Project Final Report

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Project Title: World Epic Earthquake Visualization
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Please Read this gist for Detailed Description of Our Project
https://gist.github.com/kminamisawa/98ef077e218f3a7d8845029b43770b26

Overview and Goals of the Project
The purpose of this project is to assist analyzing the trend of the earthquakes by visualizing them. There is a number of earthquakes happening every day around the world. The location and the magnitude of earthquake differ from earthquake to earthquake, and some of them cause major damages. To minimize the damage from the earthquake, it is important to analyze the trend of the earthquakes and predict the future earthquakes.

The goal of the were the following:

1. Each circle represents an earthquake based on the location and the magnitude of the earthquake. The radius increases as the magnitude of the earthquake increases.
2. Each circle is placed onto the map based on the location of the earthquake.
3. Multiple earthquakes can be visualized on the map at the same time.
4. Earthquakes are visualized in chronological order. The final result will be like a time-lapse of earthquakes in the past few years.

Background and Related Work
We have spent hours looking for the best solution to render the map in a way we would like to use. We have come to a conclusion that Plotly provides the best solution for our project needs. Plotly is an open source project, and its Python graphing library allows us to create interactive, publication-quality graphs. Their API (https://plot.ly/python/) as well as examples were very helpful. The followings are the official examples from plotly that we have referenced:

Offline usage of plotly: https://plot.ly/python/offline/
Dropdown menus: https://plot.ly/python/dropdowns/
Intro to Animation: https://plot.ly/python/animations/

We have also used various references to search syntax of panda library and PyQt.

Description of the project

The data we have used is from United States Geological Survey (USGS.) USGS is a scientific agency of the United States government. USGS has earthquake information available to the public at https://earthquake.usgs.gov/earthquakes/search/. Our program fetches the data from USGS every time the application is run. This is because user is allowed to select the range of dates as well as magnitudes, so the data being used may vary from user to user.

One of the question we had was to find the hot spot of the earthquake. The answer is along the coastal line of Pacific ocean. Figure 1 illustrates all earthquakes that are larger than M3 between 2011-03-01 to 2011-06-01.

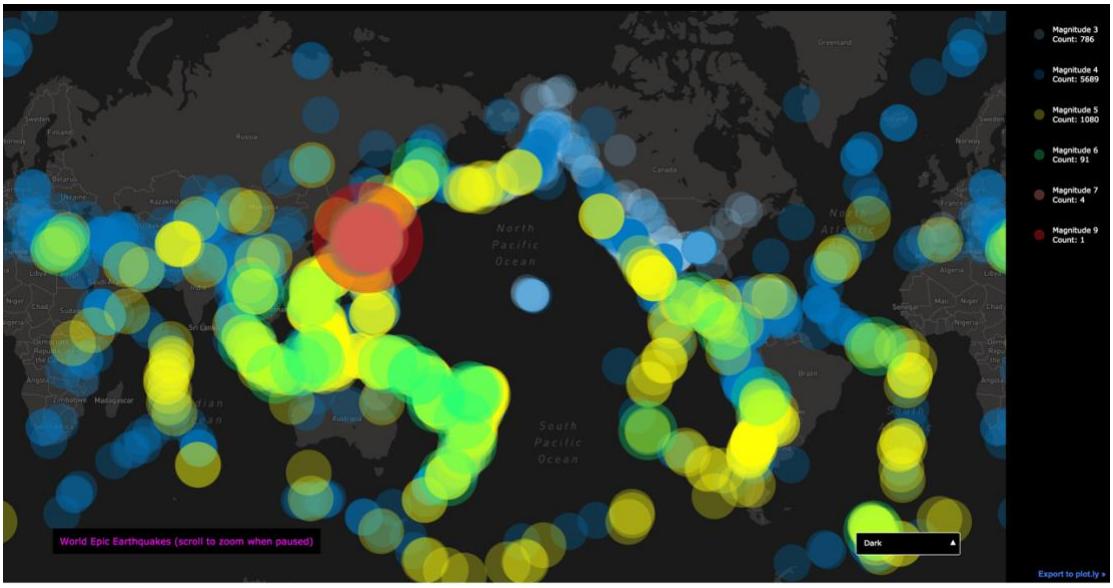

Figure 1

This figure is a little noisy to read the data, so we eliminated small earthquakes. Figure 2 visualizes all earthquake that are bigger than M6 between the same range of dates.

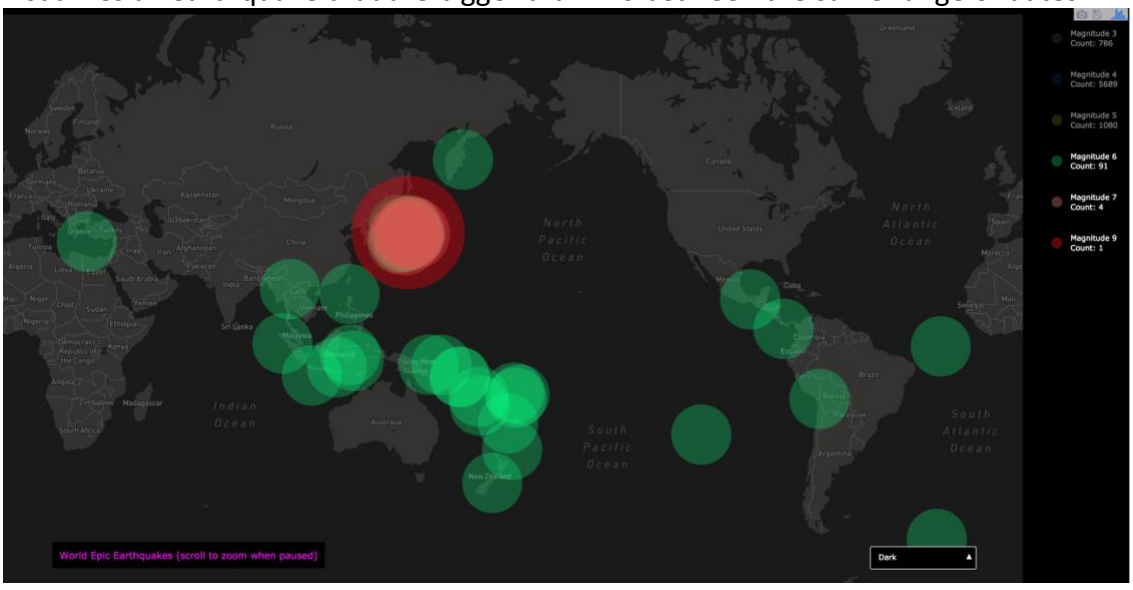

Figure 2

During these three months, almost all larger earthquake occurred along the costal line of Pacific ocean. Japan especially experienced massive earthquake as you can see in figure 3.

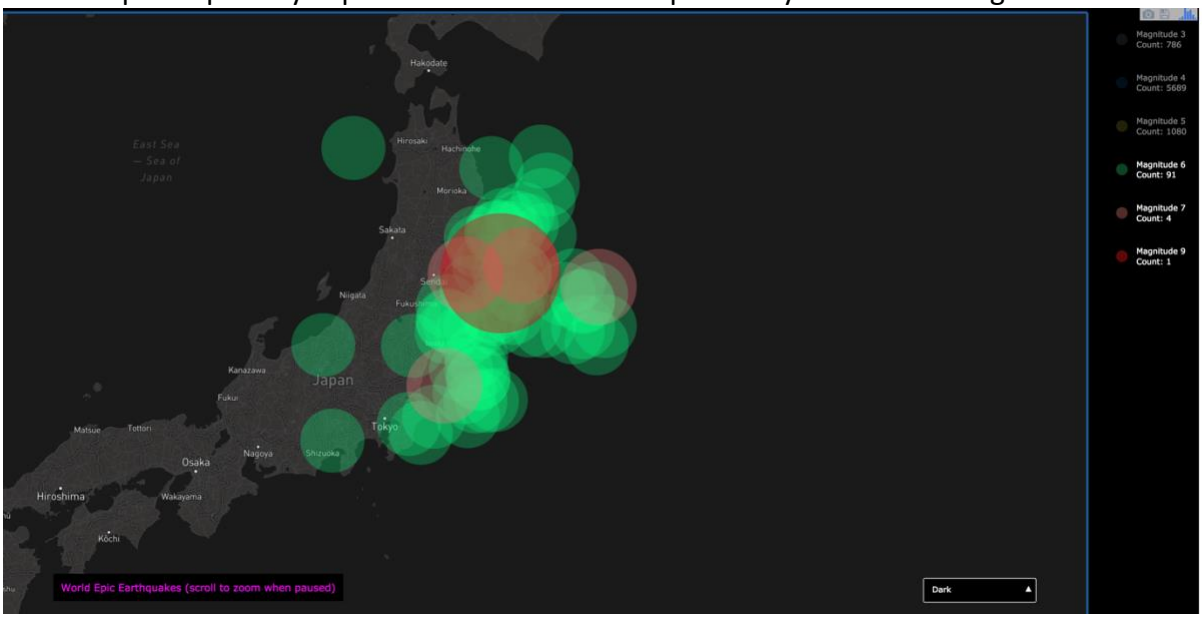

Figure 3

Another question we have answered was to find the trend before/after the massive earthquake. 2011-03-11 is the date when Japan experienced the largest earthquake in the history. Two days before the largest earthquake occurred, there were an unusually high number of earthquake in the same area. After the largest earthquakes hits Japan, there were countless of aftershocks in the same area for months. Please refer to figure 4 to 8 which visualizes earthquakes +/- 2 days from the largest earthquake.

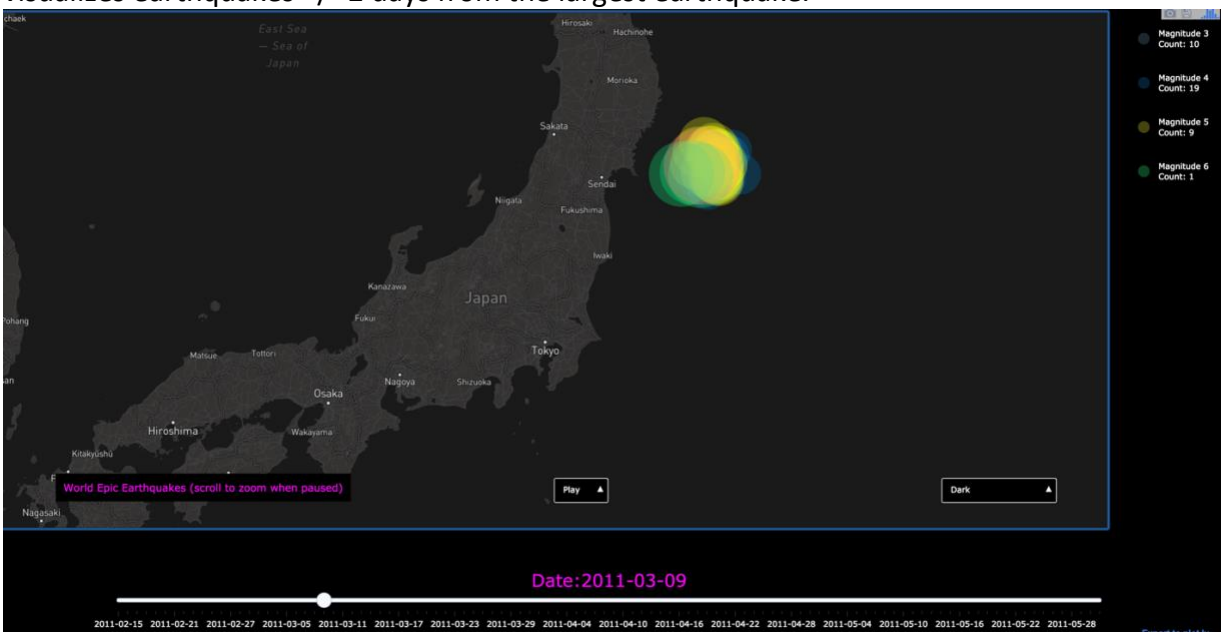

Figure 4

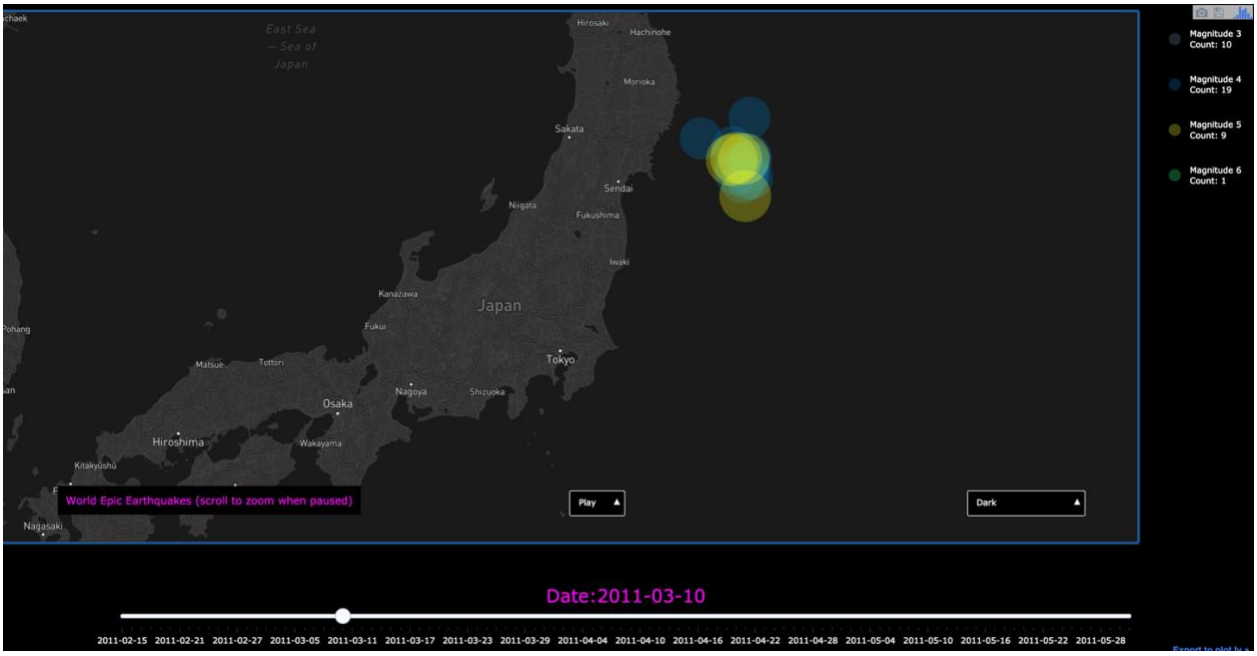

Figure 5

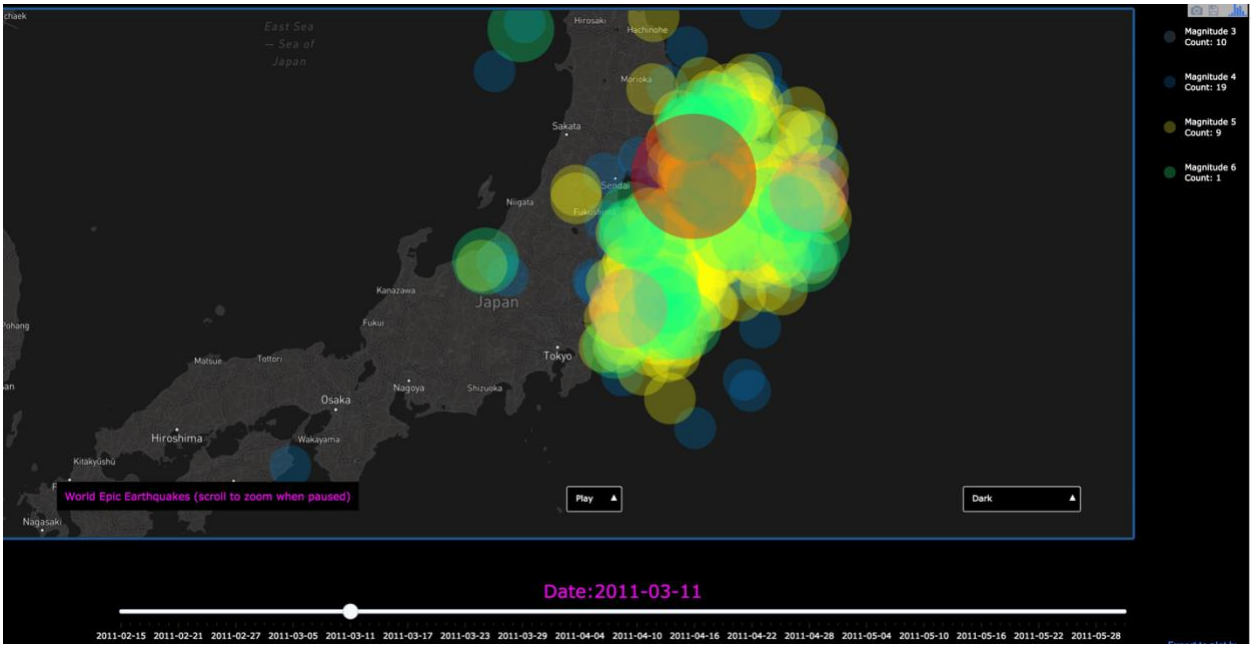

Figure 6

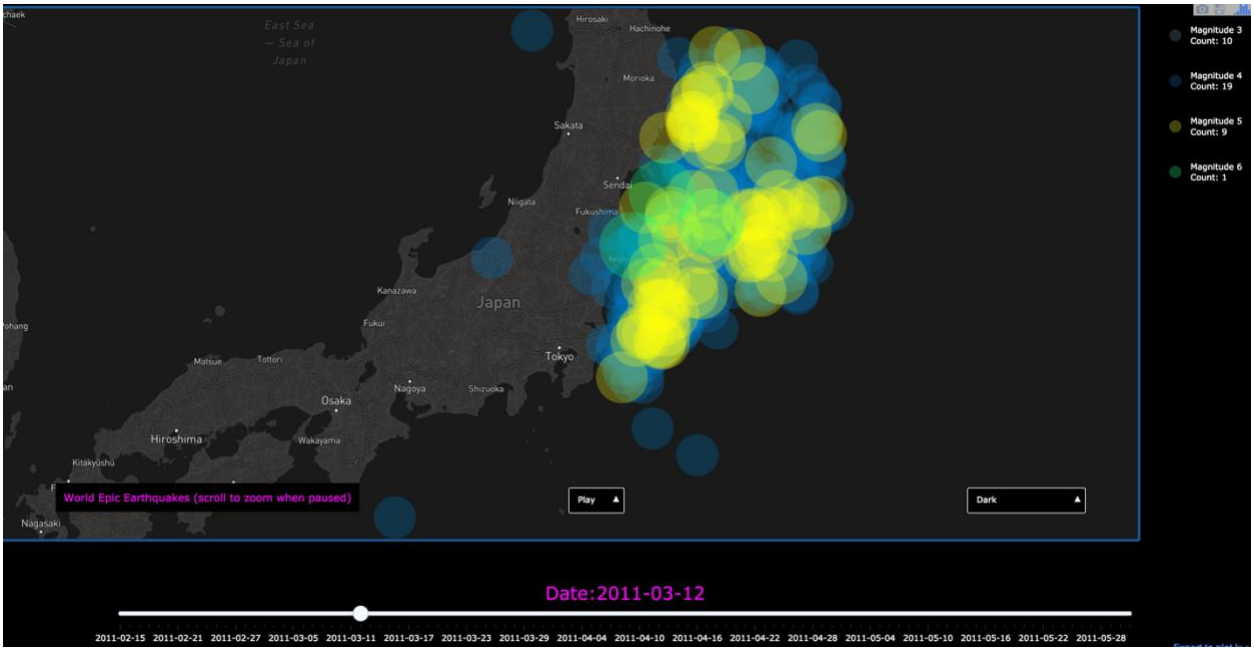

Figure 7

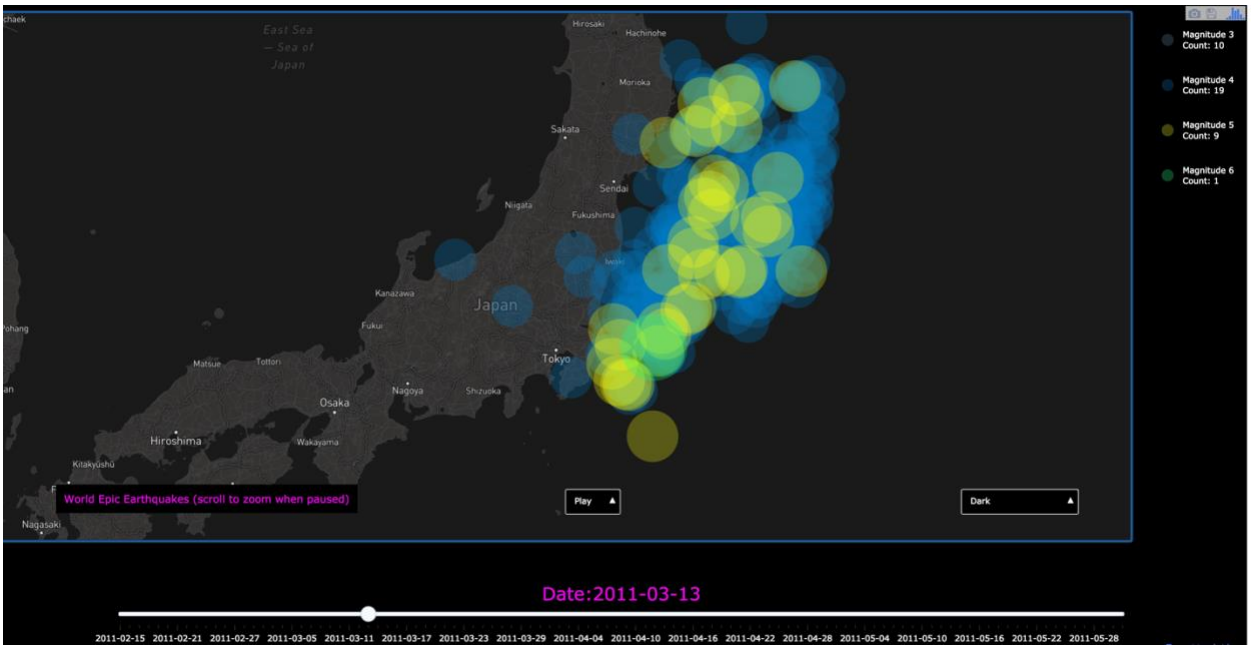

Figure 8

The new question arose throughout the project is the relationship between the depth of earthquake and its impact.

Implementation Details of the Project

Please refer to the gist link on top of the document on how to install the required components and run our application.

Our program makes heavy usage of plotly library. The map is rendered from mapbox. Mapbox is an open source mapping platform for custom designed maps. Our application calls their API from Python code.

Each earthquake is represented by a circle, and its radius and color are scaled by its magnitude. We have grouped every earthquakes into groups, so that earthquakes between M1 and M1.999.. is grouped as M1, earthquakes between M2 to M2.999… as M2 and so on. We can still see the exact magnitude of each earthquake by hovering over to the specific earthquake.

The animation is done by making a sequence of frames. We were originally going to render earthquakes minute by minute, but it significantly sacrificed the performance of our program. This is because there are too many earthquakes happening every day, and the number of frames exceeded the capacity of our animation method. Therefore, we have decided to render the earthquake day by day, and it comfortably animates the earthquakes.

The slide bar on the bottom interact with the animation, and the user may rewind/skip the animation. The slide bar is made of sliders component on Plotly.

Difference from the Description in the Design Document

We have met all of the goals on the design documents and successfully completed the project. We can say the outcome was more than our initial expectation on interactivity with user and the cleanliness of the visualization. This is largely due to the plotly library. We have heard about plotly library before, but it was our first time to use it. Their library allowed us to visualize earthquakes with interactive control of map and rich details.

Evaluate the Project

We can say our project was very successful. The strength of our program is its usability and the controllability. Use may interactively visualize the earthquake with custom range of dates and magnitudes. Another strength is the cleanliness. User may separate earthquakes by their magnitudes, so we can reduce the noise when the data is big.

The weakness of our project is that we were not able to visualize earthquake minute to minute. We are technically able to do so, but it would sacrifice the performance of the program and takes a long time to visualize the earthquakes. Another weakness of the project is that we cannot fetch the data from USGS that are too big. There is no solution for this at this point since USGS limits the size of the files to download.

Additional Comments

Please read the gist (link on the first page) on how to run our program.

Our application requires to install multiple components. If you wish not to install them or have issues installing them, please find HTML files under html folder. These HTML files are pre-generated HTML files from our project, so you can see our result on pre-selected range of dates and magnitudes.