in war at the selected year

Optional features include:

- Incorporating the data about military alliances and international trade and finding a way to visualize it over time

- A special view showing the simulated characteristics of the world or of the selected countries if some or all wars did not take place
- A pseudo-3D version of the power ranking bar-graph that allows the display of the power data on the map naturally. This may also include some version of more imaginative area-based graphs to show casualties or other war related statistics(inspired by [this](#)):



Questions:

- a. Our initial questions included:
 - i. What's the history of wars? - tell the story
 - ii. What's the price of wars? - show clearly
 - iii. how are power and alliances related to war outcomes? - give opportunity to see patterns

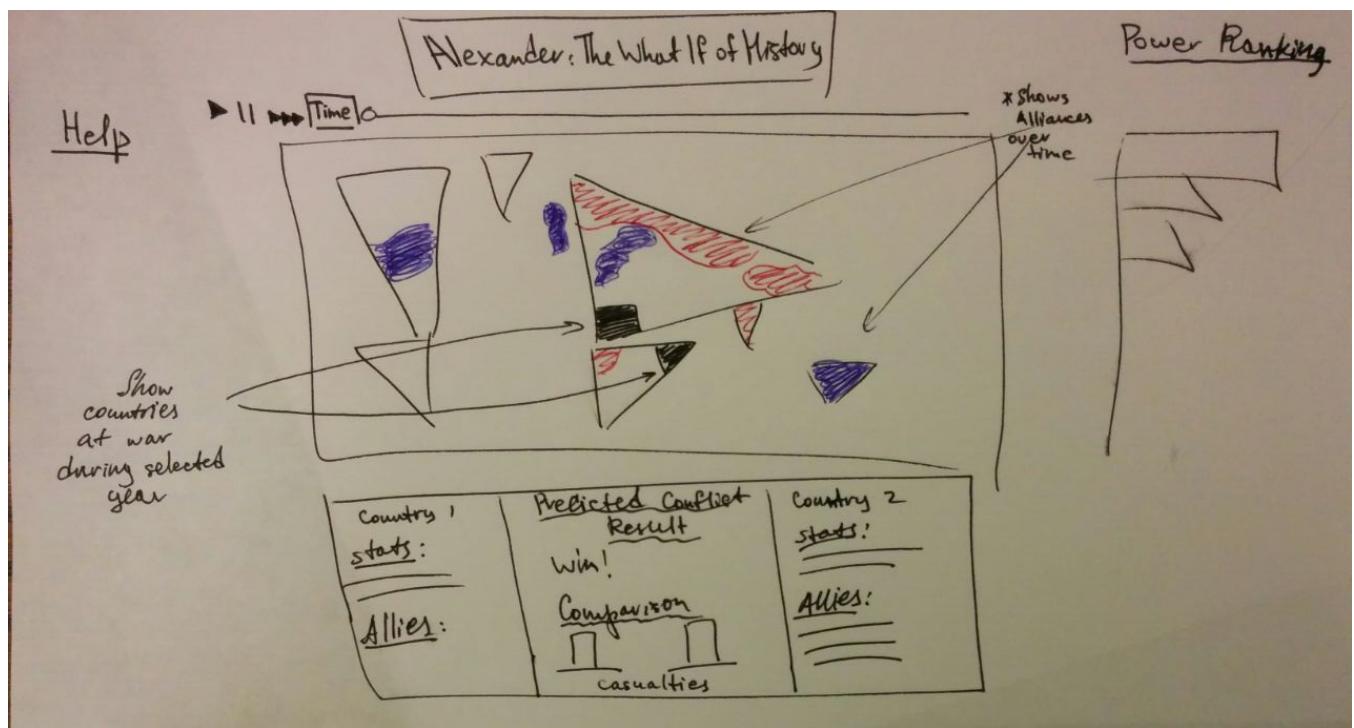
b. Novel questions that we discovered:

i. What if there were no wars?

Evolution after TF check-up

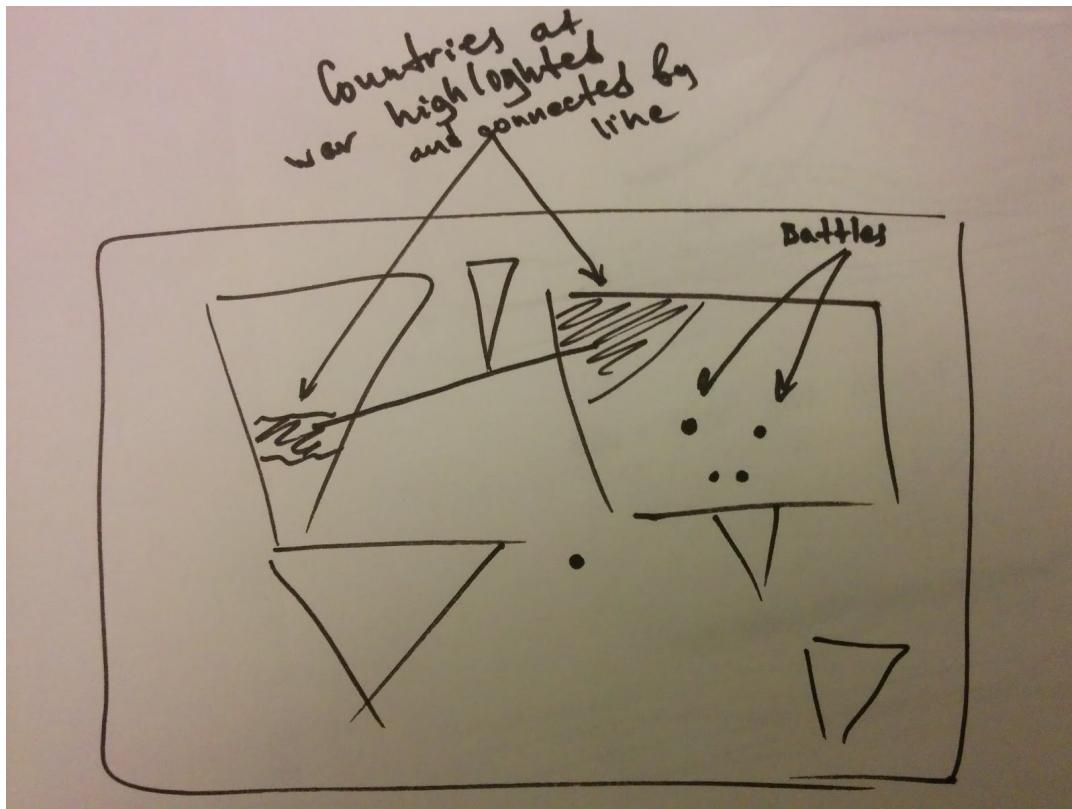
Upon further analysis of the data, we became more and more convinced that reliable predictive modelling of the outcome of conflict between 2 selected countries in a given year in the way we originally conceived it would probably be prohibitively difficult to implement. We thus decided to focus on letting users analyze the real data and on communicating the message of the real cost of warfare to the wellbeing of world's societies.

In light of this, the previous design (below) on which we agreed did not seem appropriate any more.

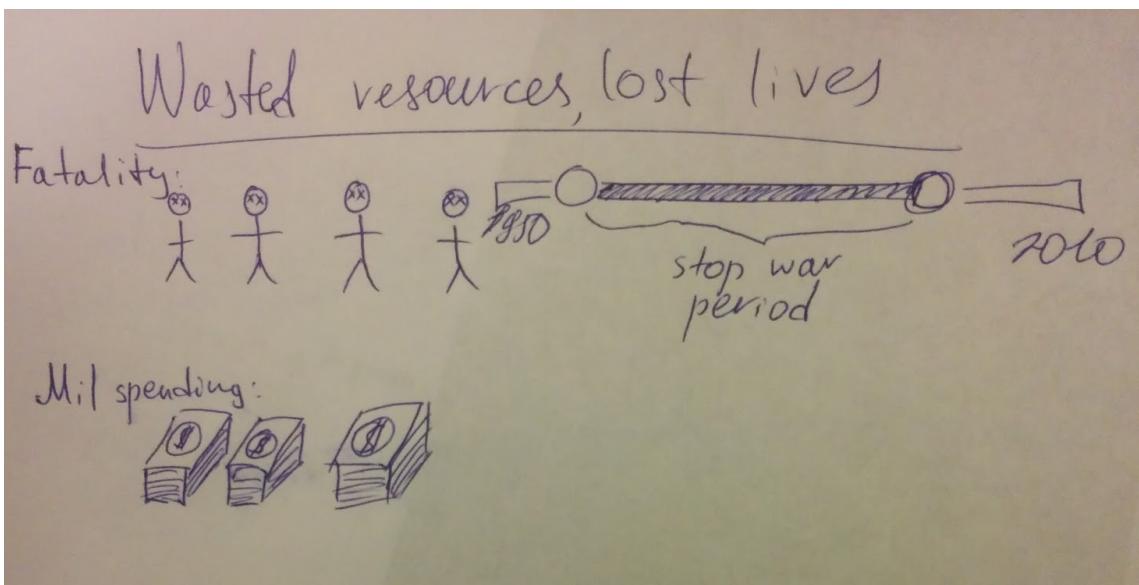
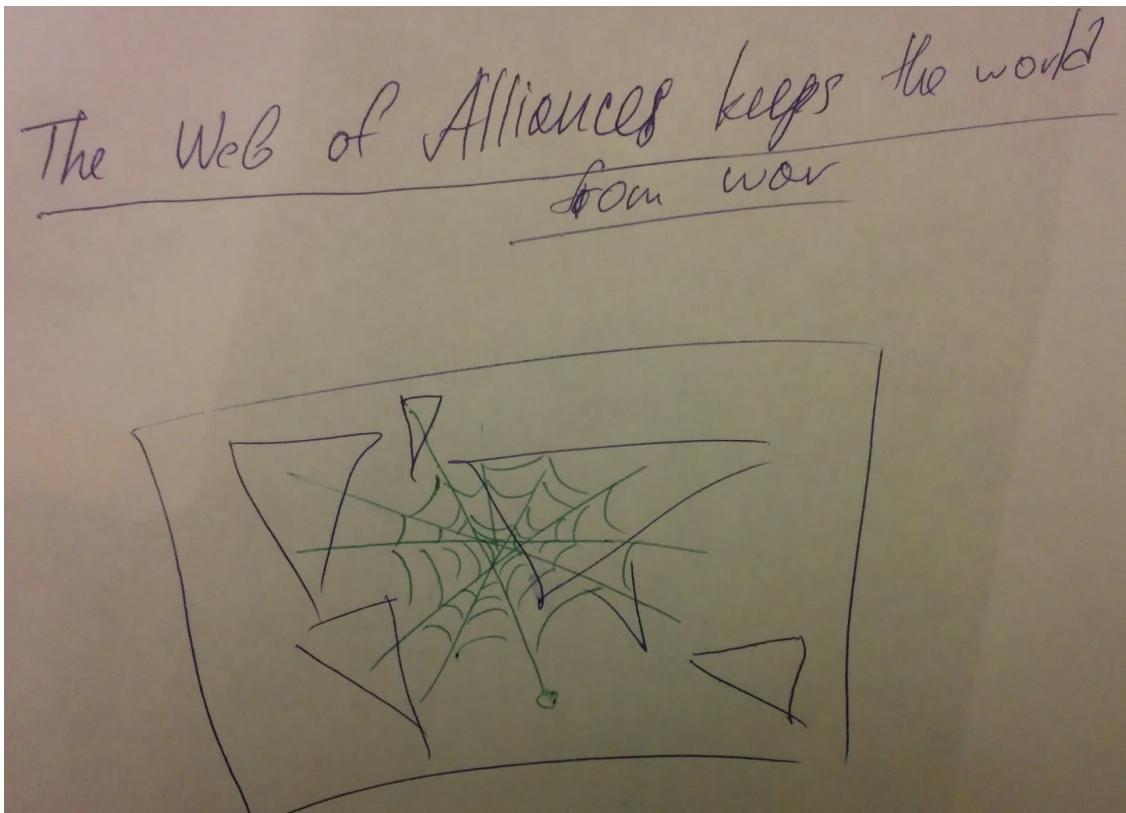


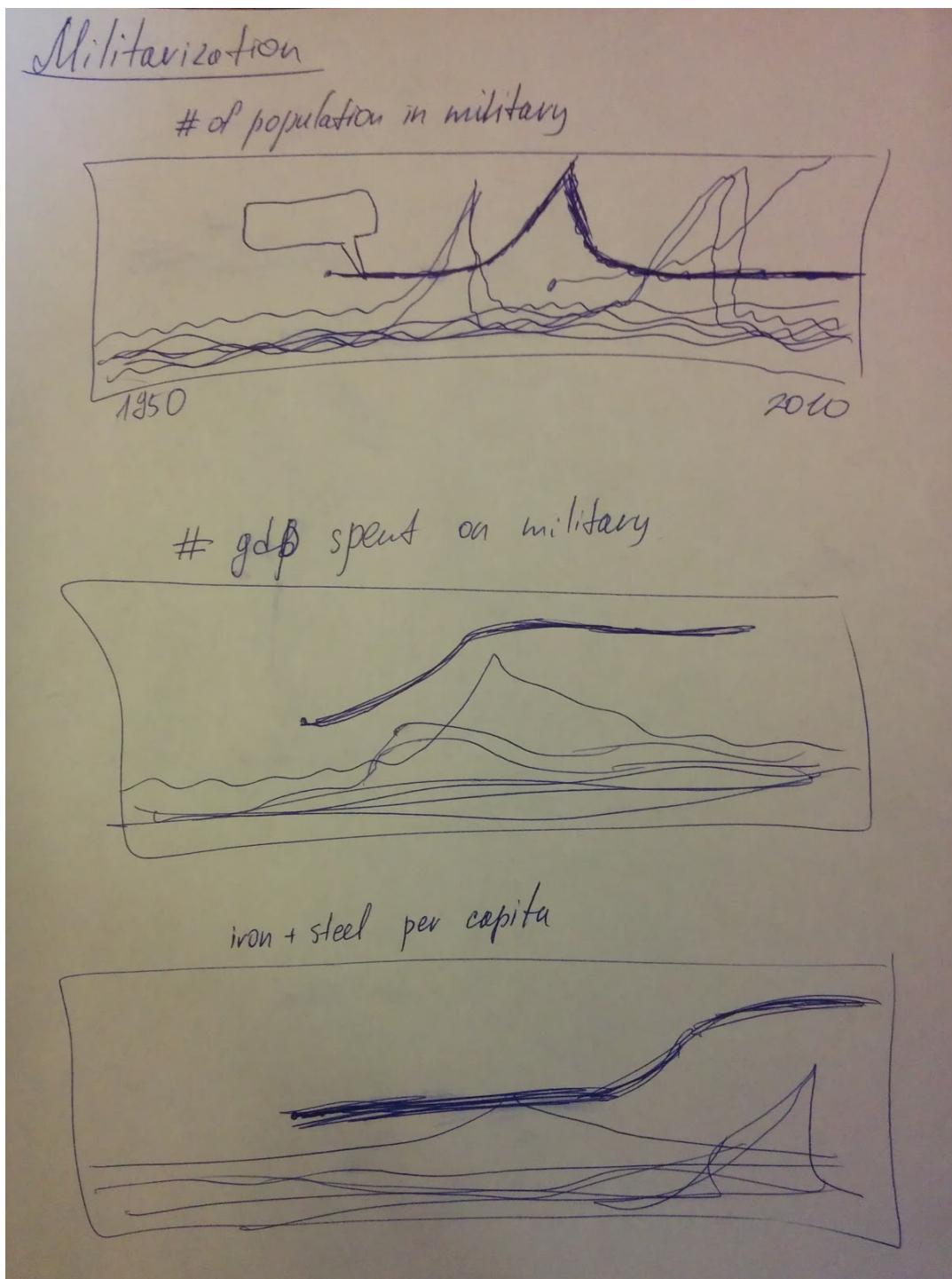
The comparison between just 2 countries stopped being interesting without simulated battles (After all, what's the point of comparing 2 countries if one can compare all of them? Even less so if the data for some countries is much more comprehensive than for others).

We then did more brainstorming and came up with several basic views that seemed both complicated enough to search for interesting patterns and apparent enough so that the main messages we want to communicate would be clear without a lot of thinking:

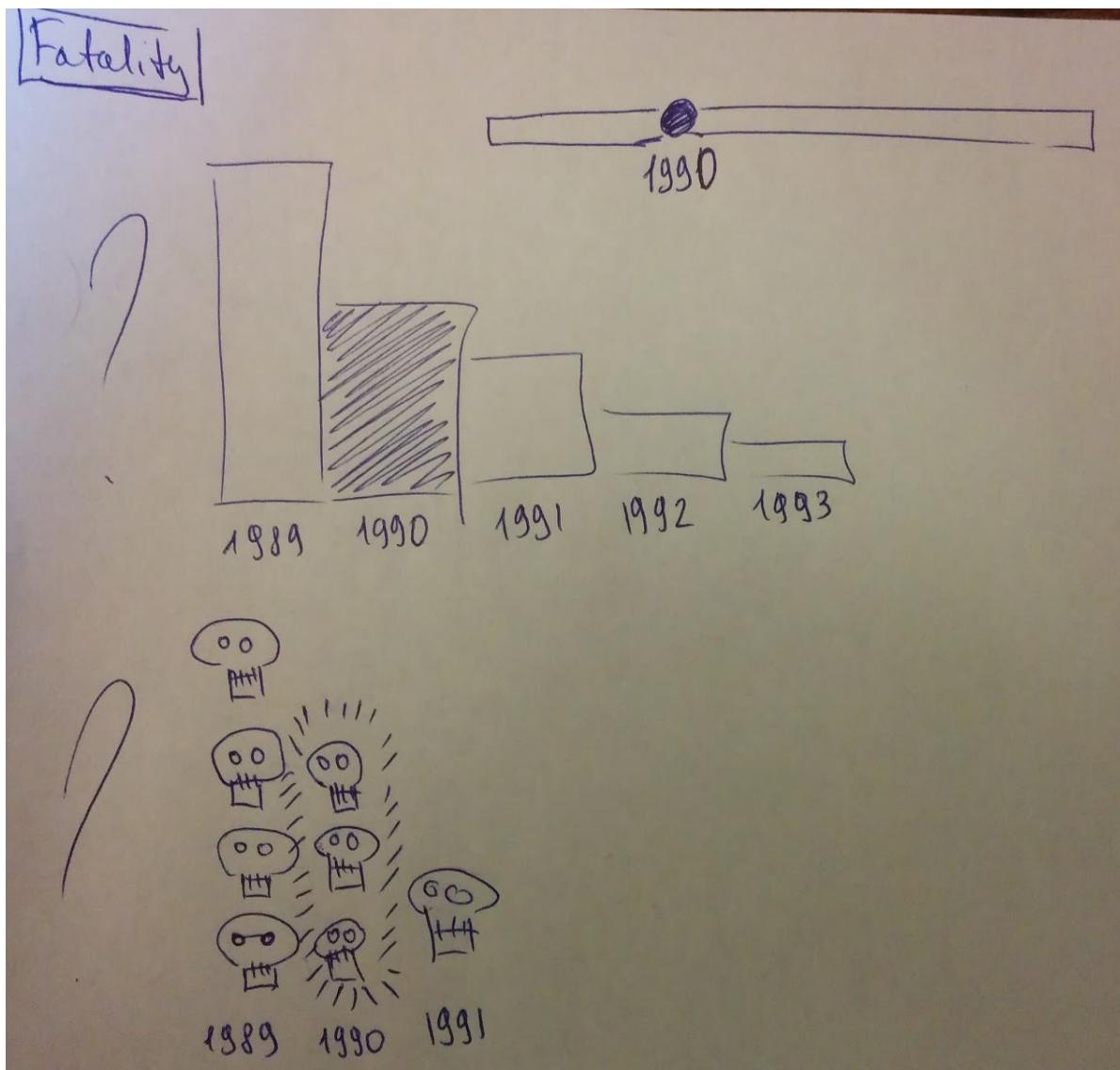


(this view and others would change over time with a slider, which is not always shown)





(multiple coordinated views of different characteristics that allow us to compare countries by the part of the available resources these countries spend on military)



(Different Ideas for bar charts, including pictograms and highlighting over time)

Data

1. Correlate of war [project](#):
 - a. [National Material Capabilities](#) - this dataset is a time series of military expenditure, military personnel, energy consumption, iron and steel production, urban population, and total population for every country since 1812¹
 - b. [Formal Alliances](#)² - includes information about bi-lateral international agreements of 4 kinds: defense, nonaggression, neutrality and entente.
 - c. [Inter-State War Data](#): including the battle-related combatant fatalities suffered by the state, year in which the war took place and a lot of other features (see ipython data processing notebook for details)³
2. GDP time series from [Penn World Tables](#)⁴
3. [PRIO](#)
 - a. UCDP/PRIOR Armed Conflict [Dataset](#) - information about warfare since 1946, including intrastate conflicts⁵
 - b. Conflict [Sites](#) since 1989⁶

¹ Singer, J. David, Stuart Bremer, and John Stuckey. (1972). "Capability Distribution, Uncertainty, and Major Power War, 1820-1965." in Bruce Russett (ed) Peace, War, and Numbers, Beverly Hills: Sage, 19-48.

² Gibler, Douglas M. 2009. International military alliances, 1648-2008. CQ Press.

³ Sarkees, Meredith Reid and Frank Wayman (2010). Resort to War: 1816 - 2007. Washington DC: CQ Press.

⁴ Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.1, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, Nov 2012.

⁵ Gleditsch, Nils Petter; Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg & Håvard Strand, 2002. 'Armed Conflict 1946–2001: A New Dataset', Journal of Peace Research 39(5): 615–637.

⁶ Dittrich Hallberg, Johan 2012. PRIO Conflict Site 1989–2008: A Geo-Referenced Dataset on Armed Conflict. *Conflict Management and Peace Science* 29 219-232 - [Link](#)

- c. Battle Death [Data](#), including civilians killed in combat, since 1946.⁷

Implementation

Progress at First Milestone



- Map in the center
 - Allows user to hover over country to display tooltip
 - Will be used in future to control the three visualizations at the bottom
 - Optional Feature: Highlight countries currently involved in war on the world map
- Time slider at the top
 - Allows the user to select a time from 1816 to 2007

⁷ Bethany Lacina & Nils Petter Gleditsch, 2005. 'Monitoring Trends in Global Combat: A New Dataset of Battle Deaths', European Journal of Population 21(2–3): 145–166.

- Updates all of the other visualization views based on the time
- Bar chart at right
 - Displays top 20 countries in terms of % of world's warpower
 - Composite Index of National Capability
 - Will be updated in future to show the country's color, which will make it more clear when one country grows stronger than another
- Blank SVGs for the three views at bottom
 - The left view will allow the user to click on a country to permanently select it
 - The rightmost view will update itself when the user hovers over a country
 - The center view will display statistics that reflect the “clicked” country and the “hovered” country
- Data-wise, we finalized collecting all the data we will need for our project
 - Most of the data is processed in some form
 - Country index data is completely processed
- You can find our data analysis code in `/data_processing/processing_code.html` on our project Github

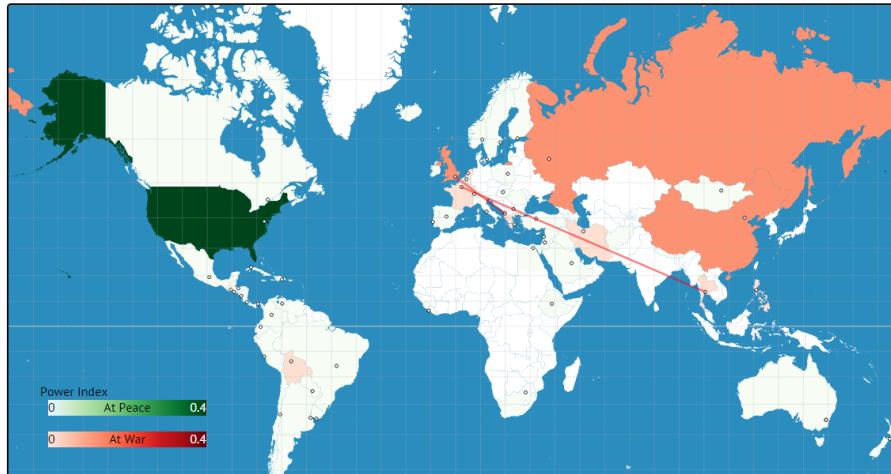
Final Project Implementation

View 1 - Battle and Power Visualization

The War to End All Wars?

World War II ended in 1946. Many, including US president Woodrow Wilson, hoped that this would be the last war that humanity would have to face. Let's see if this was actually the case. Press "Play" to step through history year by year. Hover over any feature to examine it in detail.

Yr: 1946



Power Index: Part of the world's material capabilities accumulated in a particular country at the given time. It is calculated based on total and urban population, military expenditure and personal, iron and steel production and primary energy consumption. ([Details Here](#))

In the visualization above, countries engaged in warfare are highlighted in red. If there is a line connecting a country to another, it indicates that the two are at war. A country that is highlighted in red but with no line is undergoing some form of internal conflict. Starting 1989, data is present to allow one to identify individual battles on a global scale, represented by red circles.

● Time Slider

- Uses JQuery UI so that we can easily animate it
- Goes from the end of World War II (1946) to 2007
- Also, it looks very pretty because of JQuery UI

● Play Button

- Calls a recursive method that animates the slider from the beginning to the end
- Disables the slider throughout the duration of the animation so that the user doesn't try to travel through time while animating
- Re-enables the slider at the end of the animation

- The Map Itself
 - Legend
 - Shows what the country's power index is in both the peace as well as the war states
 - Overlayed on top of the map so that it is always visible
 - Power Indices
 - A country is colored based on the percentage of the world's power that it controls
 - Capitals
 - A few selected capital cities are displayed on the map
 - Hovering over them tells which country the capital is of
 - Lines
 - Lines appear between the centers of countries currently at war. Hovering over the lines allows the user to read the names of both combatants.
 - Blips
 - Transition into the page when the user goes to a year with available blip data
 - Transitions out when the user selects a different year

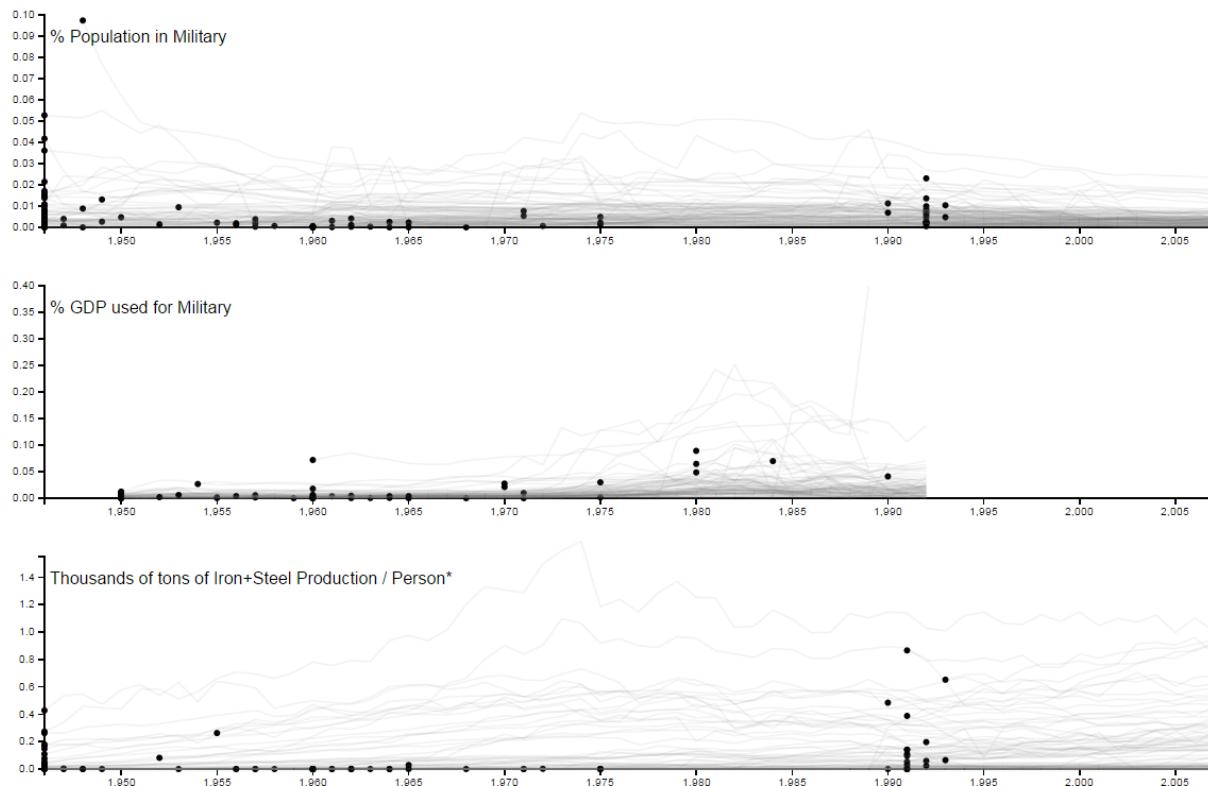
View 2 - Resources wasted on war. This is the “coordinated view” part of our project.

There are three different graphs that have some interconnectivity. When the user

hovers over one of the graphs, a tooltip appears detailing which line the user is hovering over. The line is then subsequently highlighted on all three graphs through the use of an EventHandler!

Resources Wasted on War

Since World War II, the proportion and volume of resources that the societies of the world spend on warfare has not declined, despite efforts by peacekeeping organizations to decrease it. The charts below contain information on the amount of resources countries use towards their military.



* This is considered by some to be an important measure of a country's military

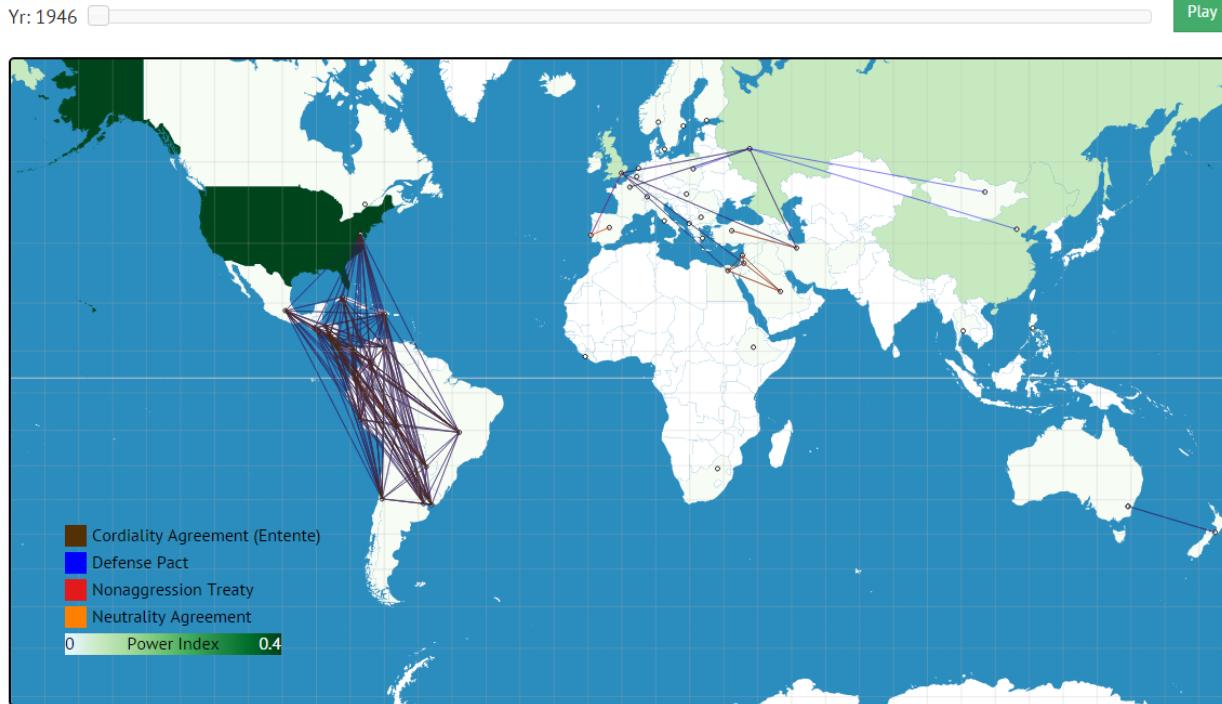
View 3 - Alliances and Cooperation

This view is very similar to view 1. The primary difference between these two views is the lines that are drawn on the map. Instead of drawing data about wars, we now draw 4 different kinds of alliances. It is very interesting to track these over time, as it is possible to see the developments of the Cold War through the progression of these

alliances. One positive note is that the number of alliances only seems to be increasing over time, making world peace seem a lot more likely than it actually is.

Progress

Although war never truly ended in 1946 following WW2, some progress has been made regarding world peace. Let us explore international agreements that have been made since 1946. Press "Play" to step through history year by year. Hover over any feature to examine it in detail.



View 4 - Pictograms

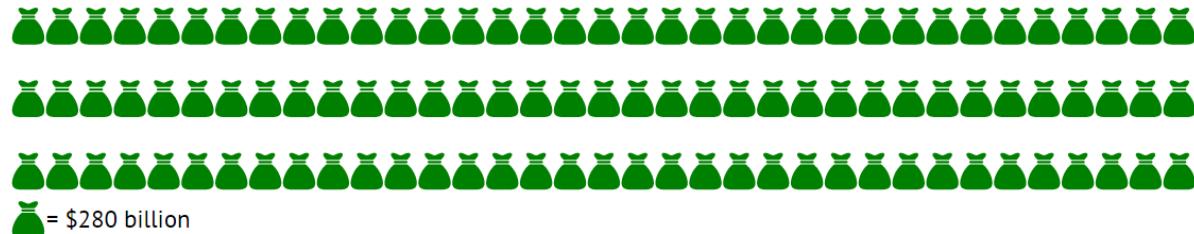
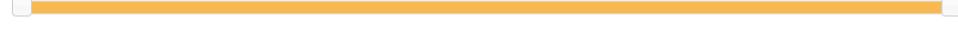
Finally, we have two pictograms showing the resource loss due to war in a very simple, easy-to-access format. The top pictogram shows how many lives could have been saved if no war occurred during the time period indicated by the range slider. The bottom one indicates how much money could have been saved in the same amount of time. As an added bonus, we added the cost of providing malaria nets to all 3.2 billion people in the world who are at risk of malaria as a fraction of a money bag on our bottom pictogram. It's interesting to note that the money that would have been saved

by avoiding all military expenditures could have been used to provide 900 malaria nets for each one of these 3.2 billion people.

The Losses of War

But what if World War II were actually the world's last war? Below is a pictogram showing how many lives could have been saved and much money could have been used for better causes. For example, malaria nets could have been distributed 900 times over to everyone in danger of malaria with all the money spent in military expenditures after World War II. ([\[2\]](#))

Years: 1946 - 2007



= Cost of distributing a malaria net to everyone in danger of malaria

Evaluation

After check-up

We went through a lot of ideas for visualization, and learned how hard it is to come up with anything worth mentioning:



Our original idea to perform a war simulation didn't pan out in the end, as we were unable to find a correlation between a country's warpower and who actually won the war using simple statistical analysis. As we did not want to create a more complex model to determine the victor of a war (as this would take too much time), we instead decided to move on to a different visualization based on the same idea.

After complete implementation

We enjoyed working on these project very much and we agree that we learned a lot by working in a team and programming different parts of the application simultaneously. When we began to style our website to match modern web design standards, we were

quite shocked at how amazing all of the tools that we learned to use in this class (D3, JSON, and to a lesser extent, Bootstrap and JQuery) are for development.

Notes

TF feedback summary:

- Limit number of variables in model and check correlations (in process)
- Think a lot more about visualization and how to represent the war in time - more sketches, what visual variables, thorough justifications for design decisions (in process)

Design Studio Feedback summary:

- Make sure to consider the possibility of 2 allies fighting
- Color different sides of the war
- Additional options:
 - Complicate simulation more
 - Zoomable map
 - Allow more user interaction with simulation progress

Tasks after feedback:

1. Clean and wrangle the data, try to find correlations between features and outcomes (Grigory)

2. More sketches and thinking about vis design (several views?)
3. Tomorrow: ~working vis and good-looking process book with lots of text and pictures that make sense

Possible work division:

- Visualization design and thinking about statistical model - both of us
- Data cleaning, reshaping, stat model building - mainly Grigory in python
- Implementing visualization - more Raahil?