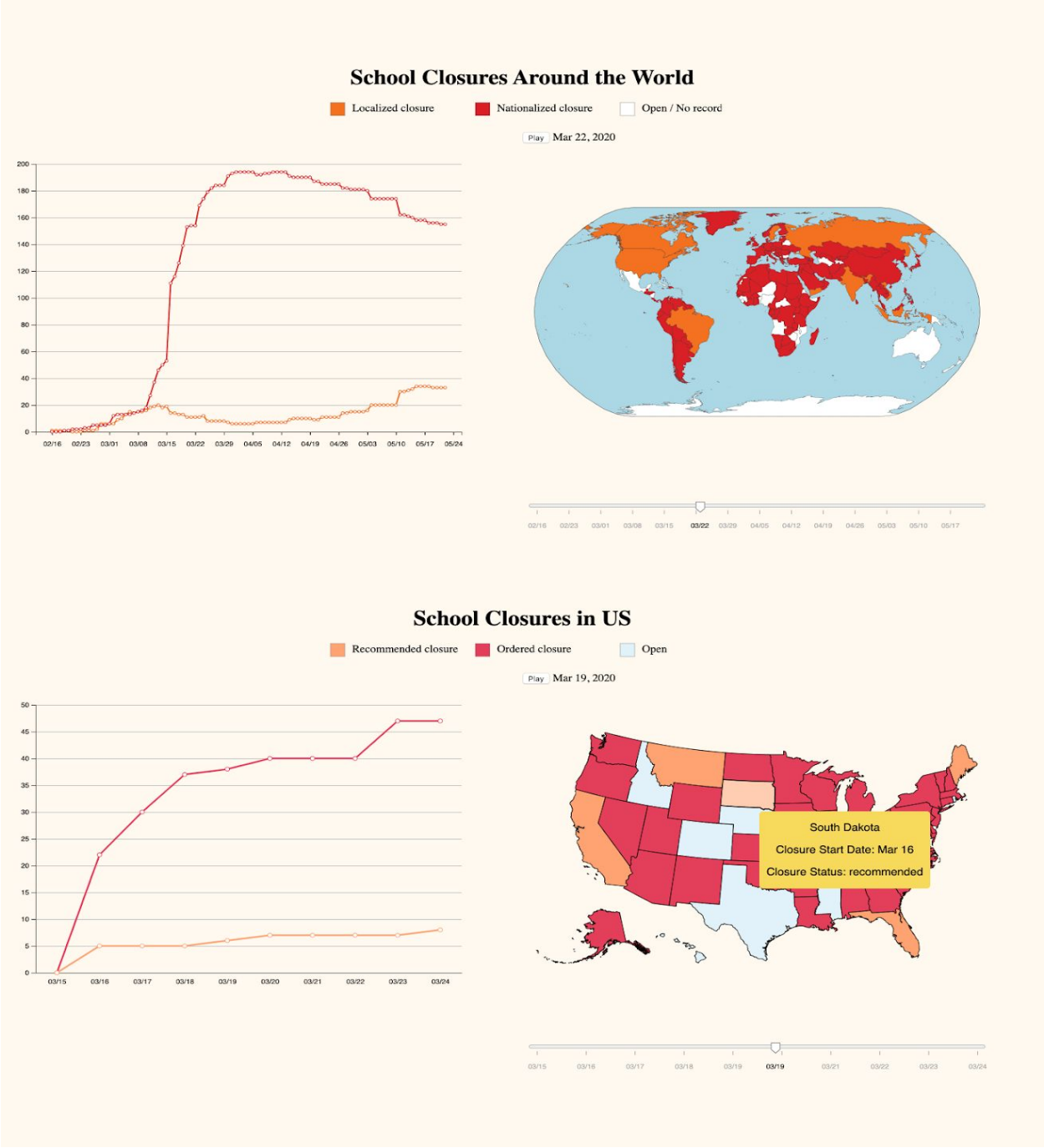
INFO 5100 Project 2 Report

School Closures Due to COVID-19

Zhongkai Liu (zl777) Yuchen Cai (yc2563) Yuhua Ma (ym474)

1. Screenshot of the data visualization:



2. Description of Data

TopoJSON is a special JSON format and encodes the geographical data information into shared typology. The TopoJSON topology describes some geometries which share arcs: sequences of positions. TopoJSON also supports multiple geometrical types such as point, polygon and multipolygon. A typical TopoJSON data format contains a single object and its own points of arcs.

The visualization of drawing and coloring the map of the world have three different data sources: world.json from[1], in which we use the country name for tooltip, countryISO for data mapping between map path and survey data. covid_impact_education.csv from [3] in which we use each country's scale in each date for map coloring, map animation and tooltip info and ISO.json from [2] is used for data preprocessing so that survey data can be mapped to map data through alpha-3 ISO and numeric ISO representation of each country.

The visualization of drawing and coloring the map of the United States have three different data sources: us.json, coronavirus-school-closures-data.csv and us-state-names.tsv. First of all, us.json from [4] is under TopoJson format which is In the us.json data source, Secondly, the coronavirus-school-closure-data.csv comes from the website [6] and contains the information of each state's name, state abbreviation, state status, state closure status, state closure start date, date closed for the academic year, state number of public schools and state public school enrollment. The us-states-names.tsv is an excel type of data source which contains the information about id, state abbreviation and full name of the state. The source is [5].

In order to draw the school closure status in every country every day on the map, we have to first process the original world school closure data from [3]. We processed the ISO data from [2] to build a mapping from the alpha-3 ISO code to the numeric ISO code, which is helpful when combining the world school closure data and map data. Since we used the numeric ISO as the id of the path element on the map, and the world school closure data only has alpha-3 ISO, a mapping is necessary.

The original world data provides everyday status for countries that start to close school. We processed the original data to an array, such that each element of the array is an array of objects, and each object contains the information including the country name, closure scale, the date, and the numeric ISO codes (mapped from alpha-3 ISO) etc.

In order to draw the school closure status in every status every day on the map, we also need to process the original US school closure data from [6]. The original US data provides the start date of each state and its closure status. Similarly to the world data, we processed the original data to an array, such that each element of the array is an array of objects, and each object contains the information including the state name, the state abbreviation, the date, the start date and the closure status.

For the world line chart, we need to aggregate the total number of countries that close school nationally and locally every day, from the processed World data. Similarly, we also need to aggregate the total number of states that ordered and recommended school closure every day, from the processed US data.

It is worth noting that we filtered out the data of the U.S. Virgin Islands, Bureau of Indian Education and Department of Defense Education Activity in the original US data, since they are not shown on the map.

3. Design Rationale

3.1 Chart Types

We want to show the scales of school closures in every country every day, as well as the status of school closures in every US state every day. We decided to show these data on maps and line charts. Maps can give the users an intuitive feeling of the distribution over the geographical location. Line charts are good at showing the trends of increasing and decreasing, as well as the accurate value of each date.

3.2 Layout

We made four charts in total, and divided them into two groups. For each group, we showed the data on a line chart and a world map, and placed them side by side for users to easily view the data in two different ways at the same time, and also for the interaction between the line chart and map (we will discuss the interactions later).

On the map, there is a slider, a play/pause button, a label showing the current date. The slider is placed at the bottom of the map, which can be considered as a process bar of the animation.

We placed the legends in the center under the title of each section, since the legend can be shared between the line chart and map.

3.3 Channels and Marks

On the maps, we used channels including geographical locations and colors to represent the status of school closure in each country and state. On the line charts, we used the position on x and y axises as the channel to represent the date and the number of countries or states, and we used the color to represent the status of closure. Also, we used lines to emphasize the trend of each status, and used circles to indicate values of each day. Date is displayed through the combination of a text next to the play button and below the slider of the map. One the line chart, we provided horizontal gridlines for users to easily view the value.

For the color chosen, first of all, we need the colors to be clearly distinguished. Second, we need to follow the usual convention and people's intuition. Red usually means a severe and urgent situation, and is used to represent danger. Orange often means a lower level of emergency, and is used to represent warning. Therefore, we choose to follow this convention. For the world data, there are two scales of school closures, nationalized closure and localized closure. The nationalized closure is a more serious situation, which is therefore represented by red, while the localized closure is represented by orange. Similarly, for the US data, there are two status of school closures, state ordered closure and state recommended closure, which are represented by red and orange respectively. Also, we picked a different kind of red and orange in the US charts to distinguish from those of world charts.

3.4 Interaction Design Rationale

In our data visualization, we designed and developed 7 interaction as following:

- Mouseover on line charts (tooltips, marker line)
- Click on line charts (marker line, interaction with maps)
- Mouseover on maps (tooltips)
- Animation of maps (play/pause button)
- Sliders of maps
- Zoom in/out on maps
- Interaction between animation and slider

Line charts

When the users hover over the line charts, a marker line would show up to indicate the position on the x-axis, and a tooltip would show detailed information including the selected date, the number of countries or states for each status, and the circles of the selected date would increase and become solid. This interaction is introduced for users to easily view the data of a specific date.

In addition, the users can also click on the line chart. When the user clicks a specific date on the line chart, a marker line would be fixed at the selected date, and it also updates the map and the slider to that date. If the animation of the map is going on when the click occurs, then it will pause the animation and the user can play the animation starting from that date. It is the highlight of our data visualization project that we enable the user to interact with the map by clicking the line chart. We consider this is a nice and helpful feature for users. If the user wants to view the corresponding situation on the map of a specific date that interests him or her on the line chart, he or she can simply click that date.

Maps

The first interactive element on maps is the tooltips when mouseover. Tooltip enables the user to see certain information of the data such as the date or the names of states. By viewing the visualization, we want to provide more information that is visible to the user. Tooltip just makes it achievable.

On the world map, if the user put the mouse over certain countries on the map, the name of the country, along with each updated scale's data and status will be shown in the text box. On the US map, if the user put the mouse over certain states on the map, the name of that state, along with the closure start date and closure status will all be shown in a text box.

The second interactive feature on maps is the play/pause button which controls the animation. The design idea of a play button is through clicking, the map will automatically evolve based on the change of dates originated from the linking data source.

On the maps, after clicking the button, the text on the button will change from "play" to "pause" while the world map will change its state day by day from the starting date to the end date. If the user presses "pause" during the playing process, the map will stop at the current date and the button's text will change from "pause" to "play". The map can continue its animation process if the user presses the "play" button again.

Since the maps contain detailed information of hundreds of countries, we added a zoom in and out interaction for the users to check out the details of each country's or state's information. The zoom in and out is controlled by the mouse wheel.

Another important interactive element in our design is the slider under the world map and US map. The slider is designed for the purpose of controlling the display of different dates of data. The user can drag the slider forward and backward or click at a specific date on the slider. During the process of dragging, the visualization will update maps based on the dates. Therefore, we enable the users to choose to view data on a selected date.

One important feature that our team accomplished is the interaction between the play button and the slider. We wish to create an experience of viewing our visualization just like watching a movie on the computer. The tool we provide is the play button works as the start button and the slider which works as the progress bar. You can drag the progress bar when you see videos. Similarly, you can drag the slider to see different visualizations during your watch. Last but not the least, we make the interaction between the play button and slider more "intelligent". If you click the play button and normally the visualization will begin and the slider changes according with the change of dates. Furthermore, if you interrupt the animation by dragging the slider, the animation will pause and can resume the animation from the new date.

4. The Story

Nobody has ever perceived to which degree the coronavirus has brought to America. Beyond normal people and experts' imagination, the virus is spreading dramatically fast across the whole country and outweighs the influence of the Great Depression. It also has changed the global power distribution and economic recovery. Western developed countries suffered a lot during the pandemic time since the pillar industries of them, the service industry, are nearly all shut down. Everyone is staying at home to keep safe, therefore nobody goes out for meals, or go to the bar, or go to the movies, or travel with family. The coronavirus also changed many lives of normal people as well. Many people lose friends or family members. As for our team, we are all staying at Ithaca and all of our study plans have been infected to some degree. We want to discover, to find out the hidden pattern behind the data. This becomes our motivation for conducting this project regarding the coronavirus' influence on education.

Our main goal is to show the outbreak trend of COVID-19 over education around the world and in the US. We chose the world map and US map to give the users an understanding of how the virus spread via geographical location and the correlation between school closures and the pandemic. Two line-charts are also drawn to show the quantitative trends.

The closure started localized in China and spread across the world quickly. The national closure amount reached top on April 1st and started to drop down after that shown on the world line chart. This shows that the epidemic in the world has gradually been brought under control and the COVID-19 impact on education is gradually decreasing. Some countries have experienced the whole process from localized closure, nationalize closure to localized closure and finally reopen again which can be seen clearly using the interactive tooltip. Some countries have no record about the COVID-19 impact on education, such as Burundi and Somaliland, the users can have their own idea of why these countries have no data record. From the geographical location, we can see that the decision of school closure starts from Asia, spreads to North America around March and continues to spread to South America and Africa around the middle of March and spread to Australia at the end of March. Greenland is the first country that decided to change the

closure status from nationalized to localized at 04/12 and finally reopened school at 04/20 for education. A few South American and African countries also started to change the policy to recover schools for education around the end of April. More countries in Asia start to reopen the schools including China which is the first country that decides to close school.

In the us-map visualization, the changing variable is the starting date of the states that take actions to close the schools. It begins from March 15 and ends on March 24. On the first day, the map is still in the color of light blue, indicating that no single state begins to take actions. While on March 16, several states began to take actions. The action is divided into two categories: recommended closure and ordered closure. The audience could draw the insight that the states that take actions in the early days are on the west coast and east coast. This implies the virus breakout at both sides rather than the inner states in America. The virus is likely to be brought by travelers who have gone to countries suffering from the virus. Due to the long period of Incubation and no healthy check at the border, those patients with no sign of sickness enter the US and blow the bomb upon the public health. Another insight is that inside only ten days, all homeland states notice the threat and take the action to close the schools. Finally, only eight schools take the action of recommending closure of the schools rather than strict government orders, which shows the autonomous tradition of the American people.

5. Team Contribution

- **Yuchen Cai (30h)**
    - Brainstorm the ideas for this project. (2h)
    - Looking for three datasets and drawing sketches of potential visualizations. (2h)
    - Code and debug the us-map visualization including the interaction like play button, slider and tooltip. (20h)
    - Outlining the final report. (5h)
- **Yuhua Ma (30h)**
    - Brainstorm the ideas for this project. (2h)
    - Looking for and understanding the datasets. (2h)
    - Implementation of world map including map visualization, map animation, slider bar and tooltip. (20h)
    - Final report (5h)
- **Zhongkai Liu: (40h)**
    - Brainstorm the ideas for this project. (2h)
    - Looking for and understanding the datasets. (2h)
    - Organized the daily meeting on Zoom and allocated team works every day
    - Preprocessed data for all data visualizations (4h)
    - Designed and developed the world and US line charts, including the interaction between line charts and maps. (10h)
    - Debugged the world and US maps, especially the interactions on the maps (10h)
    - Designed and implemented the layouts of the data visualization (2h)
    - Combined the line charts and maps, and tested and fixed the final version (5h)
    - Final report (5h)

Appendix

A. Data Sources

[1]world map data

https://raw.githubusercontent.com/plotly/plotly.js/master/dist/topojson/world_50m.json

[2]world country ISO data

https://github.com/lukes/ISO-3166-Countries-with-Regional-Codes/blob/master/slim-3/slim-3.json

[3]world survey data:https://en.unesco.org/COVID19/educationresponse

[4]US map json: https://github.com/jeffrz/info3300-spr2020/blob/master/datasets/us.json

[5]US states name data:

https://github.com/jeffrz/info3300-spr2020/blob/master/datasets/us-state-names.tsv

[6]coronavirus-school-closures-data:

:https://www.edweek.org/ew/section/multimedia/map-coronavirus-and-school-closures.html

B. Code References

[7] tooltip reference: https://bl.ocks.org/tiffylou/88f58da4599c9b95232f5c89a6321992

[8] slider reference: https://bl.ocks.org/johnwalley/e1d256b81e51da68f7feb632a53c3518

[9] animation reference: http://bl.ocks.org/rgdonohue/9280446

[10] D3 TopoJSON example: http://bl.ocks.org/mapsam/6083585

[11] D3 tooltip example: https://bl.ocks.org/d3noob/a22c42db65eb00d4e369

[12] Draw the legend: https://www.d3-graph-gallery.com/graph/custom_legend.html

C. Libraries:

D3: https://github.com/d3/d3

topoJSON: https://github.com/topojson/topojson

d3-simple-slider: https://github.com/johnwalley/d3-simple-slider

Please note that we did not download d3-simple-slider and include it locally because it depends on many other libraries. We got permission from Prof. Jeff Rze. to link the library directly

instead of downloading them. Please see the question and answer on CampusWire (https://campuswire.com/c/GF8A0A226/feed/1131)

D. Link to the Github:

https://github.com/ZhongkaiLiu/INFO5100-Project2