Natural Disasters: Statistics and Earthquake Shockwaves Prediction

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Introduction

Problem Description

- Earthquakes and their impact.
- Earthquake Prediction vs Earthquake Forecasting

Solution

- People need to have more knowledge about natural disasters.
- We decided to help people achieve that goal with our skills.

Overall Description

Objectives

- Analyze natural disasters datasets.
- Use machine learning models to predict earthquake aspects.
- Establish a running web application that combines both of these features.
- Provide interactive map that helps users find what they are looking for faster.

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Challenges

- Dealing with many different datasets and analyzing them all at the same time.
- Exploring the right path for earthquake prediction models.
- Finding the right way to build our database and connecting it properly to our system.
- Transforming all the static design components into a React.js application.
- User authentication process.

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Limitations

- Available API can only provide maximum of 20k records.
- Actual earthquake happening prediction is impossible to be done and we can only predict the earthquakes other attributes and not the exact time.
- Browsers cannot handle rendering more than 15k markers on the map without performance drawbacks.

Design Strategy

Business Goals

- Provide pre-made plots and concluded statistical information about disasters for different users.
- Provide a prediction of the magnitude of an upcoming earthquake.

Stakeholders

- Geology geeks.
- Researchers.
- Governments.

General Tasks

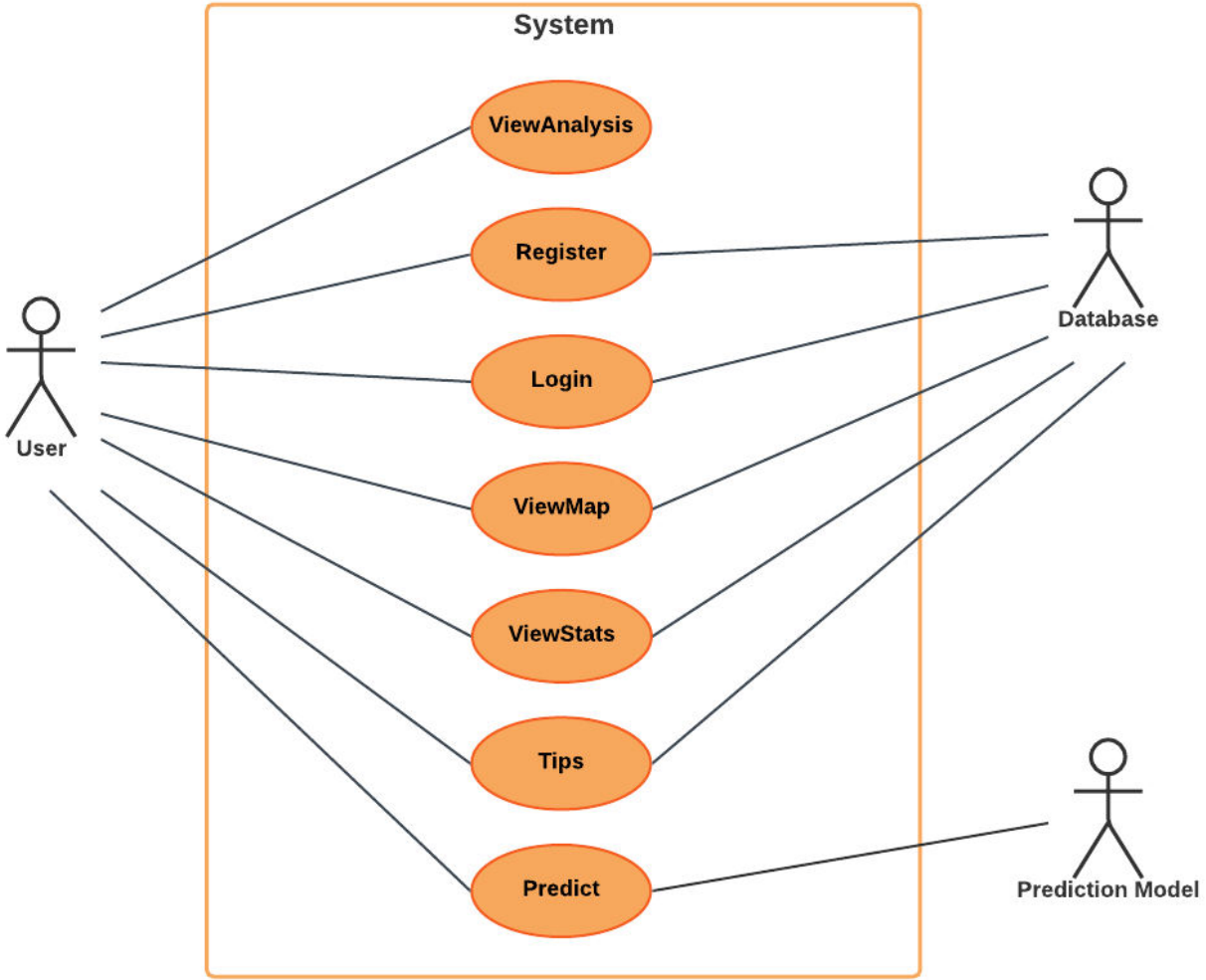
- Show graphs about disasters.
- Interact with the map to see the history of disasters.
- Show the result of our prediction.

Technological Constraints

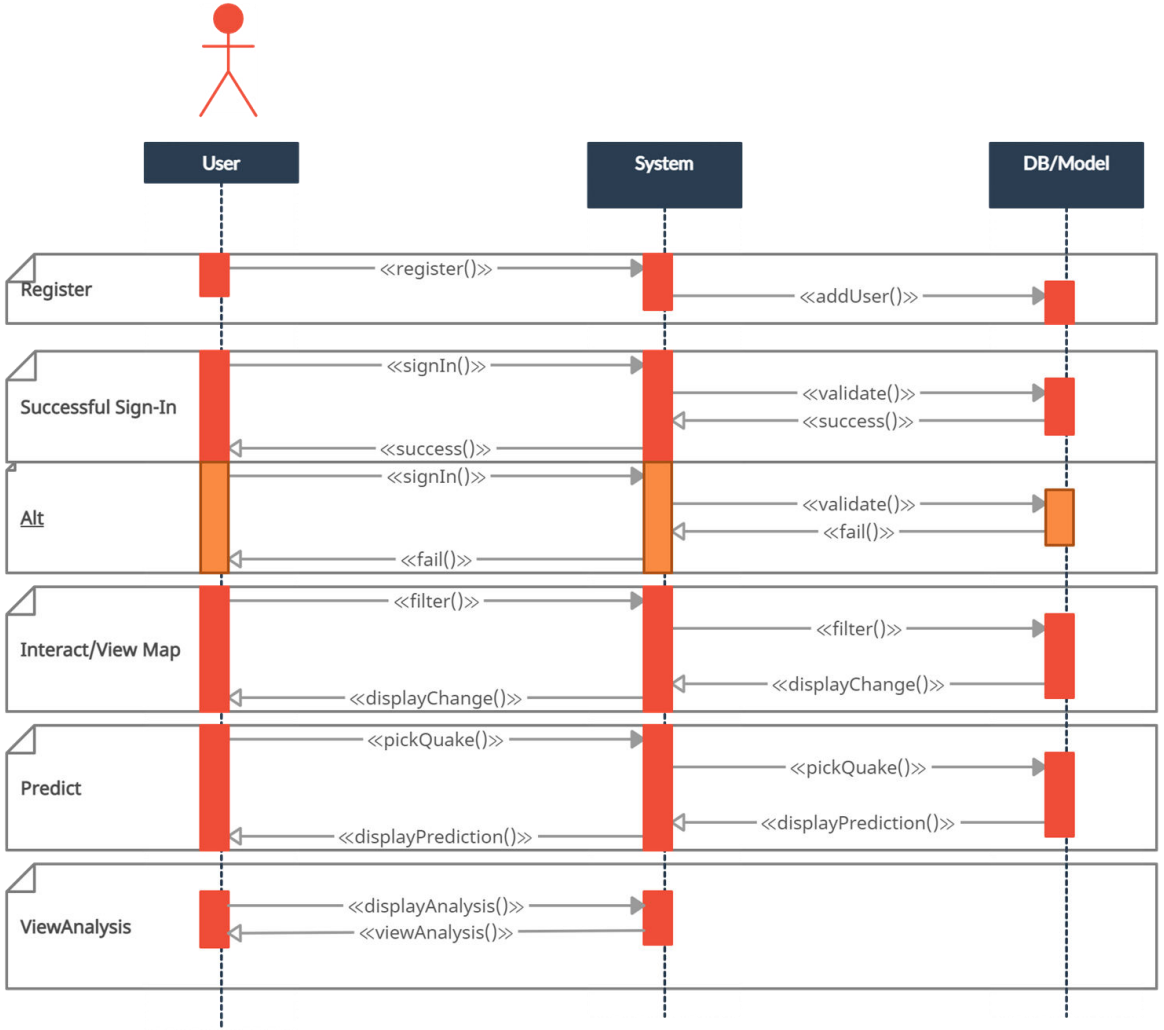
- Should browse from PC.
- Should have an internet connection.

System Design

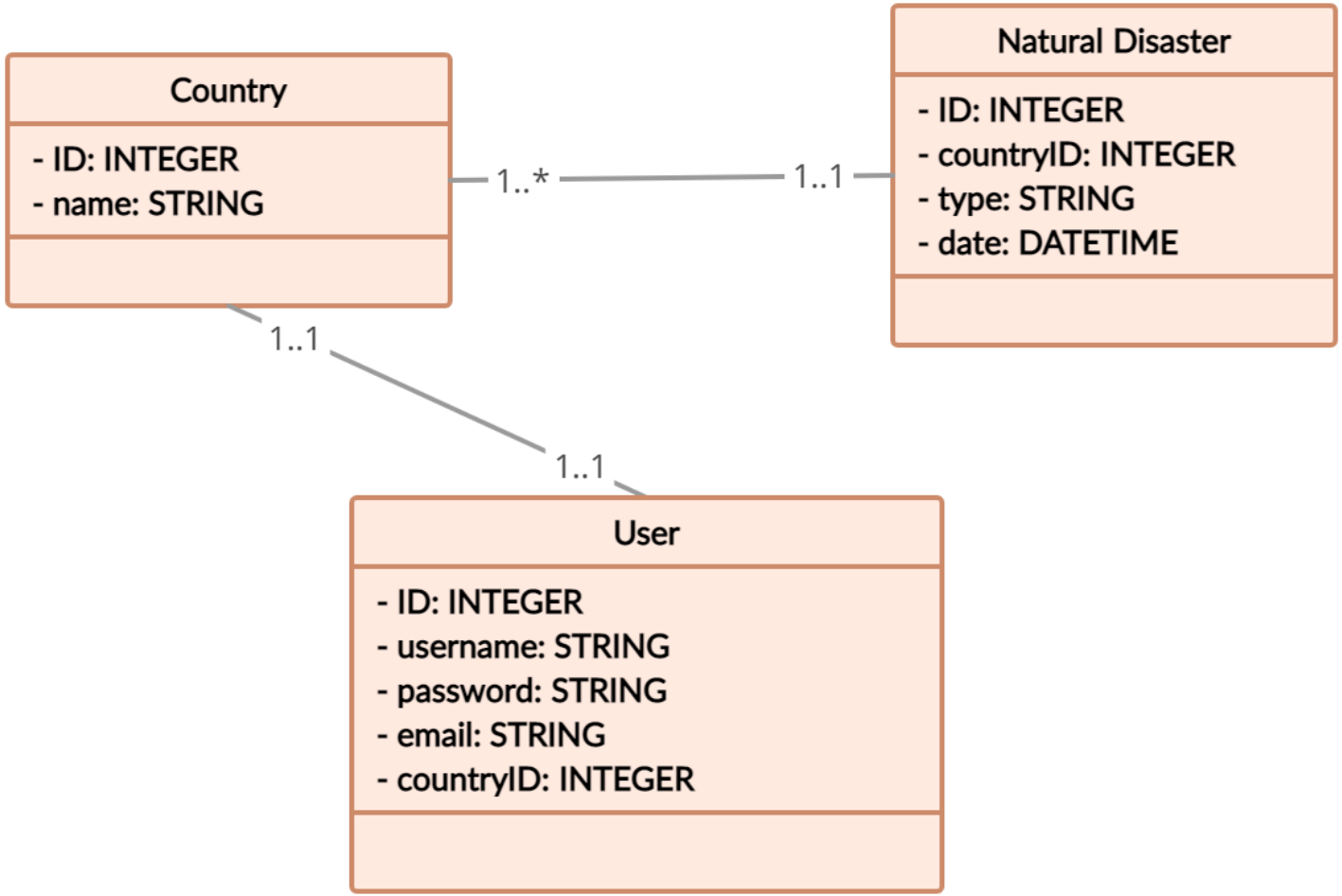
Use-Case Diagram



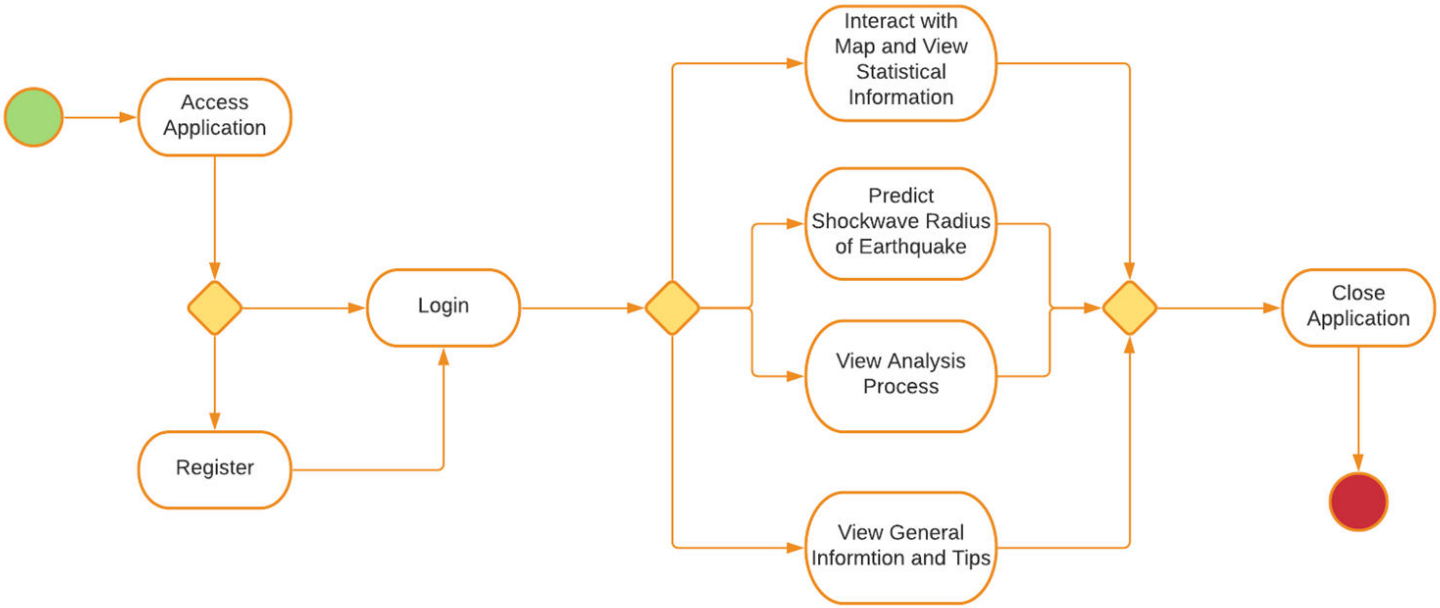
Sequence Diagram



Class Diagram

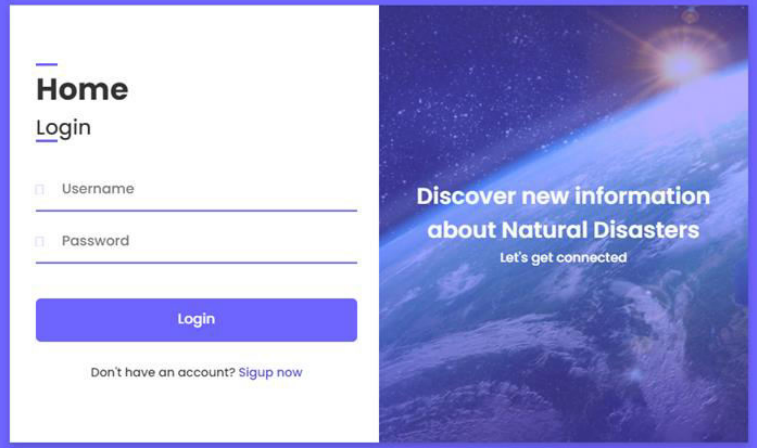


Business Process Model and Notation (BPMN)



Implementation

Sign In/Sign Up



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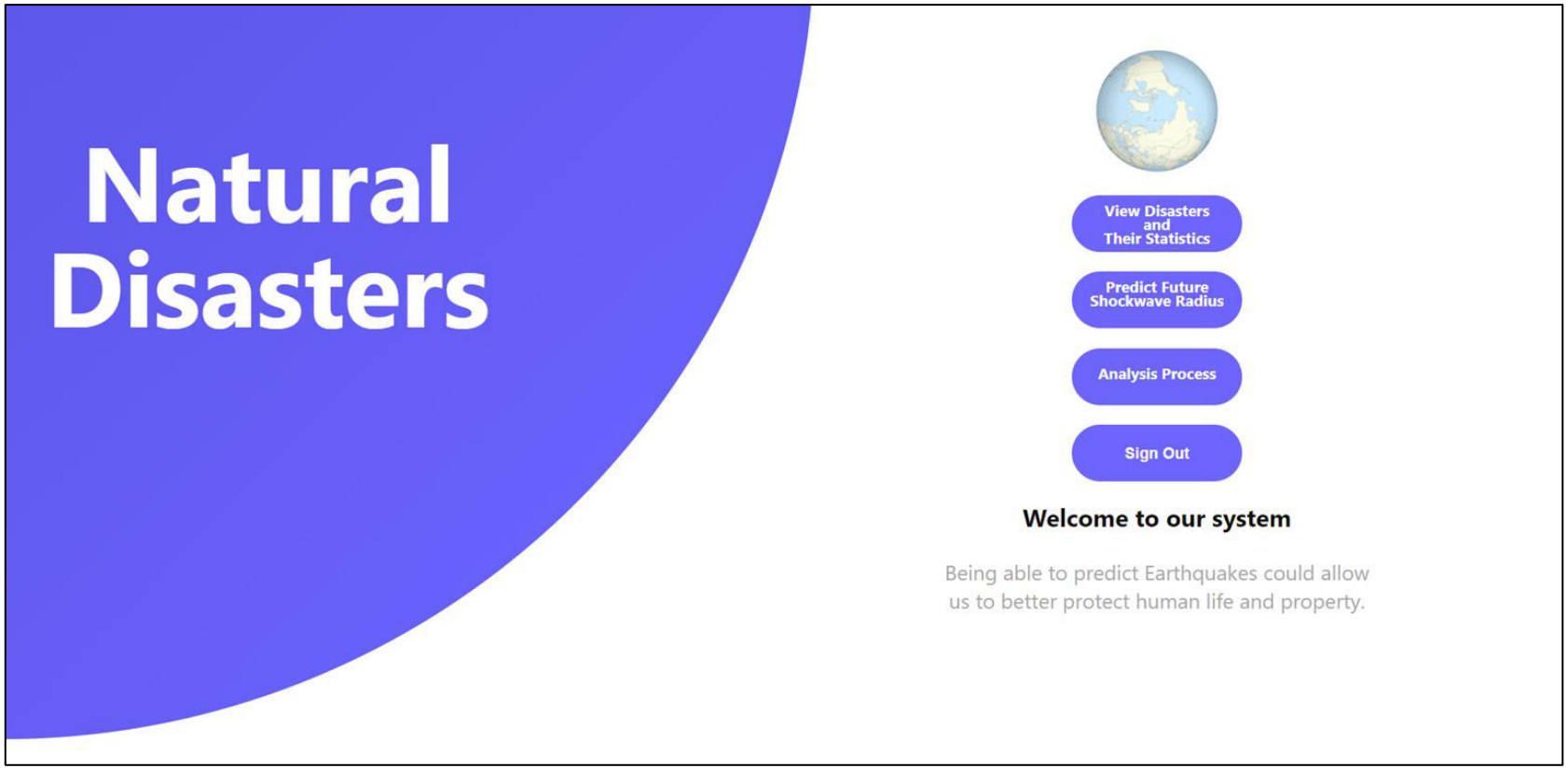
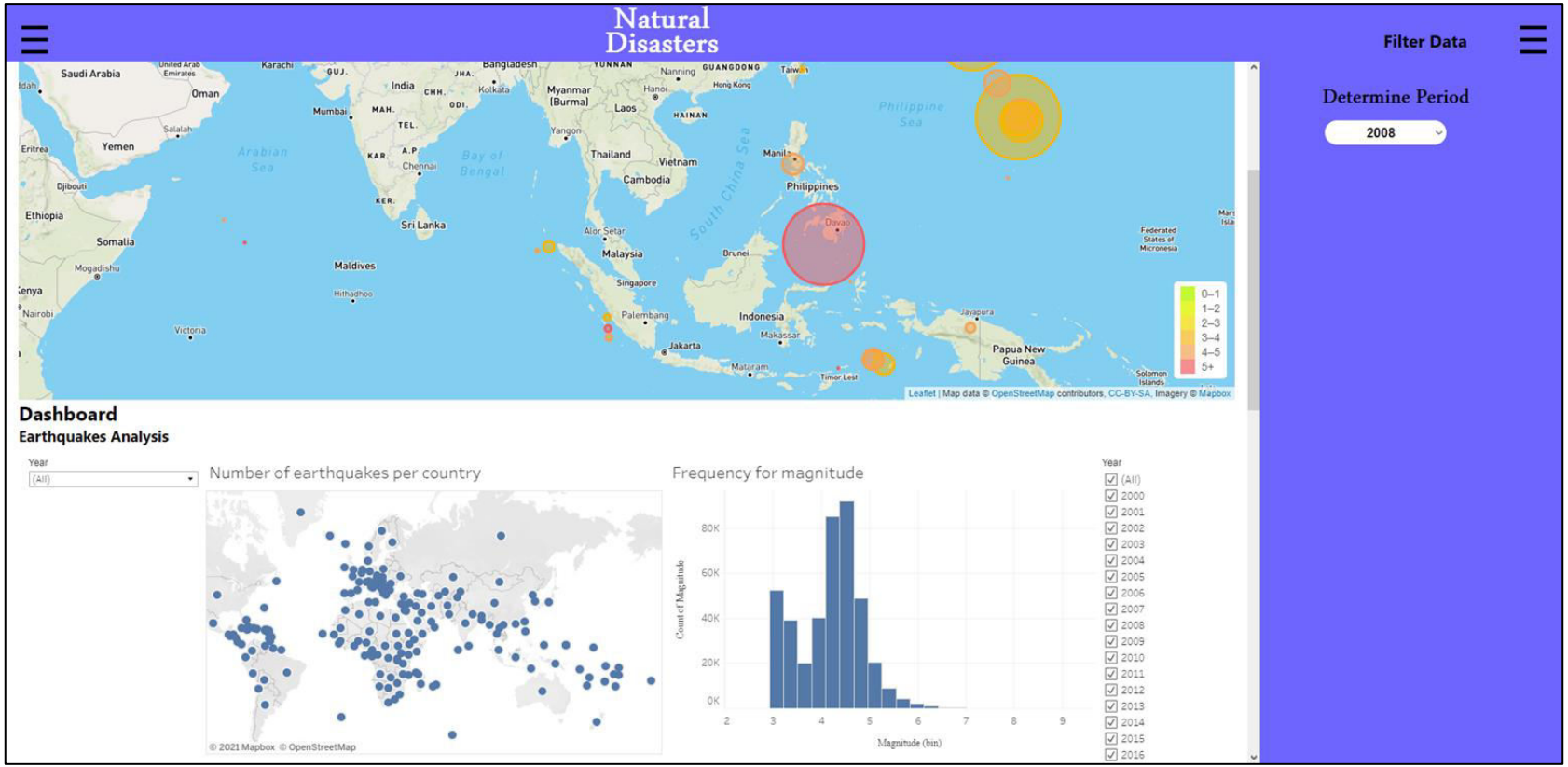
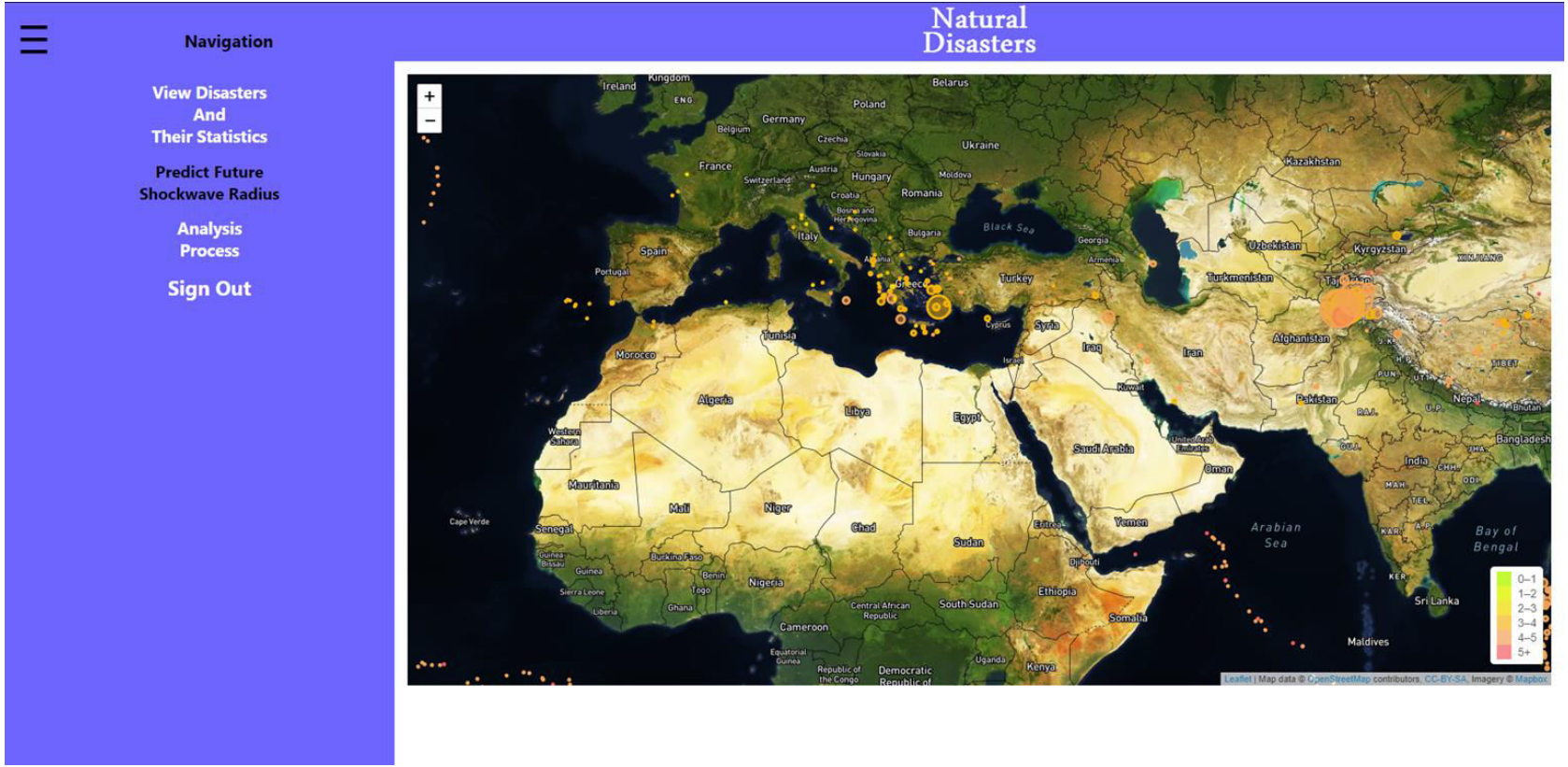
Home


Natural Disasters
View Disasters and Their Statistics
Predict Future Shockwave Radius
Analysis Process
Sign Out
Welcome to our system
Being able to predict Earthquakes could allow us to better protect human life and property.

Interactive Map and Dashboards



Prediction


Navigation
View Disasters And Their Statistics
Predict Future Shockwave Radius
Analysis Process
Sign Out
Natural Disasters
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

Analysis Process

Natural Disasters

(Earthquakes Datasets Exploration)

Preliminary Wrangling

This document is to explore our earthquakes' datasets which contains data from x to y. So, we could explore the patterns and hidden behaviours of earthquakes.

[2]:
```
# import all packages
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sb
import requests
import glob
from geopy.geocoders import Nominatim
from geopy.extra.rate_limiter import RateLimiter
import time
import datetime
import pycountry
import us
from scipy import stats
from pymongo import MongoClient
from math import cos, asin, sqrt, pi
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.linear_model import LinearRegression
from sklearn import metrics

%matplotlib inline
```

Our motivation goal is to explore the behaviour of the disasters and to find explanation for the unexpected ones. And to find relation between properties of every disaster (e.g. the relation between the magnitude and focal depth). Also, try to predict some earthquake aspects.

What is the structure of your dataset?

The main dataset of this project which is earthquake's dataset with 22 features. We are interested in some of them which are (time, latitude, longitude, depth, mag). All of this features are numerical value except magType which are categorical value.

What is/are the main feature(s) of interest in your dataset?

The most important features are the magnitude and focal depth.

What features in the dataset do you think will help support your investigation into your feature(s) of interest?

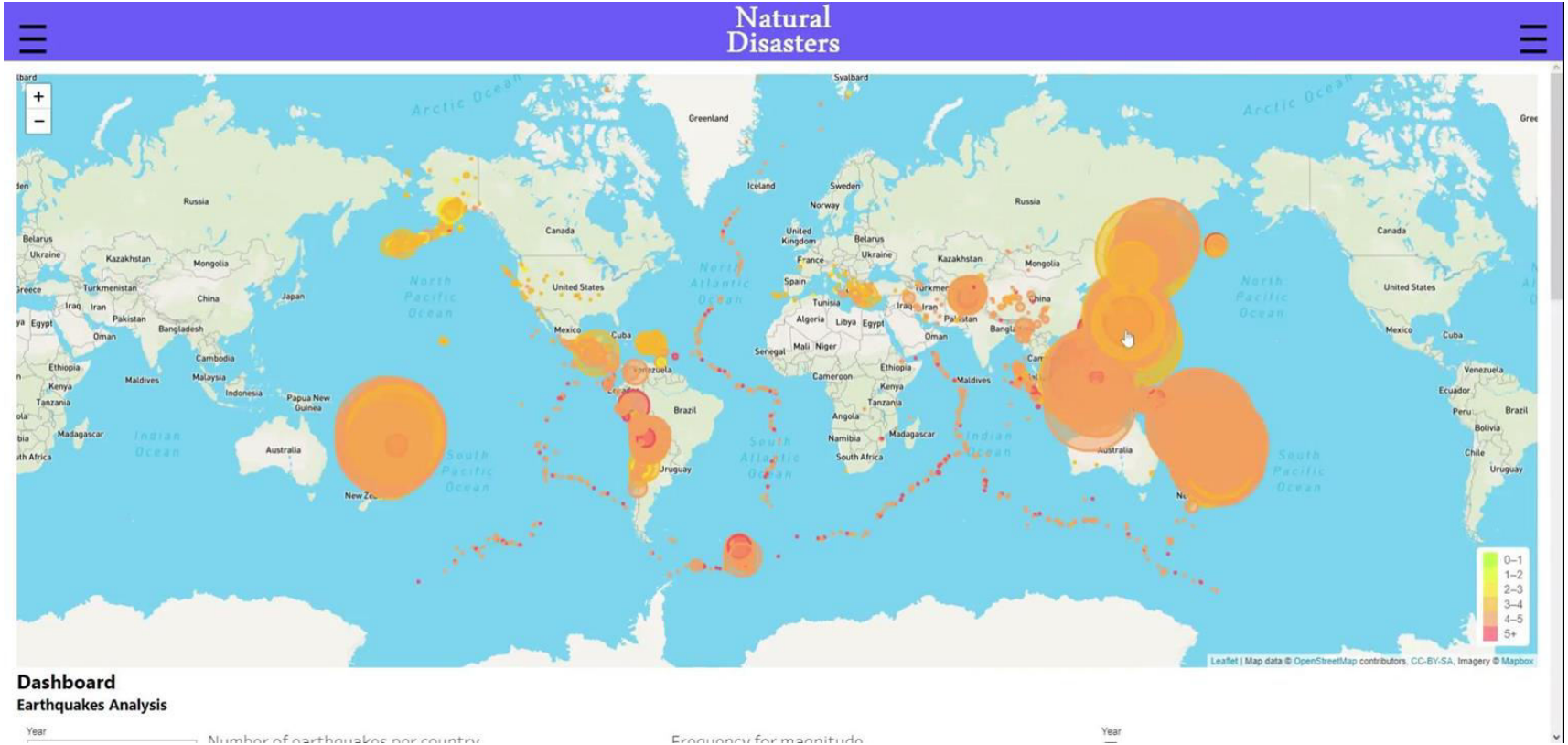
We have other features that will help us such as longitude, latitude and timestamp. Also, there will be other features we will calculate from the data we have such as the number of aftershocks.

[4]:
```
for i in range(22):
    year = 2000 + i
    url = 'https://earthquake.usgs.gov/fdsnws/event/1/query.csv?starttime={y}-01-01%2000:00:00&endtime={y}-06-01%2023:59:59&minmagnitude=3&orderby=time'.format(y=year)
    r = requests.get(url, allow_redirects=True)  # to get content after redirection
    pdf_url = r.url
    name = '{}-1.csv'.format(year)
    with open(name, 'wb') as f:
        f.write(r.content)

    url = 'https://earthquake.usgs.gov/fdsnws/event/1/query.csv?starttime={y}-06-01%2000:00:00&endtime={y2}-01-01%2023:59:59&minmagnitude=3&orderby=time'.format(y=year, y2=year+1)
    r = requests.get(url, allow_redirects=True)  # to get content after redirection
    pdf_url = r.url
    name = '{}-2-0.csv'.format(year)
    with open(name, 'wb') as f:
        f.write(r.content)
```

Trial and Demo

Video Demo


Natural Disasters
Dashboard
Earthquakes Analysis
Year
Year
0–1
1–2
2–3
3–4
4–5
5+
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

QR-Code

Project Evaluation

Wrangling Process

- Data cleaning.
- Data analysis.

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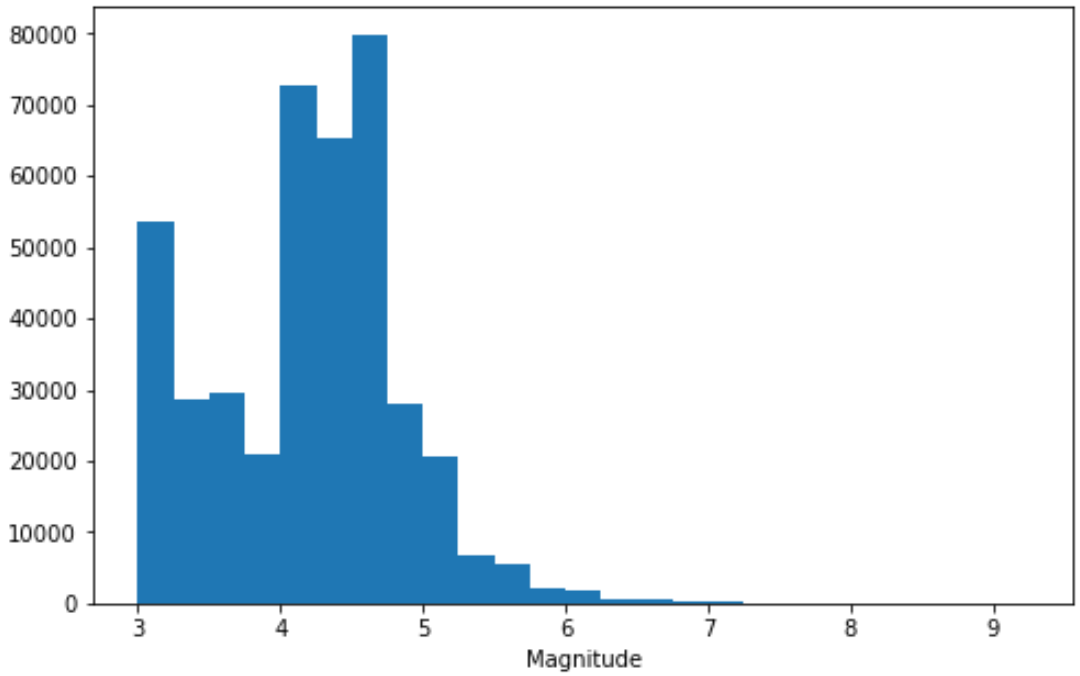
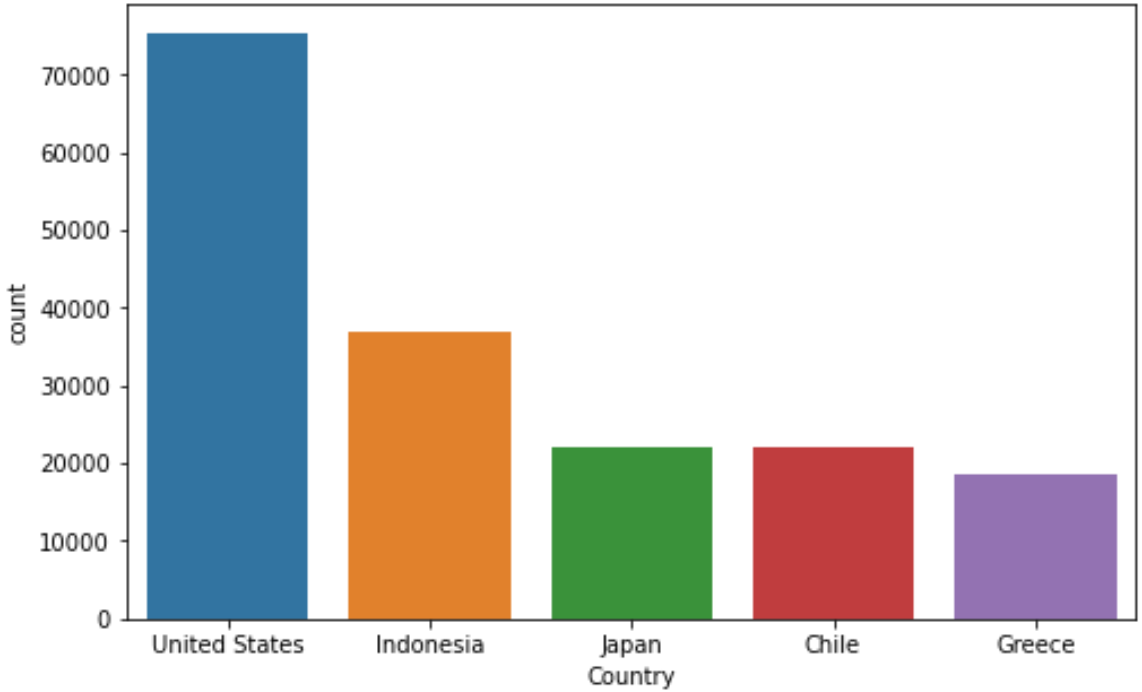
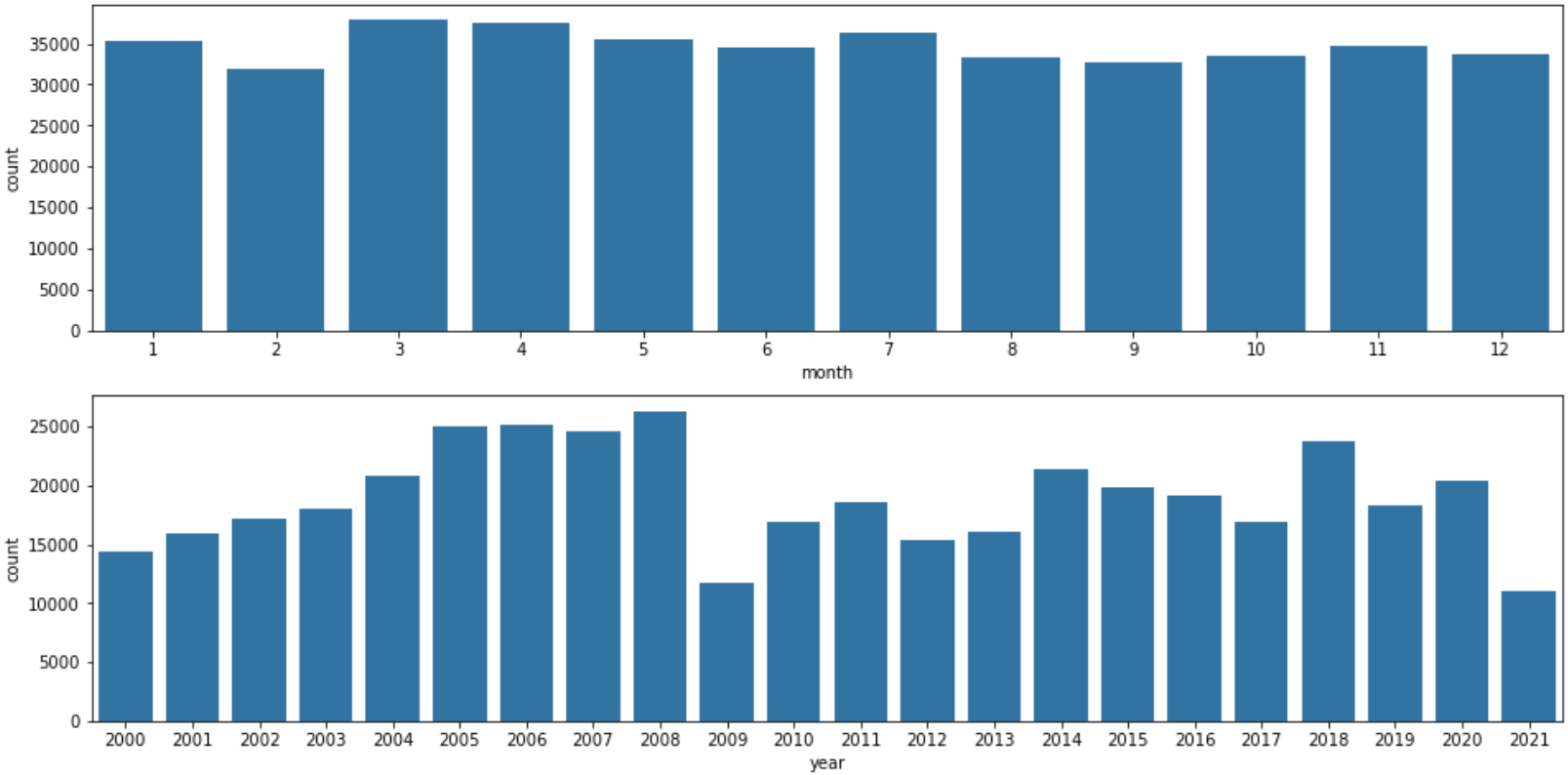
Frequency of magnitude

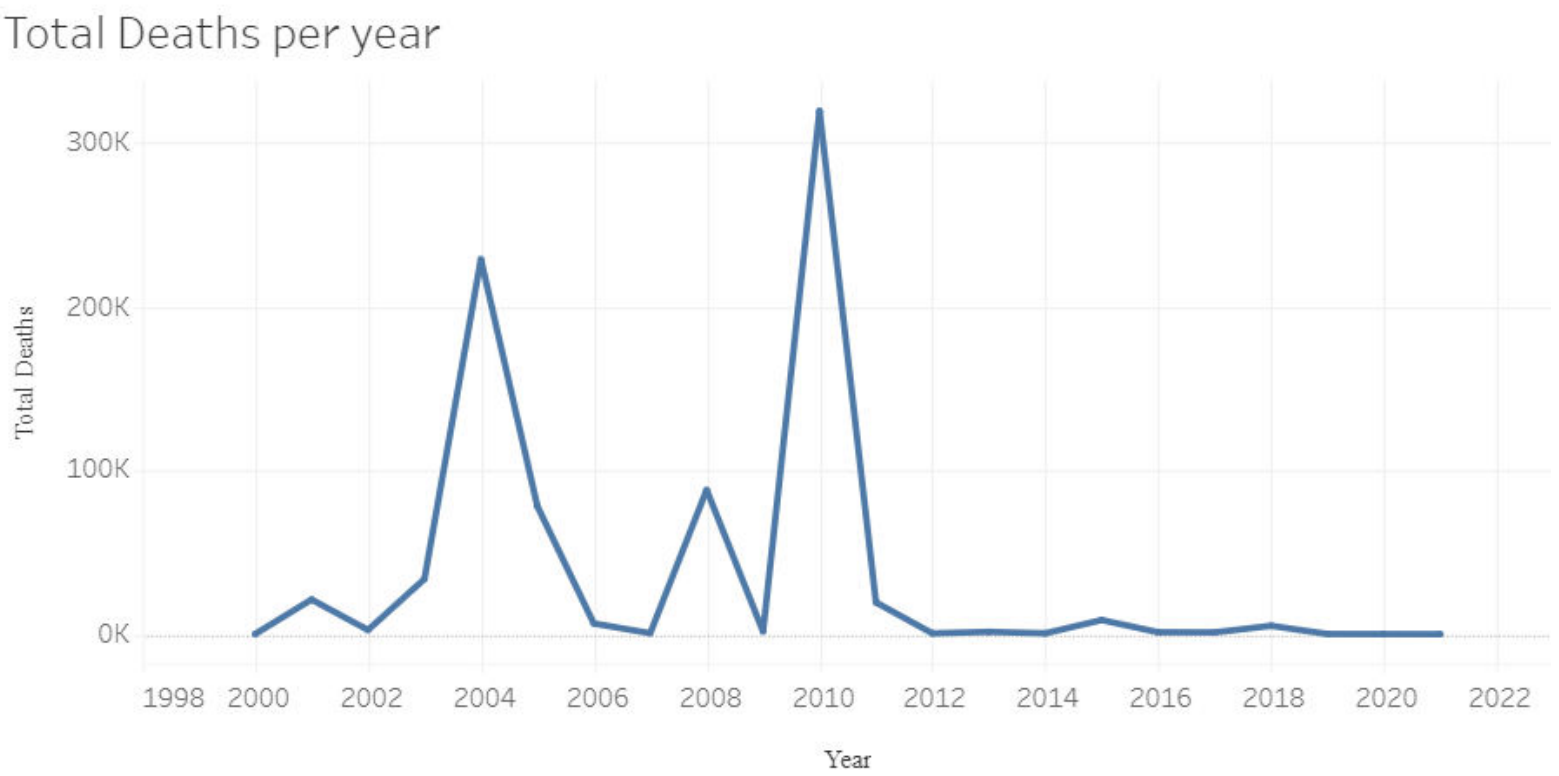


Top 5 countries

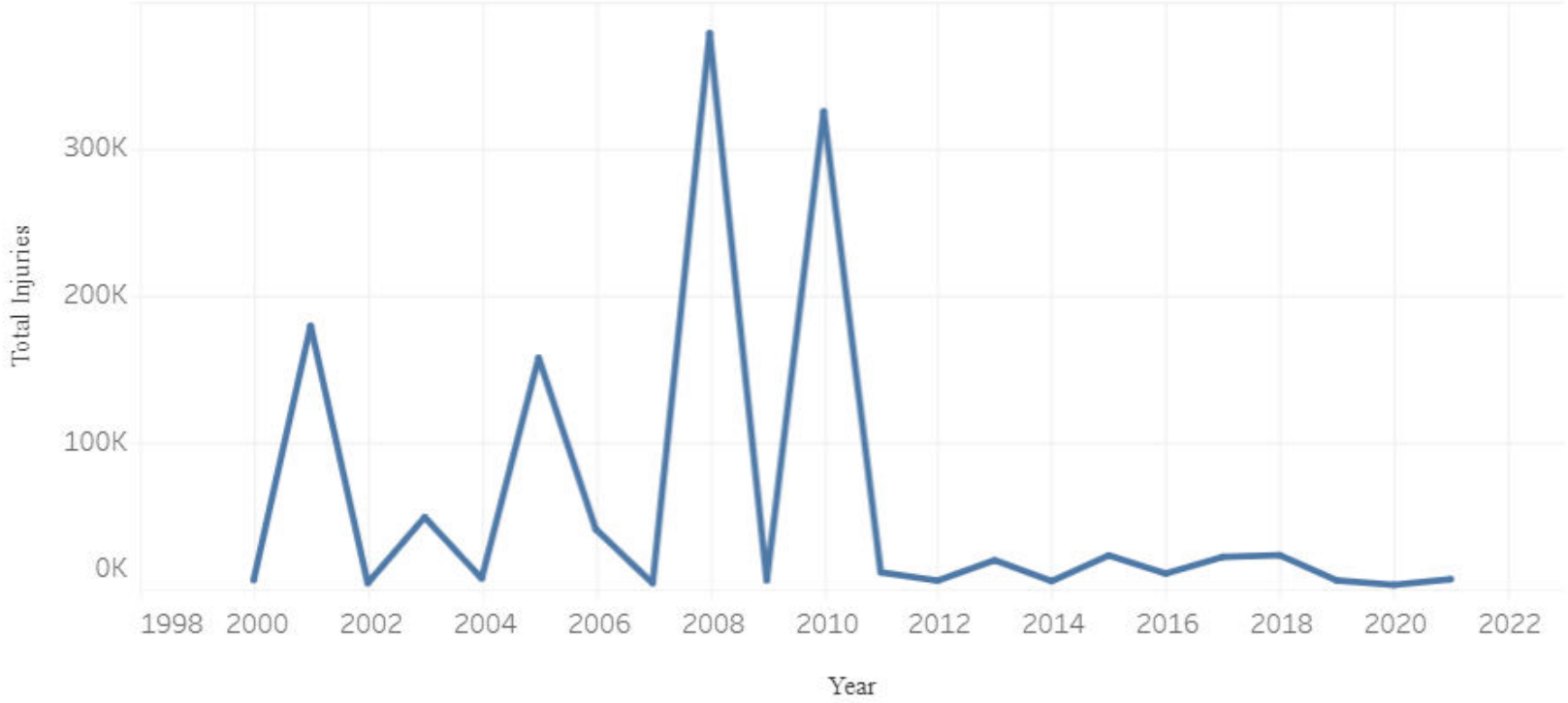


Earthquakes per year and month




Total Deaths per year
300K
200K
100K
0K
Total Deaths
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year

Total Injuries per year

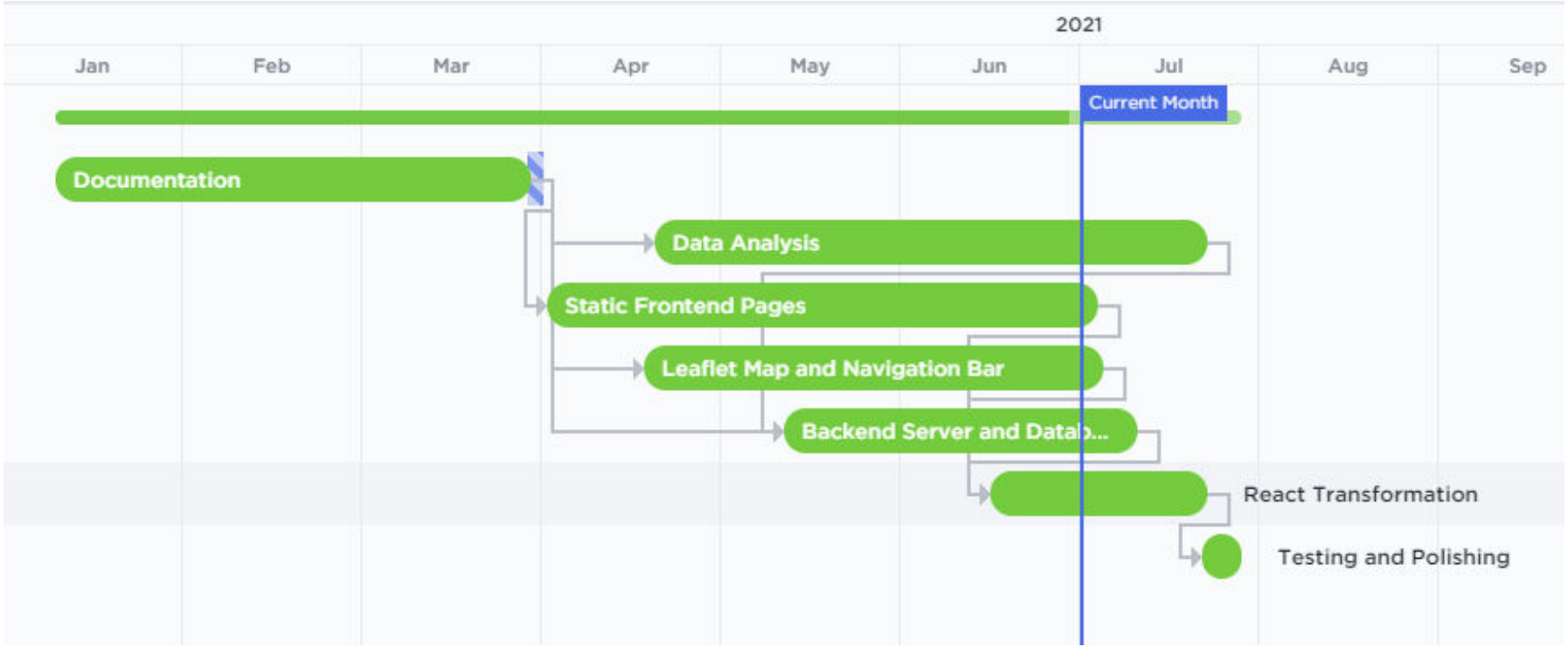


Prediction Process

- Models used.
- Accuracy achieved.

Project Timeline

Gantt Chart


2021
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Current Month
Documentation
Data Analysis
Static Frontend Pages
Leaflet Map and Navigation Bar
Backend Server and Datab...
React Transformation
Testing and Polishing

Github Commits

May 16, 2021 – Jul 26, 2021

Contributions: Commits

Contributions to main, excluding merge commits and bot accounts

Conclusion and Future Work

Conclusion

- Main points
- Significance of the results

Future Work

- More data can be systematically inserted into the database.
- Add other Natural Disaster types to the system.
- Make the Application responsive for mobile devices usage.
- Try to enhance our prediction accuracy

References

- *https://www.seowebsitedesign.com/the-waterfall-model-of-software-development/*
- *https://www.seowebsitedesign.com/the-waterfall-model-of-software-development/*
- *https://www.ngdc.noaa.gov/hazel/view/about*
- *https://earthquake.usgs.gov*
- *https://www.adobe.com/mena_en/products/xd.html*
- *https://app.creately.com/diagram/*
- *https://mongoosejs.com/docs/guide.html*
- *https://docs.mongodb.com*
- *https://leafletjs.com*
- *https://react-leaflet.js.org*
- *https://reactjs.org*
- *https://blog.jumpstartinsurance.com/can-aftershocks-be-predicted/*

Thank you!

Questions?