- **Basic Info**

  Title : US Mass Shootings (1966-2017)

  Team :

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  Github : https://github.com/samansepehri/US-Mass-Shootings

- **Background and Motivation**

In last 50 years, the United States has had over 300 mass shootings that resulted in over 1900 deaths and over 2400 injured. The death tolls and places are different in every case, and the most recent mass shooting in Las Vegas had more than 500 victims, a very tragic incident with an uncommonly high number of victims. We believe that knowing more about the details of these incidents is of interest to many people like ourselves, who are currently living in the United States.

- **Project Objectives**

We would like to get some insights about common patterns in past US mass shootings. In particular, some interesting questions we would like to answer and some quantities and patterns we would like to show include:

- Number of people killed and injured per year
- Visualize the location of the incidents on a US map
- Are these incidents more common in some states than others?
- Is there a correlation between number of people killed and injured in an incident?
- Are these incidents more common in certain months or days of the week?

- **Data**

Our main data source is www.kaggle.com, which provides a CSV file with information of US mass shootings since 1966.
URL: https://www.kaggle.com/zusmani/us-mass-shootings-last-50-years/data

- **Data Processing**

The data requires some processing to be used in our visualization. There is no “state” column in the data set, but it can be extracted from the “location”. There is no longitude and latitude in the dataset, but we can get the city where the mass-shooting happened, so that we can use that to locate positions on map. The “date” column is a simple string, which is not appropriate for certain comparisons and analyses we want to do. We will extract the year, month and date from this column. Since we also want to analyze patterns about days of the week, we will need to extend the data with the corresponding day of the week in which each incident happened. We also need certain

aggregate quantities, such as number of victims per state and total number of victims per year, which are not directly included in the data set. We will either pre-compute some of these values or compute them on the fly with JavaScript.

- **Visualization Design**

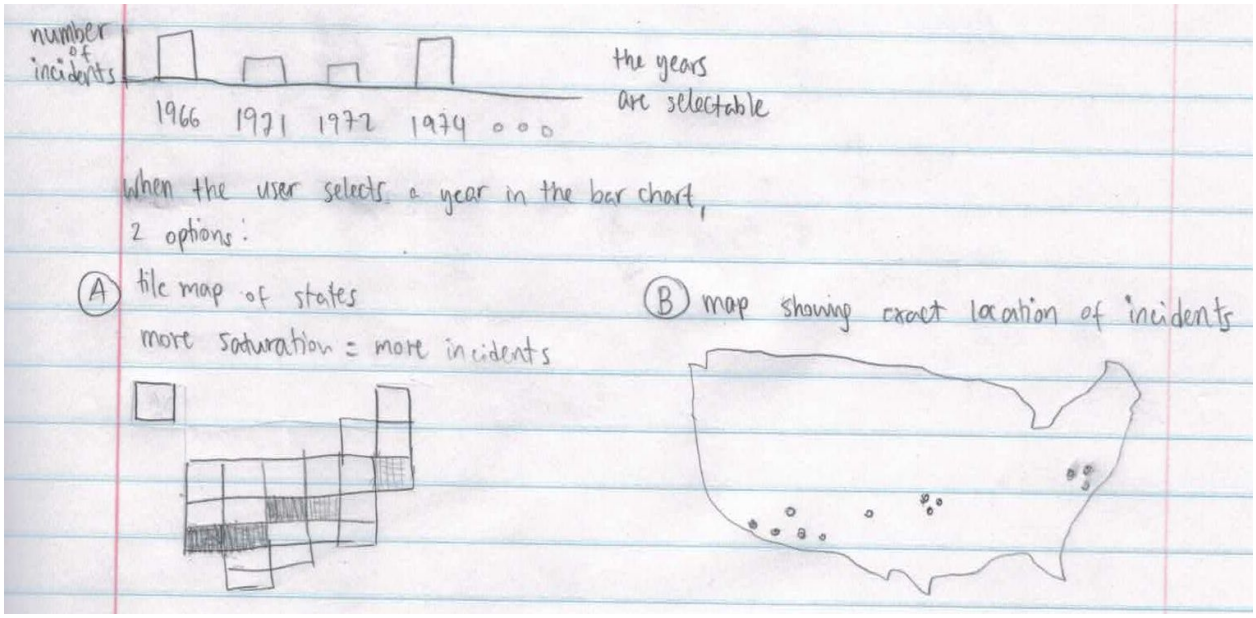
We guide our design by the general rule “overview first, zoom and filter, then details on demand”. The following sections describe some proposals to achieve an effective visualization following this idea.

Overview by year and location

We propose that the initial state of the visualization show a bar chart with the total number of incidents per year. The years are selectable. When the user selects a year from the bar chart, the visualization is updated with a map that shows more information about the selected year. Allowing the user to select more than one year might also be a useful addition.

We propose two options for the map:

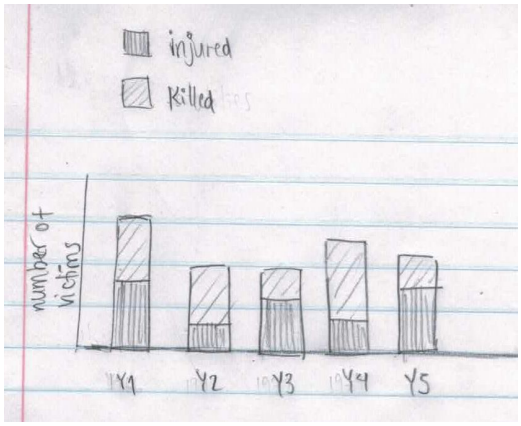
A. A tile map that shows each state and uses saturation as the channel to indicate the number of incidents.
B. A more traditional US map that shows the exact location of the incidents.



We believe both map options are valuable in different cases. Map A is useful for a quick overview of the number of incidents per state. Map B shows more detailed information of the locations and allows nice zoom and filtering, which is especially useful if most incidents

happened in the same state. One important thing to note is that some incidents in our data set do not have exact location information available, so for some years in which exact location information is scarce, Map A might be more appropriate.

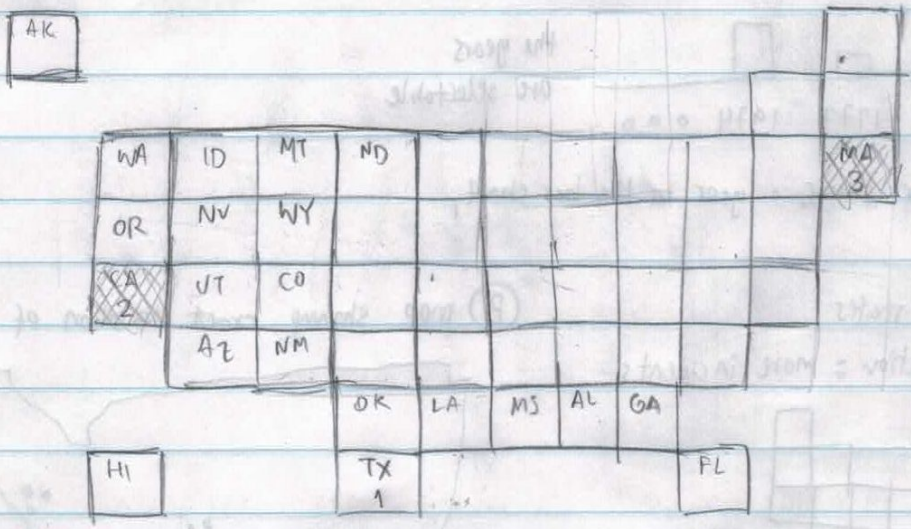
Another interesting alternative for an overview of the data per year is a bar chart of the number of victims, where each bar has two components: injured and killed, as shown in the following chart. In some cases, visualizing the total number of victims per year provides interesting insights that are absent in a chart of total number of incidents. For example, one single incident in 2017 had more than 500 victims, and the number of victims per year is often less than 50.



Filtering and details

Each map alternative proposed in the previous section provides different ways to filter the data and get more information about specific incidents.

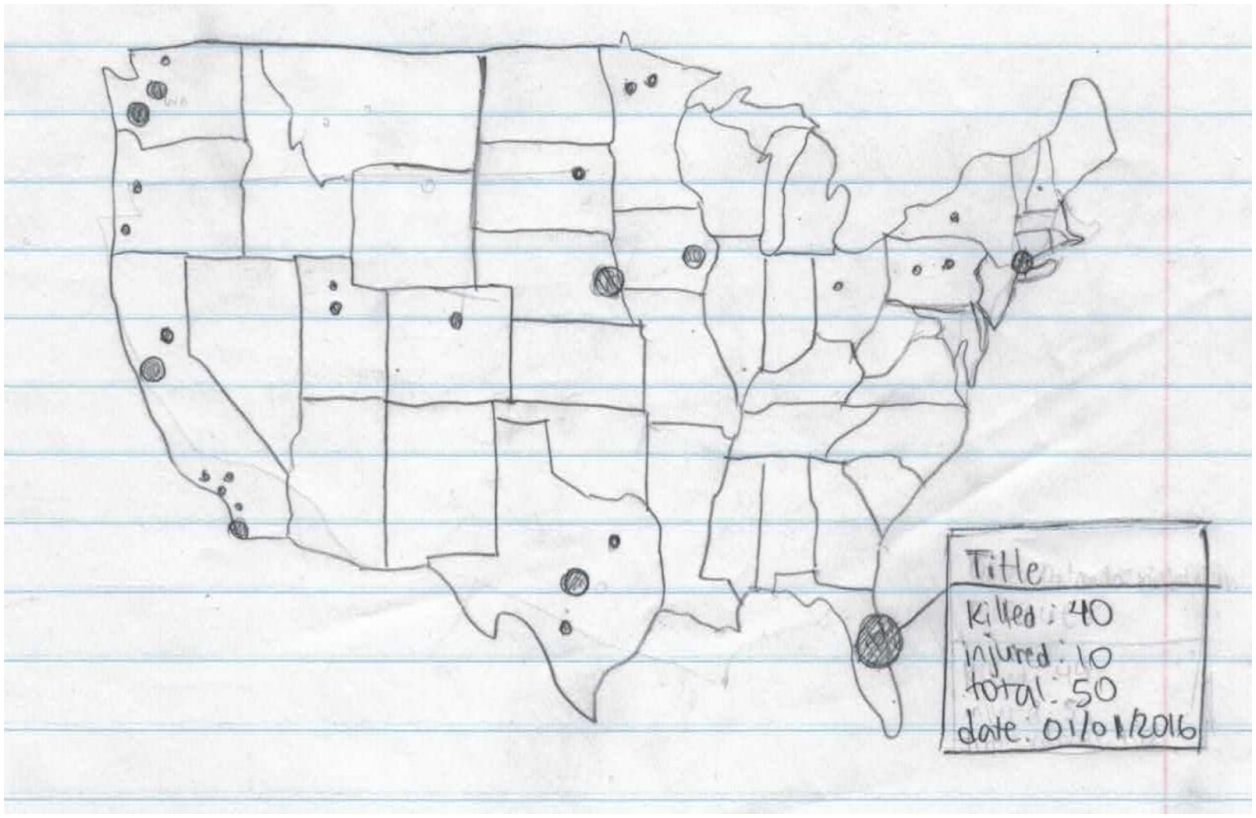
Map A: The user can select states from the tile map, which in turn displays a table of detailed information of the incidents in the selected states.



Selected States: CA, MA

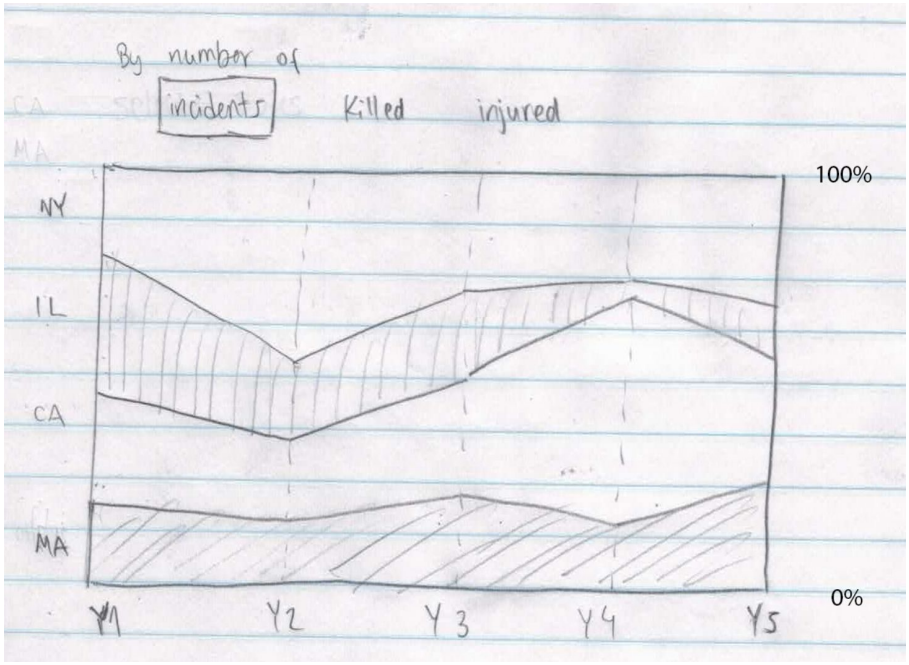
Title	Location	Date	Fatalities	Injured	...
title 1	San Bernardino, California	01/01/2016	1	5	
title 2	San Bernardino, California	02/02/2016	2	4	
title 3	Boston, Massachusetts	03/03/2016	3	3	...
title 4	Chelsea, Massachusetts	04/04/2016	4	2	
title 5	Boston, Massachusetts	05/05/2016	5	1	

Map B: This map uses circles as marks for each incident. The size of the circle can be used as a channel to encode a relevant criterion such as number of victims, and the position of the circle can be used as a channel to encode the city where the incident happened. When the user points to a circle, a tooltip with detailed information is shown.



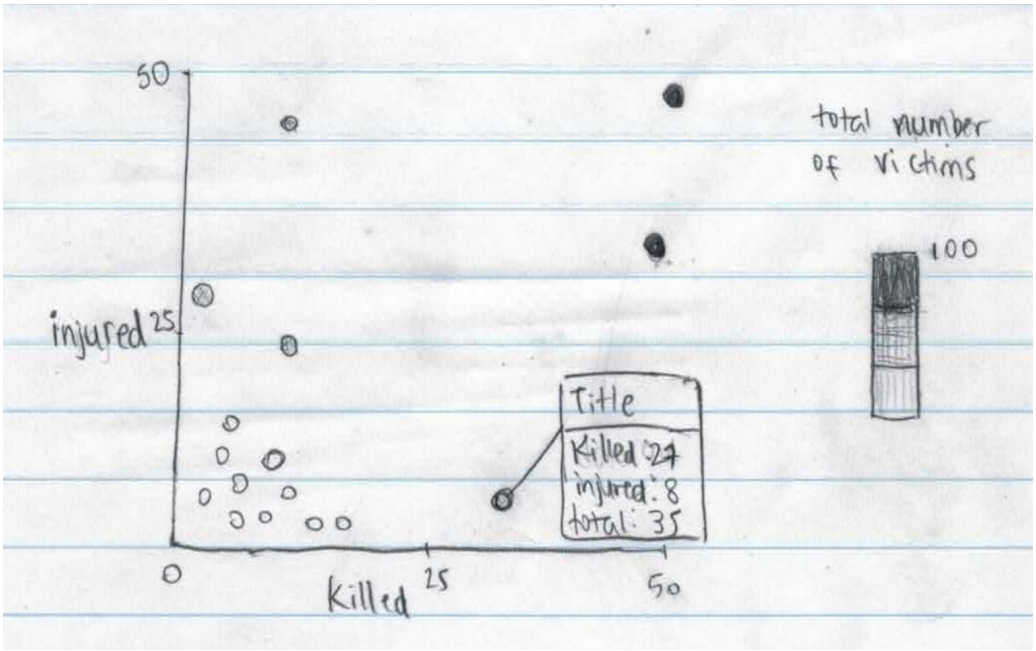
Comparison of changes over time in different states

We also want to get some insights about changes over time for different states. One alternative to achieve that is with a graph like the following, which shows the percentage of incidents in different years for different states. Other quantities of interest that could use the same type of graph are the number of people injured, killed and total victims. This type of graph is useful for our data because in some cases, plotting absolute values is not be the best choice. For example, one incident in 2017 had 585 victims, and the number of victims in one year is often less than 50. Comparing percentages is more appropriate for cases like this.



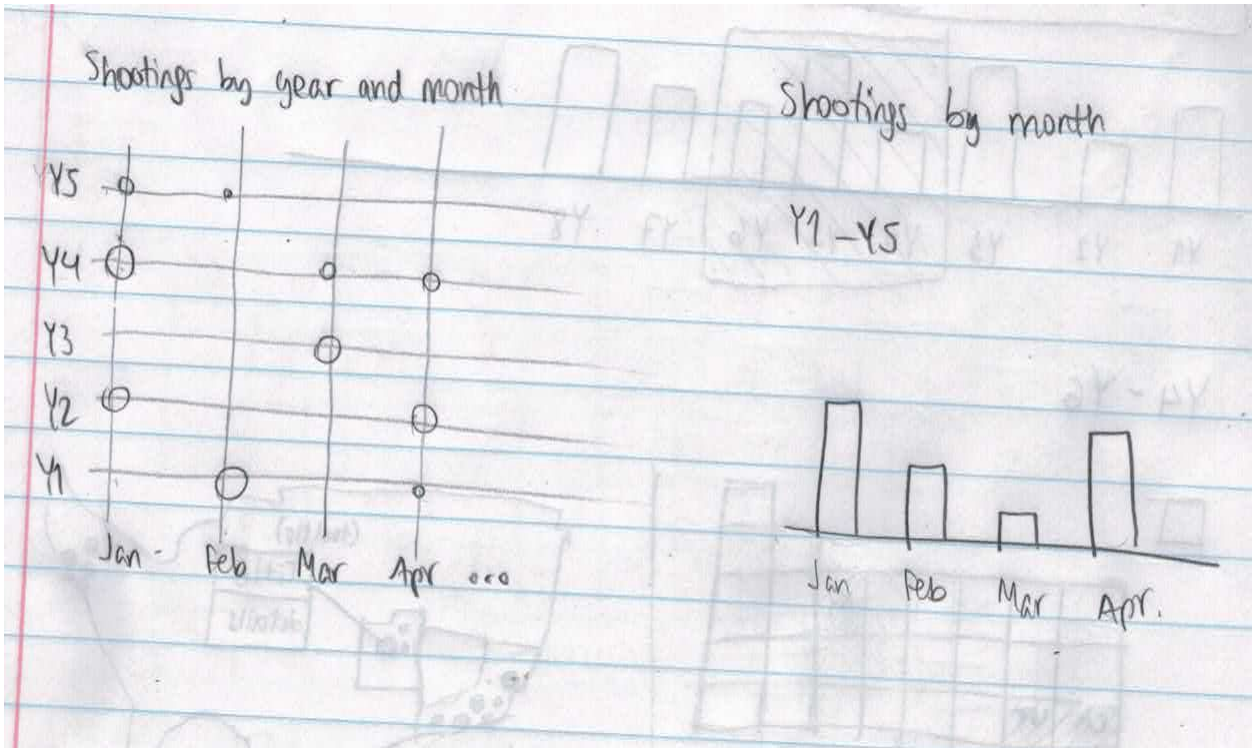
Correlation killed - injured

It would also be interesting to get some insights about correlations between number of people injured and killed in each incident, for which we propose a scatter plot. As shown in the following plot, each point corresponds to an incident and the color encodes the total number of victims. A tooltip is also available when the user points to an incident.



Patterns per month and day of the week

To analyze if some months or days of the week are more common for these incidents, we propose two alternatives shown in the following figures. One alternative is to show circles of different size (proportional to the number of incidents) for each combination of year - month and year - day of the week (the graph only shows months, but the same design applies to days of the week) in a grid-like arrangement. The other alternative is a bar chart by month (and day of the week), which provides a more concise representation, but the information per year is lost.

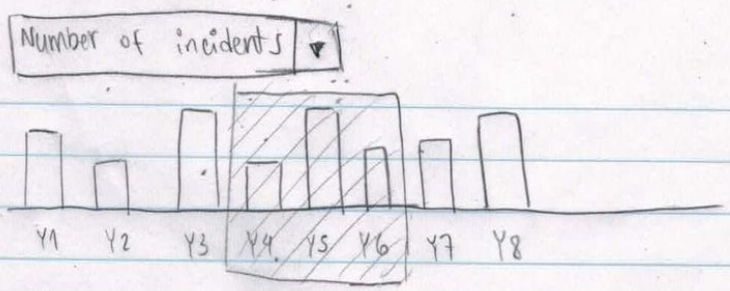


Proposed interactive visualization incorporating previous designs

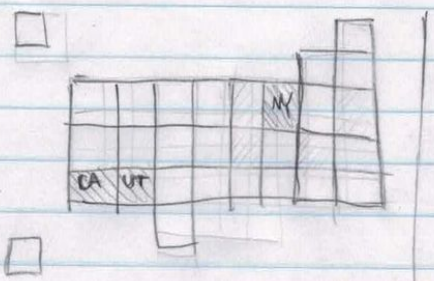
The initial state of the visualization is an overview bar chart by years. The next level is to display a map for the selected years. The next level allows the user even more filtering, depending on the type of map (option A or B).

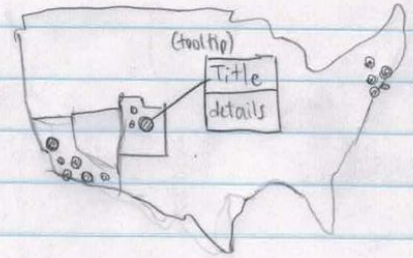
In addition, the visualization displays a comparison between different states and a scatter plot of injured - killed. The visualizations of frequency per month and day of the week are not shown in the following figure due to space limitations, but it should also be included in some part of the layout.

US mass shootings



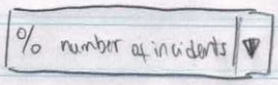
Y4 - Y6

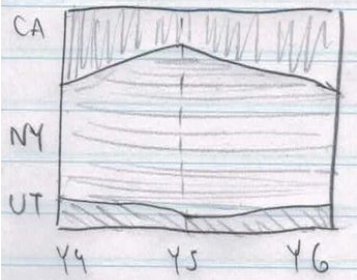




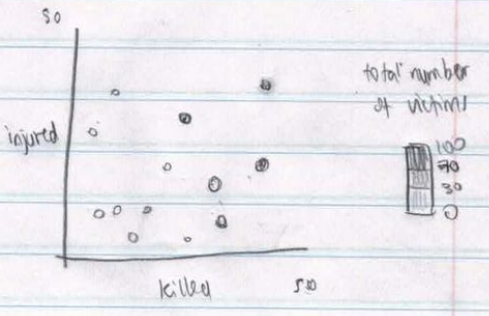
Incidents (Y4 - Y6)

Title	Location	Killed	injured	total	more details...
title 1	Salt Lake City, UT	1	4	5	
title 2	Provo, UT	2	3	5	more details...
title 3	Los Angeles, CA	3	2	5	
title 4	San Francisco, CA	4	1	5	





Scatter plot



- **Must-have features**

  - Overview bar chart per year (either number of incidents or number of victims)
  - At least one map from the proposed options
  - The map must be updated to show information about the selected year
  - Table of incidents
  - At least one graph that compares some quantity (such as incidents or victims) between states.
  - Scatter plot killed - injured
  - Visualization of frequency by month and day of the week (at least one of the proposed options)

- **Optional features**

  - Allow the user switch between number of incidents and number of victims in the overview bar chart
  - Allow the user switch between different map options (tile map and geographical map) or show them side to side
  - Allow the user select more than one year
  - Allow the user switch between different comparisons (such as incidents or victims) between states
  - Allow the user rearrange the layout
  - Make the table of incidents sortable by column
  - Allow the user switch between different visualization alternatives for frequency by month and day of the week.

- **Project Schedule**

Action Points	Oct	Nov				Dec
	Oct 28	Week 1	Week 2	Week 3	Week 4	Dec 1
Project Proposal	■					
Data processing		■				
Bar chart by year		■				
Table of incidents		■				
Map		■	■	■		
Project milestone			■			
Comparison between states				■	■	
Frequency by month and day				■		
Scatter plot				■		
Tweak interactivity				■	■	
Optional features					■	
Final submission						■

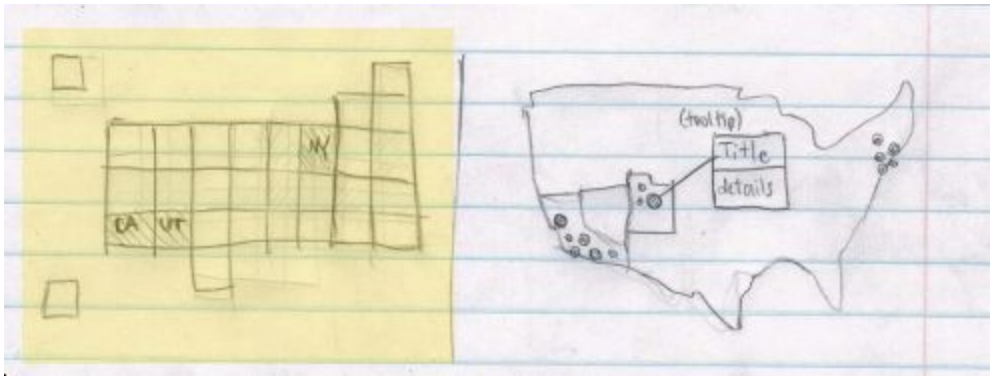
- **Data processing**

In order to get the correct location for each incident, we had to process the rows in the CSV file and add another attribute to specify the state names (abbreviations). There was some missing information for some entries. For example, some rows did not have (lat, long) information. Besides, the location values for different rows were not consistent. Some of them had only the name of the town or city as the location. We also had to remove 4 corrupted rows from the original data set because the number of fields did not match the number of fields of the data set and they missed some important information such as location, date and number of victims.

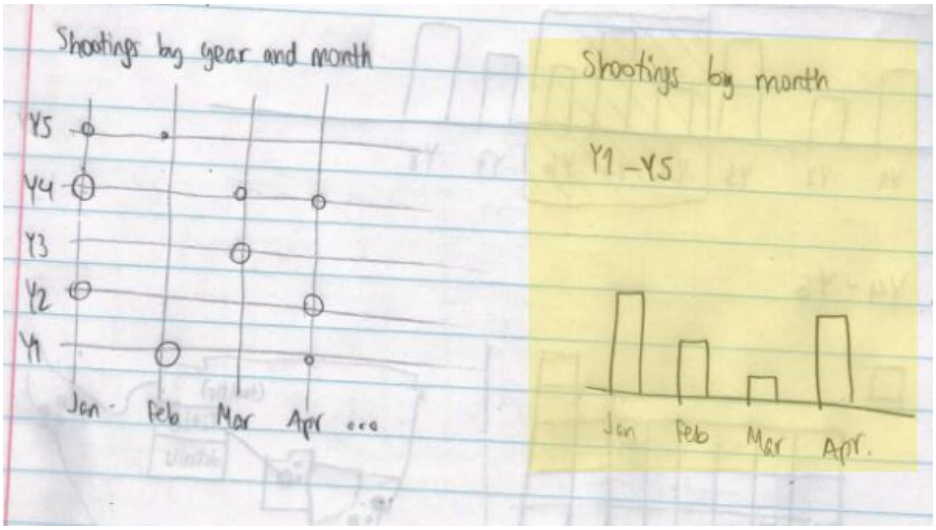
The format of the date field in our original CSV file is “mm/dd/yyyy”. Since one of our charts is a bar chart of frequency by day of the week, we parsed the date of each row and computed the corresponding day of the week to extend the data set. Parsing the date was also necessary for our main bar chart by year. Finally, to get the list of states with their positions in our tile map (row and column) we used the 2012 election CSV files we had from HW6.

- **Peer review**

Feedback from other people helped us decide to choose between different options we designed in our original proposal. From the feedback we got from the peer review in class, and also from talking to the teaching assistant, we decided that the tile map would be a better option to visualize the location of the incidents (highlighted in yellow below), since it is more concise and showing the exact location of the incidents on a geographical map does not add much value.



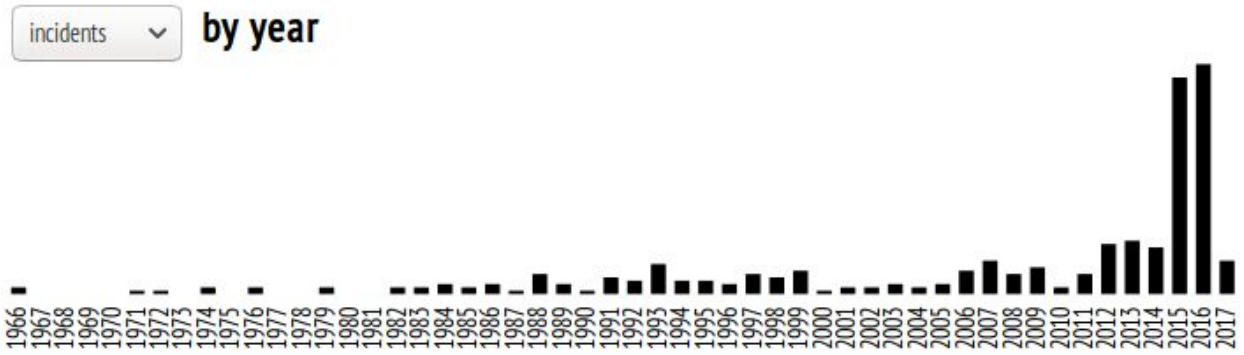
Thanks to the external feedback, we also realized that from the two options we proposed for visualizing trends by month / day, the bar chart (highlighted in yellow below) is more concise and useful, which is the option we decided to implement in our first prototype.



- **Prototype implementation for first milestone**

Bart chart by year

Following our proposal, the first visualization in our prototype is a bar chart of the number of incidents per year. We decided to rotate the year labels by 90 degrees to save space and be able to show all the years. A selection menu is available to switch between different criteria. For example, the figure below shows the number of incidents per year, but the interface allows switching to other criteria such as number of people injured, killed and total victims.



Tile map with information per state

Our prototype also includes a tile map that displays quantities (number of incidents, people injured, killed) per state, as shown below.

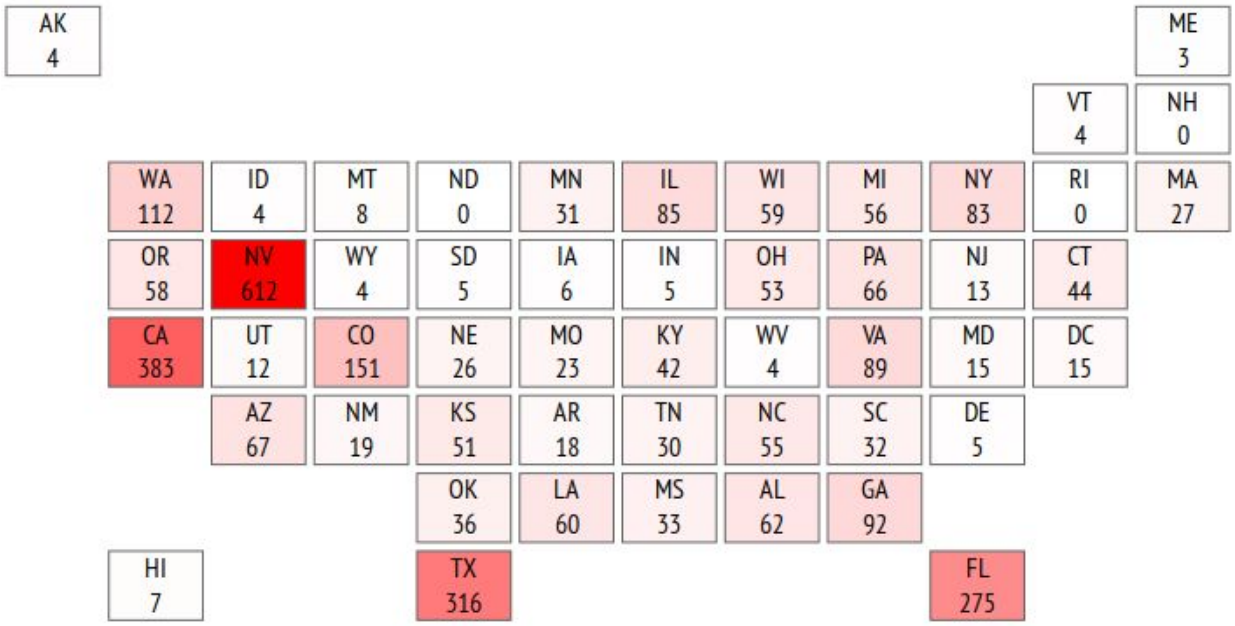


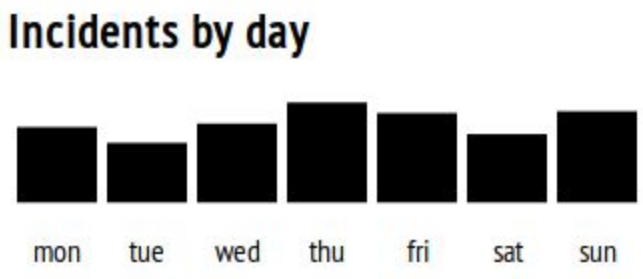
Table of incidents

Our first prototype also has an implementation of a table of incidents. In the final version, it would be linked with other views so that the list of incidents can be updated according to the selected years, states, etc.

Title	Date	State	Killed	Injured	Total Victims	Location	Area
Texas church mass shooting	2017/11/05	TX	26	20	46	Sutherland Springs, TX	Church
Walmart shooting in suburban Denver	2017/11/01	CO	3	0	3	Thornton, CO	Wal-Mart
Edgewood businees park shooting	2017/10/18	MD	3	3	6	Edgewood, MD	Remodeling Store
Las Vegas Strip mass shooting	2017/10/01	NV	59	527	586	Las Vegas, NV	Las Vegas Strip Concert outside Mandala Bay
San Francisco UPS shooting	2017/06/14	CA	3	2	5	San Francisco, CA	UPS facility
Pennsylvania supermarket shooting	2017/06/07	PA	3	0	3	Tunkhannock, PA	Weis grocery
Florida awning manufacturer shooting	2017/06/05	FL	5	0	5	Orlando, Florida	manufacturer Fiamma Inc.
Rural Ohio nursing home shooting	2017/05/12	OH	3	0	3	Kirkersville, Ohio	a nursing home
Fresno downtown shooting	2017/04/18	CA	3	0	3	Fresno, California	a street in downtown
Fort Lauderdale airport shooting	2017/01/06	FL	5	6	11	Fort Lauderdale, Florida	baggage claim area of the airport

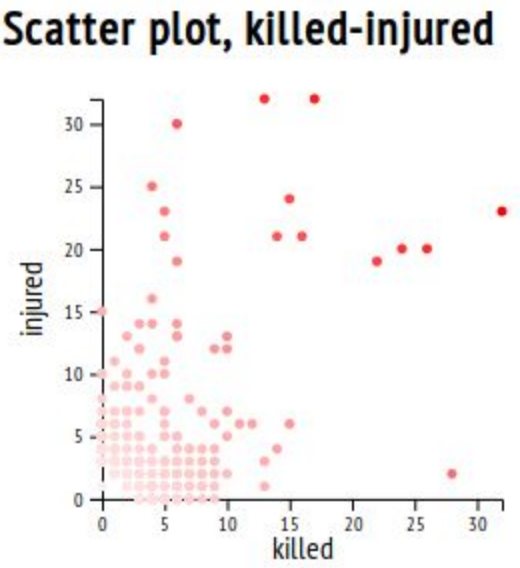
Incidents by day

We also implemented the functionality required to compute and display quantities (such as number of incidents) by day of the week, as shown below.



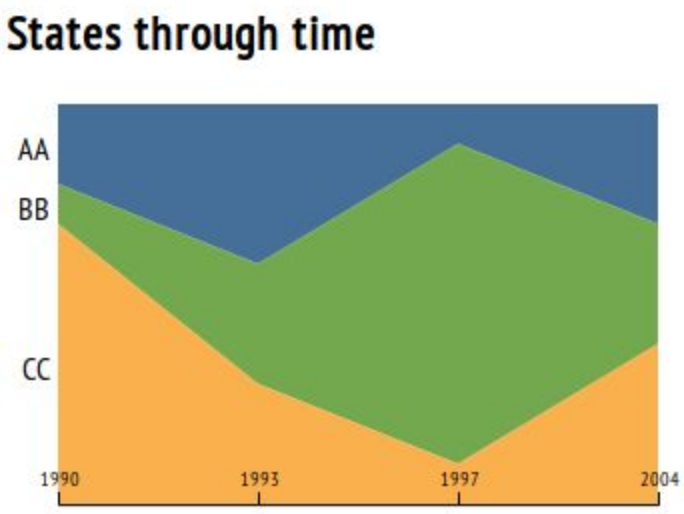
Scatter plot killed-injured

As designed in the original proposal, we also implemented the scatter plot killed-injured for our first prototype, as shown below. Each circle represents an incident and the saturation is proportional to the number of total victims.

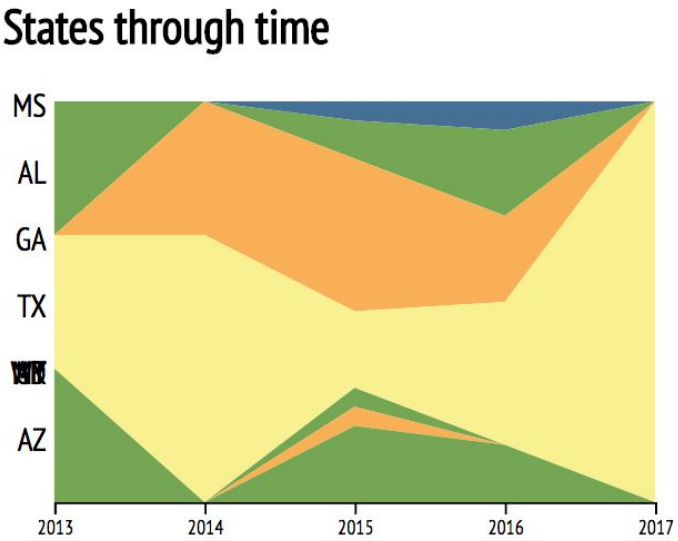


Comparison of states through time

The following is a sample of the implemented prototype using fictitious data for the graph we designed for the initial proposal to compare the percentage of incidents in different states for different years. For each year, each state has a fraction of the vertical space that represents the percentage of incidents associated to that state from the total number of incidents during that year in the selected states. The example below compares three states over four years.



Although this seemed like a reasonable representation at first, we found some issues when using numbers from our real data set. It is not uncommon for a state to have zero incidents in many years, which causes undesired overlaps and breaks the effect of continuity, as seen in the example below.



We will consider other designs, such as line charts, which might produce a better visual result.