

**Project Title: Worldwise trade data (importing and  
exporting) visualization**

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**[https://github.com/YosefQiu/VIS\\_FinalProj](https://github.com/YosefQiu/VIS_FinalProj)**

## **Overview and Motivation:**

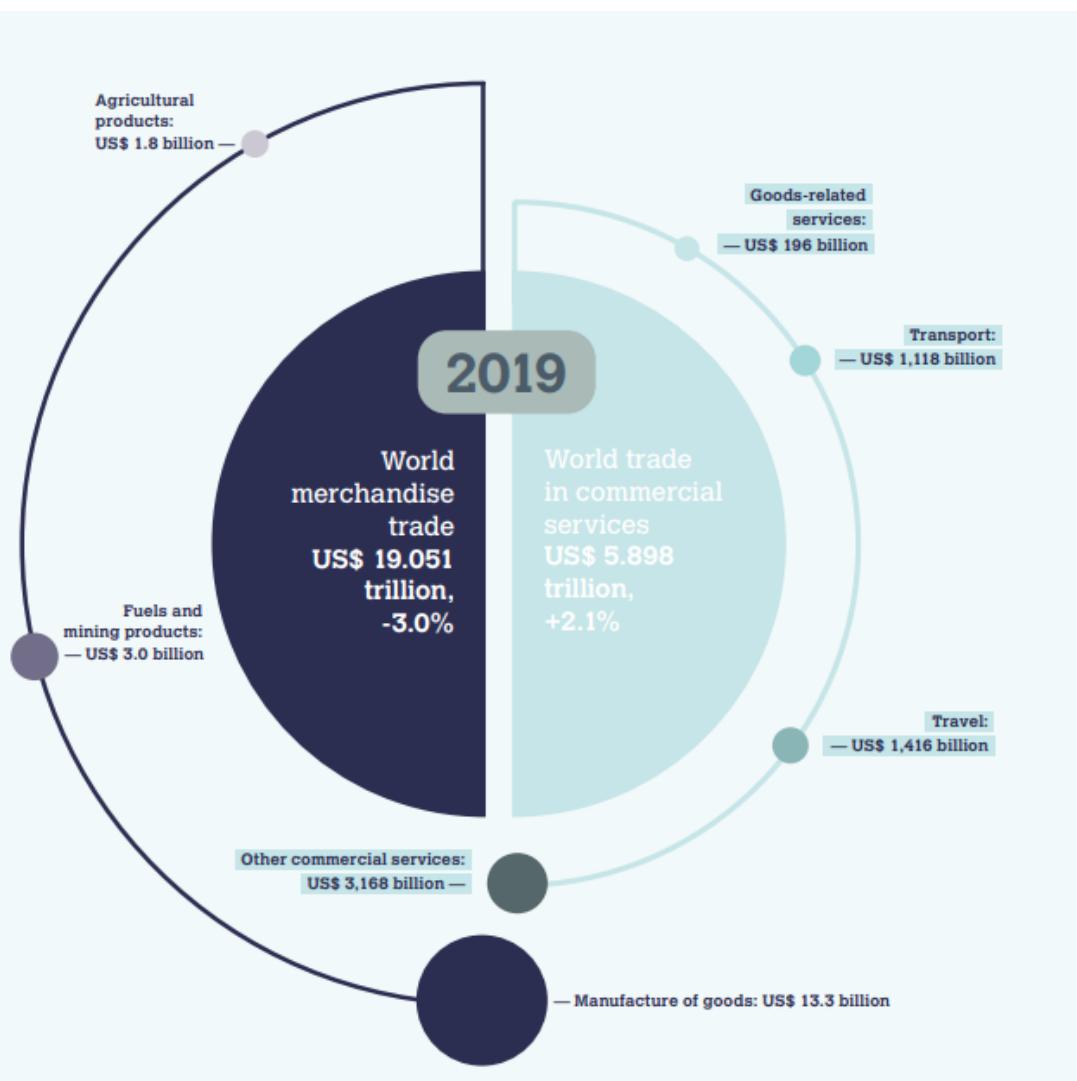
In today's economic globalization, trade between the two countries is likely to cause economic instability in a third country. In particular, this year, due to the impact of the coronavirus. The economies of various countries have been greatly affected. Therefore, we want to explore economic changes through trade differences between different countries. One of our common friends is an economics major. After listening to his views on the economy for a long time, we are all interested in the topic of economics. Moreover, in the current market, most of the economically related visual rendering results are relatively simple, or users are required to have certain economic-related background knowledge. Therefore, we want to try to make an economically relevant visual web page for most ordinary users. This web page should be able to show the recent year trading trends and all other importing and exporting information. The well-known mark of globalization is the year of China joining the WTO. After 30 years of development, China has become the second largest economy in the world. However, the anti-globalization trend is rising when Trump starts his presidency in 2016. He started a trade war between the US and China. Recent years, Covid19 also had a great impact on the global supply chain. Our web page will reflect all the changes in recent years. We hope the user could use this webpage to explore more about the trading trends across the 21 century.

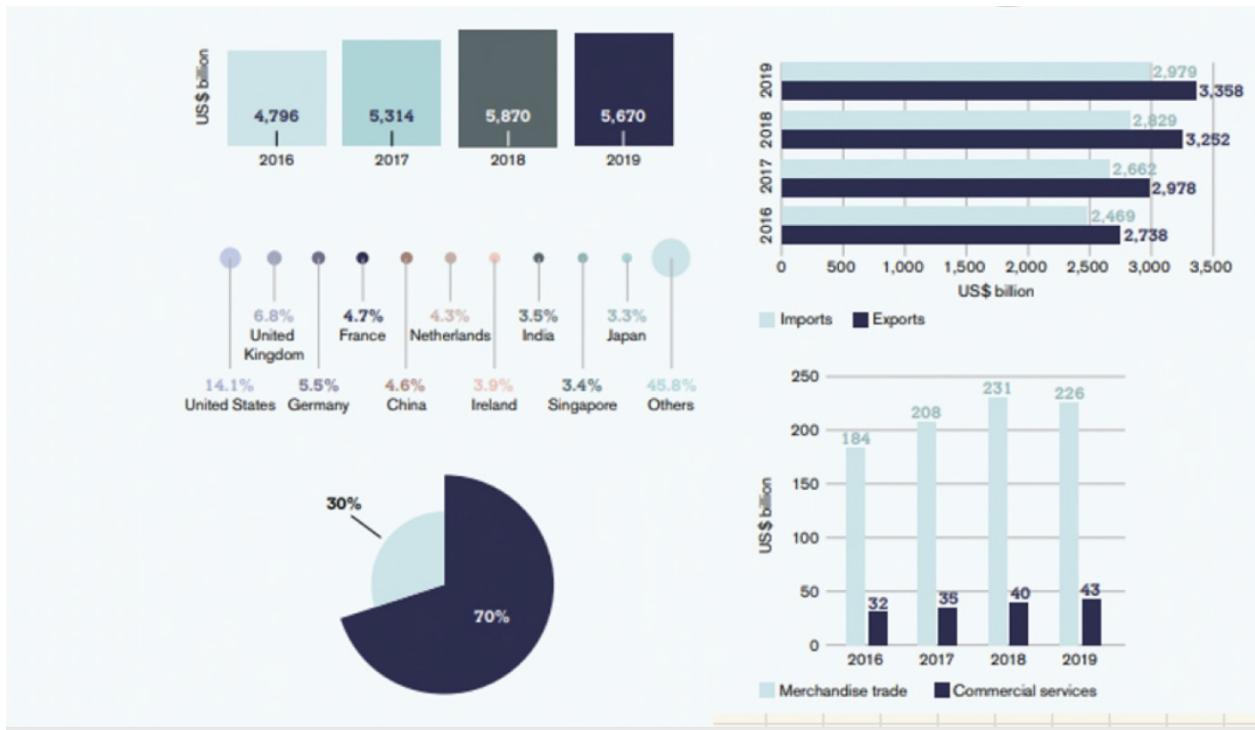
## Related Work

We first found this interesting website about worldwide trading data visualization :

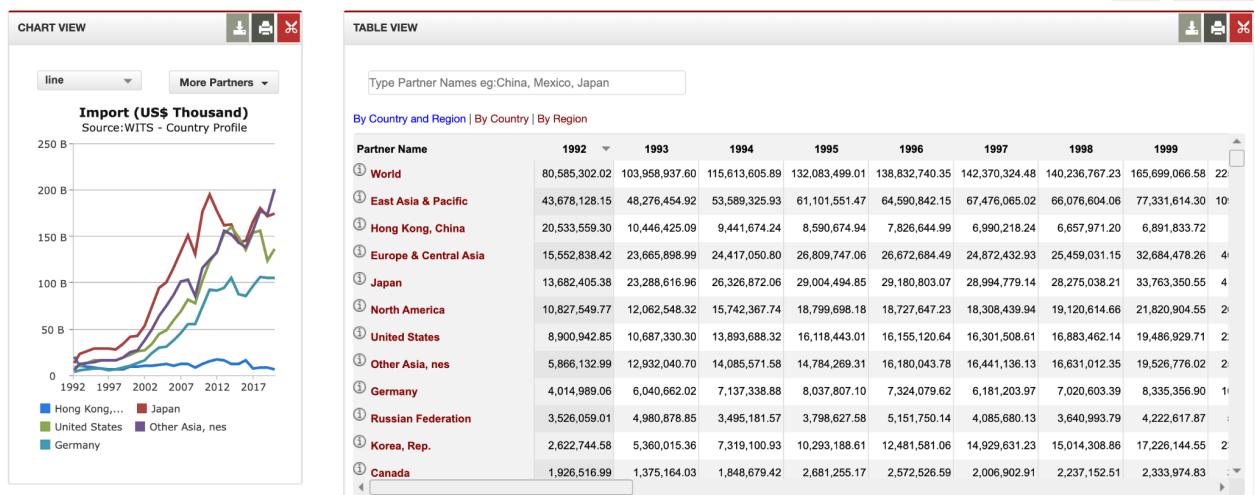
[https://www.wto.org/english/res\\_e/statis\\_e/wts2020\\_e/wts20\\_toc\\_e.htm](https://www.wto.org/english/res_e/statis_e/wts2020_e/wts20_toc_e.htm)

It provides some good looking visualizations. But this visualization only compares 2019 and 2020. We would like to include more years in our visualization.

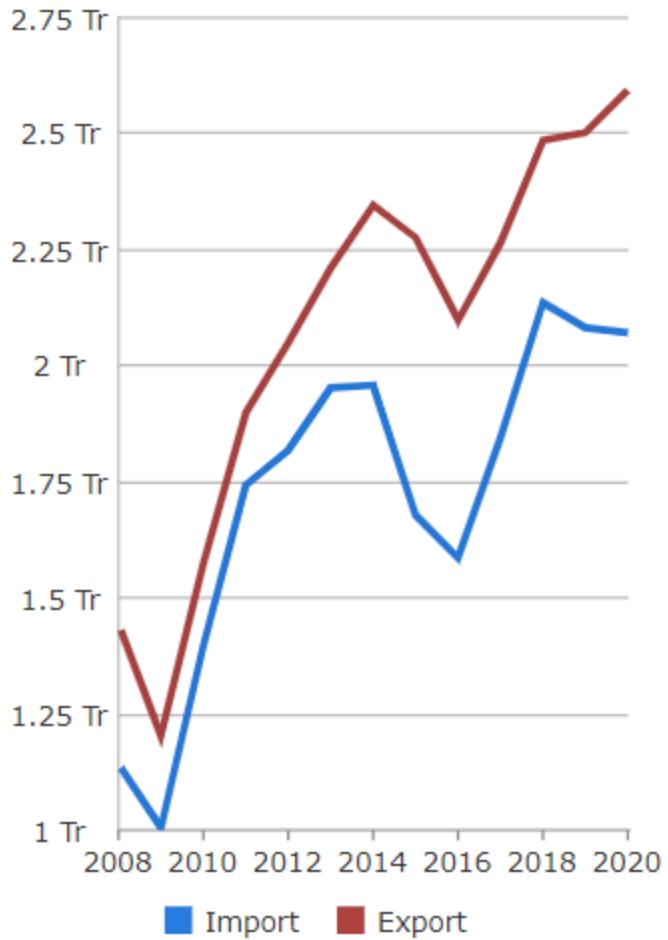




Also our data comes from the world bank database, the website provides some basic visualization.



## IMPORTS/EXPORTS



We think these visualizations look okay but don't display some facts we want to address. We are specifically interested in trading volume for different trading partners. But the user interaction in the world bank website is not user friendly. We are going to improve some of the interactions.

## Questions:

According to this visualization project, we want to solve the following problems.

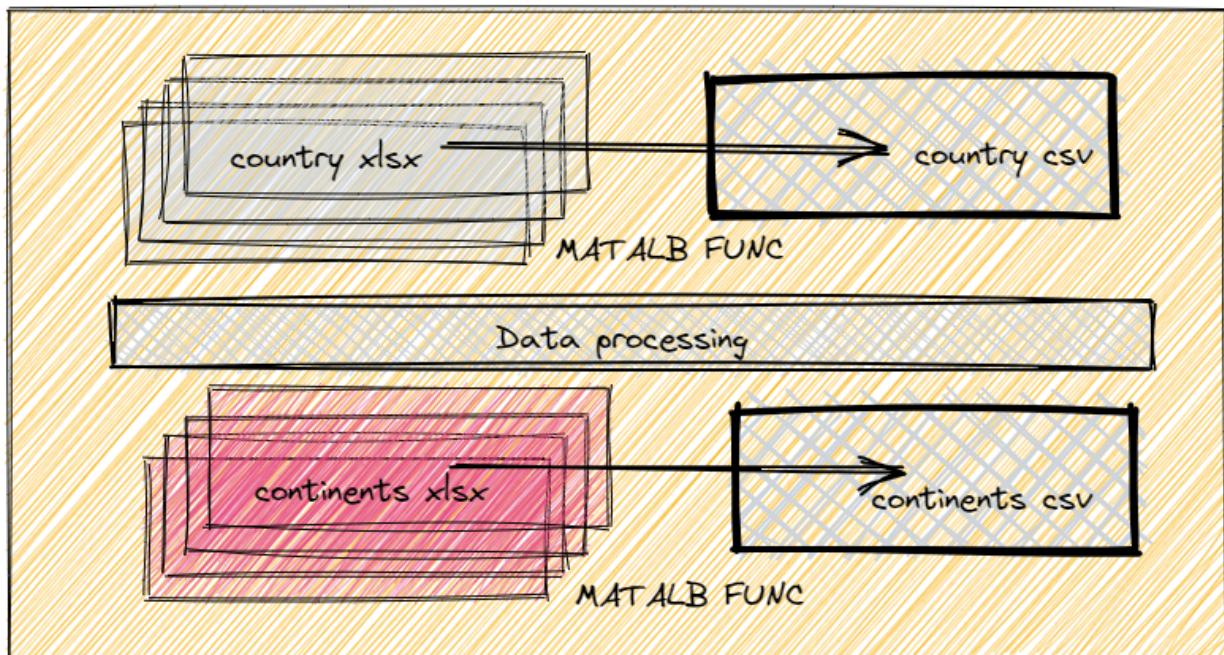
- How have the trading trends changed since the 21st century?
- What's the impact of China joining the WTO?
- How has the Covid-19 affected the trading statistics in recent years?
- What's the trading portion of each country in the worldwide trading system?
- Do anti-globalization trends affect the economy?

We will learn how to visualize complex data using HTML, SVG, and d3. Primarily, the world bank data contains multiple categories, so we will learn about how to filter data and possess data using proper computer language. Other than that, this visualization project will be helpful for education or research related to global relationships or the global economy. In the actual implementation, we found that data processing is different for different graphs. For example, for the line chart, we want to group the data by countries and year. But for chord chart, we want to format our data into a  $10 \times 10$  matrix for displaying the trading trends. So we did some basic data processing in the main javascript, and then processed the data for a second step in the specific chart. We also have some thoughts about data attributes, which will be talked about in the next section.

## Data:

We will get data from the world bank. The world bank provides complete data from the last century to the current year. We will focus on the import and export of data from different regions and different countries. The metric we used is the US dollar. And here are the data sources.

<https://wits.worldbank.org/CountryProfile/en/Country/CHN/Year/2020>



The first is the data processing part. We downloaded two types of XLSX data sets from the international trade website. The first type of data set is based on continental and national data sets, and the second type is national and national data sets. Among the countries, we chose ten countries. They are China, the United States, Japan, Korea,

Rep, Australia, Malaysia, Germany, Vietnam, Thailand, and Singapore. We will calculate these countries' share of world trade ourselves based on this data.

These data are obtained under the Country subclass of the website. We also go to the Region subclass to obtain data for secondary verification. We will use Matlab to preprocess this data, get a CSV file, and then import it using js. For each country, the downloaded data has two tables, one is an import form, and the other is an export form. Therefore, we have obtained a total of 20 Excel tables. We used Matlab to write two data processing functions. Through these two functions, data batch processing is realized, and the detailed data we need can be automatically obtained from these files—for example, some detailed information such as the trade amount of imports and exports at different years.

#### File structure

HTML: index.html & about.html

data : original data & processed Data

js: chord.js & dot.js & line.js & bubble.js & tools.js & script.js

res: img/ & foo.txt

Javascript will read this data and pass it to the front end. Our final data will look like this: a list of objects. Each object is a country or region. The value of the other object will be either import or export. Import or export objects contain 2d data, representing the trading partner and trading year. In theory, we do not need to wait for data processing again when rendering the web page. Because we will import the data preprocessed with matlab as a resource. We have already obtained all the data we need, so no more data will be added later. In addition, we also created a Tools.js using JS at the same time. and a foo.txt file. In this file, it contains all the text information we want to storytell. We use JS to read and use D3 to display.

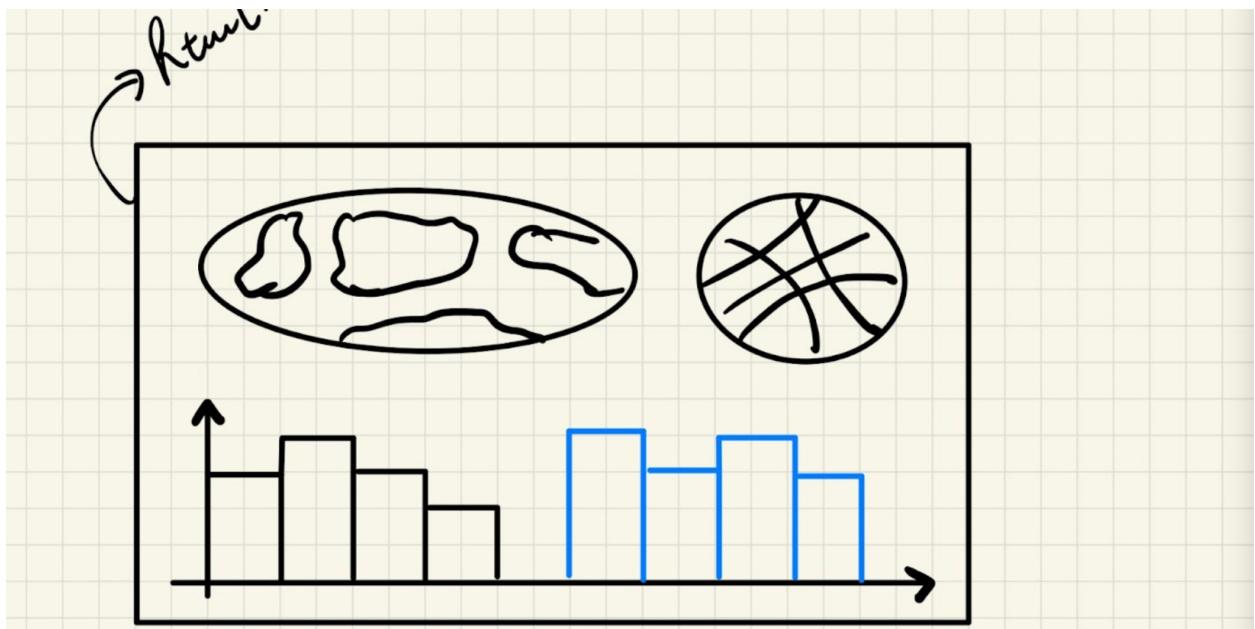
## **Exploratory Data Analysis:**

We just use some basic line charts to visualize the data trends, since it's a built-in function in excel. Line charts are used to reflect changes across the years. We used the same line charts in our visualization. Some countries have distinct trends while others don't. For example China has an increasing importing and exporting trading trend in recent years. While Japan has a decreasing trend.

We don't think these insights will help visualization design because the data is unprocessed yet at this point. Overall our data contains four dimensions and it's hard to do any simple visualization. Our design proptye looks good so far and we didn't plan to change anything.

## Design Evolution:

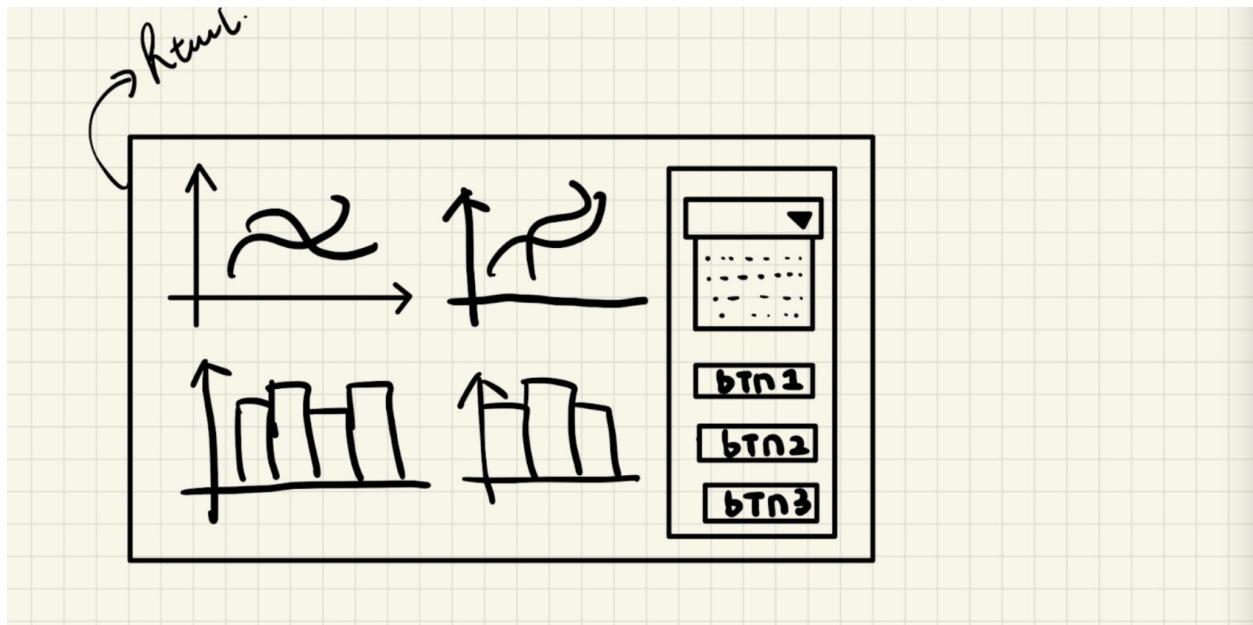
Before we determined our final design plan, we also considered another Langzhong design plan.



In this design, our visualization project consists of three parts, and in the upper left corner is a map of the world. Users can choose different countries in this graph. And the trade gap between these countries is shown in the chord chart on the right. And show the import and exit in the bar chart below.

In the end, we gave up this plan, because for this plan, we added a world map. Use the world map to select countries. But there is a serious problem. For a better layout.

We can't enlarge the world map. If it can't be large, some countries have a small area, and users can't choose quickly and accurately. For example, Japan.



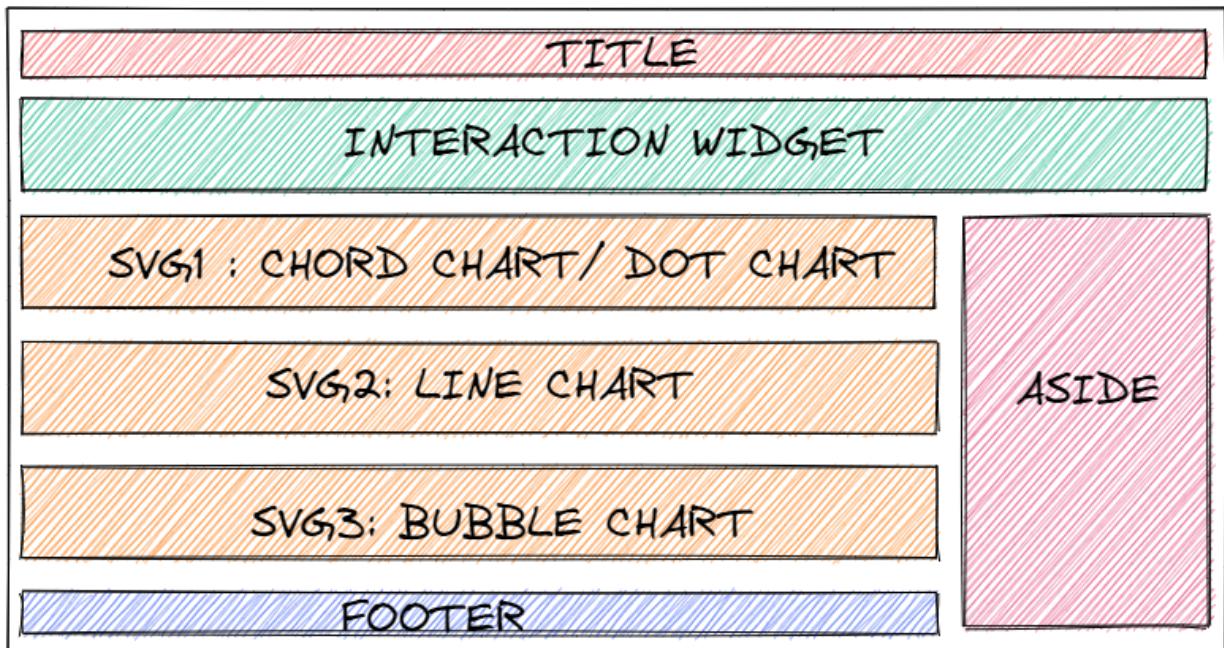
In this design, our visualization project consists of three parts. On the right is a design similar to the menu bar. Users can select countries through the drop-down box and the button at the bottom. The line chart shows the trade gap between countries (including imports and exports), and the bar chart shows the trade gap between continents and continents.

In the end, we also abandoned this plan, but retained part of its interaction design. One reason why we give up is that neither the use of line charts nor bar charts can be more intuitive and simply to show the trade relations between countries.

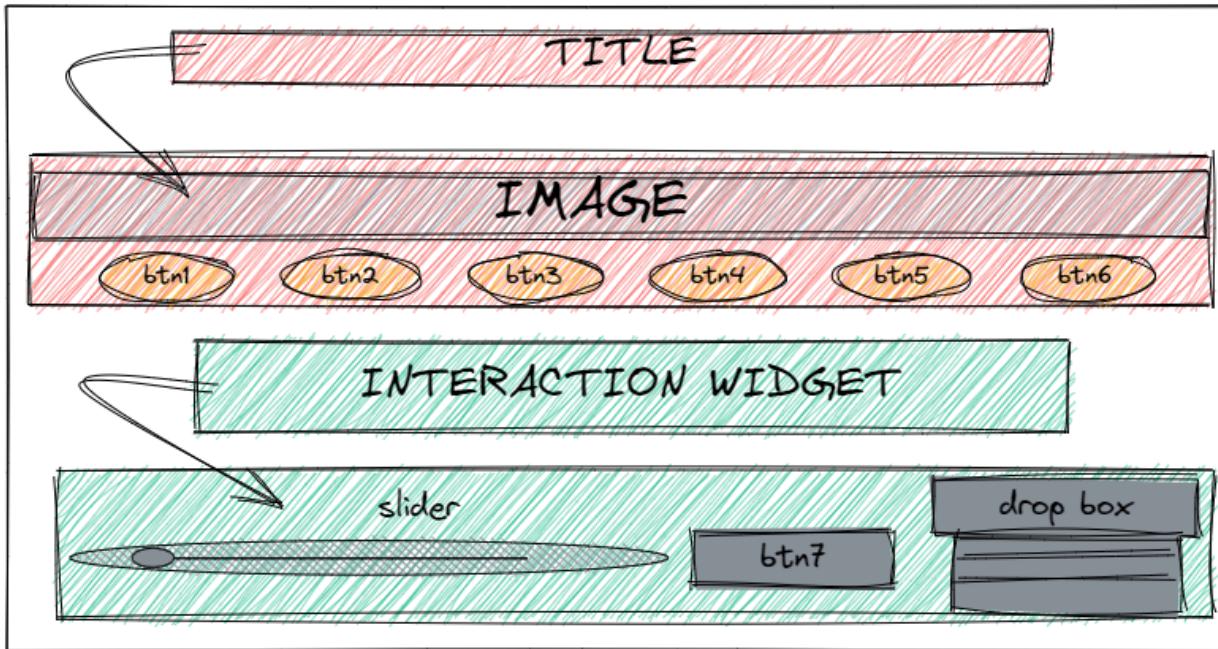
In our project, we strictly adhered to a series of design principles. For example, for the rule one, use the best visual channel available for the most important aspect of the data. In order to best show how the data changes over time, we use line graphs. In order to show the relationship between countries, we use the chord diagram. And for a better user experience, we gave up the map data structure. For rule two, the visualization should show all of the data and only the data. All our visualizations are based on real data, we didn't change any data or add useless features. And for the visualized graph, we control the size so that it fits the page, reducing the reading error that may cause users. In the perceptual part. We also strictly abide by that, for elements with the same properties, they have the same primitive. Similar data are located closer together. And between data with a large gap, we also use a series of methods such as color or location to distinguish. Maybe in terms of color, we may make a second modification, and we will choose the most suitable color. Therefore, until now, we have not deviated from our proposal.

## Implementation:

After considering and excluding several design schemes above, we determined the final design scheme.

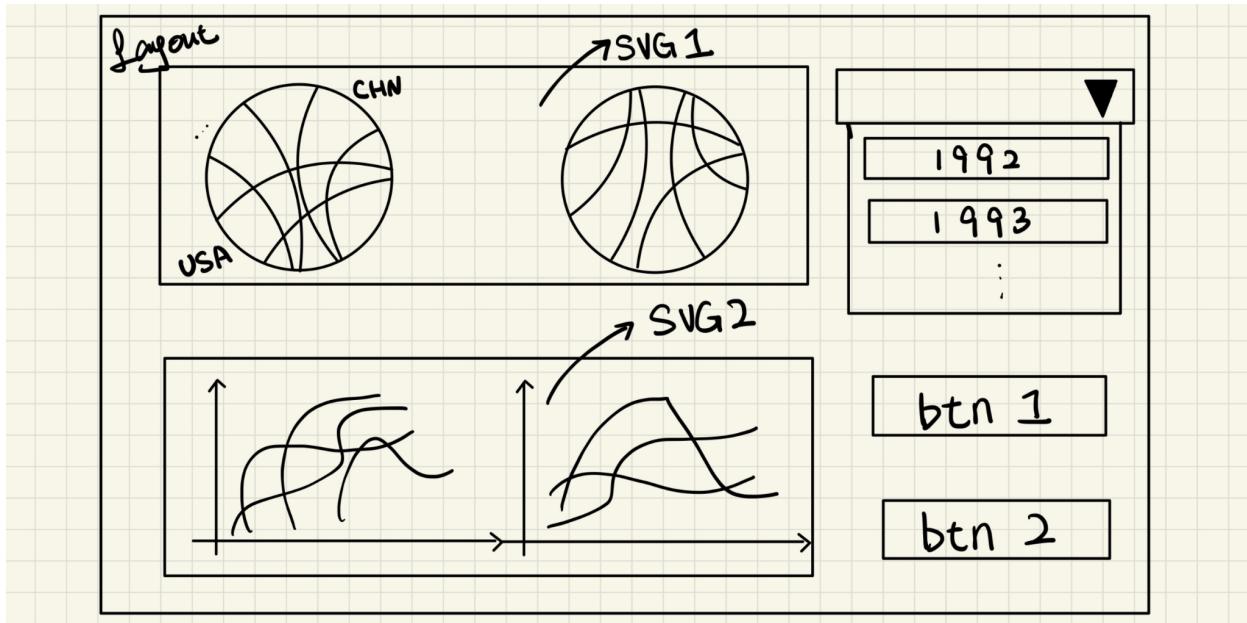


First of all, this picture shows the overall layout design of our webpage, which consists of seven parts. At the top is the title of our web page or project. Next is the interactive widgets we designed. Below the interactive widgets are three SVG parts. In this part, our specific visualization project content will be displayed. At the bottom is a footer, and some related text content will be displayed on the right.



This picture specifically shows the design ideas of our theme part and interactive component part. We will put a relevant picture behind the topic, and add 6 buttons below, these six buttons are home page, about, proposal, video, process book and GitHub link. In the interaction part, we designed 3 widgets, namely a slider, a button and a drop-down box.

This is a simple sketch of our page layout design in the milestone.

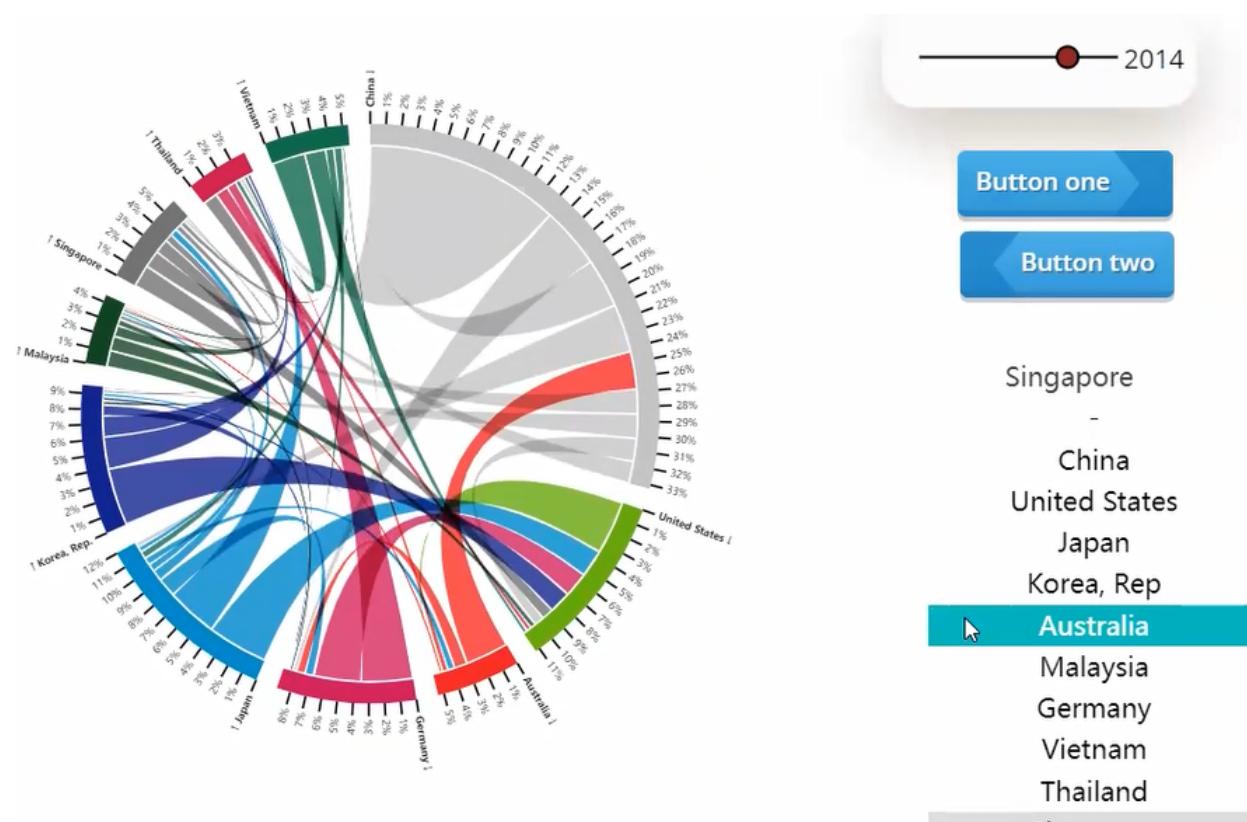


This is a simple sketch of our interaction design (initial design).

First of all, in the first picture above. We designed some buttons on the right side.

Firstly, there is a drop-down button in which users can choose different years. Then the page will automatically update two string diagrams. Then in the second picture, we showed some interactive effects. For example, the user moves the mouse or clicks on the part of the chord diagram, and then the user will find that the line diagram will also be automatically updated. And about the line chart. We plan to distinguish between bright and dark colors. And add a straight line to make it easier for users to get information.

This figure shows the current state of our visualization project.

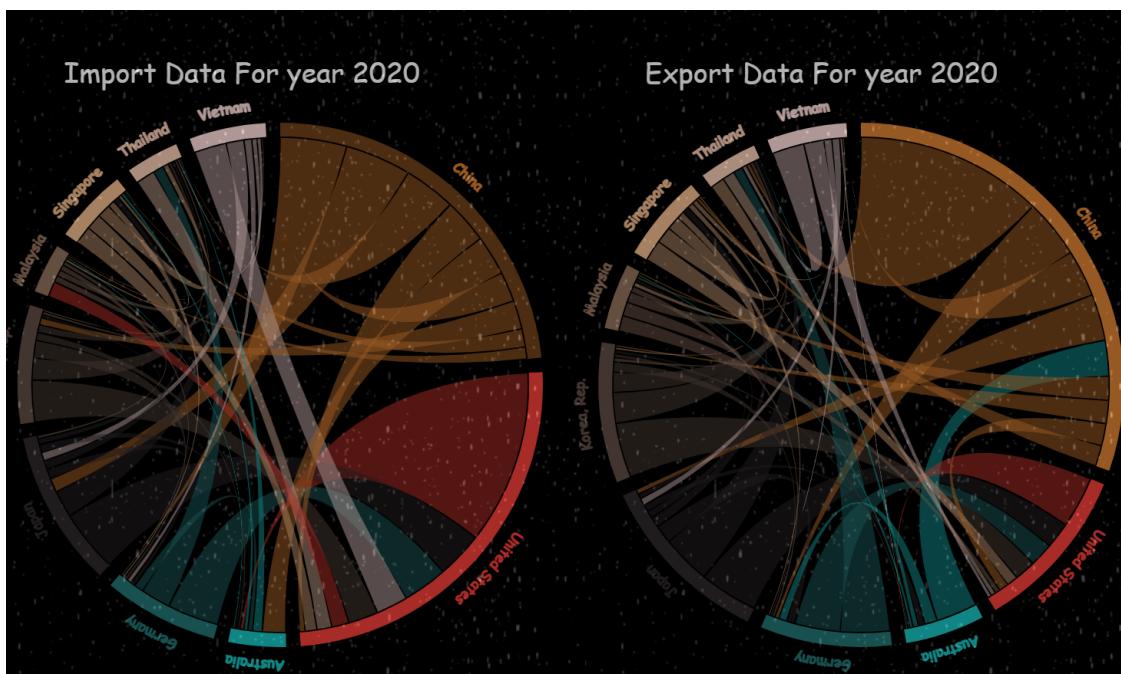
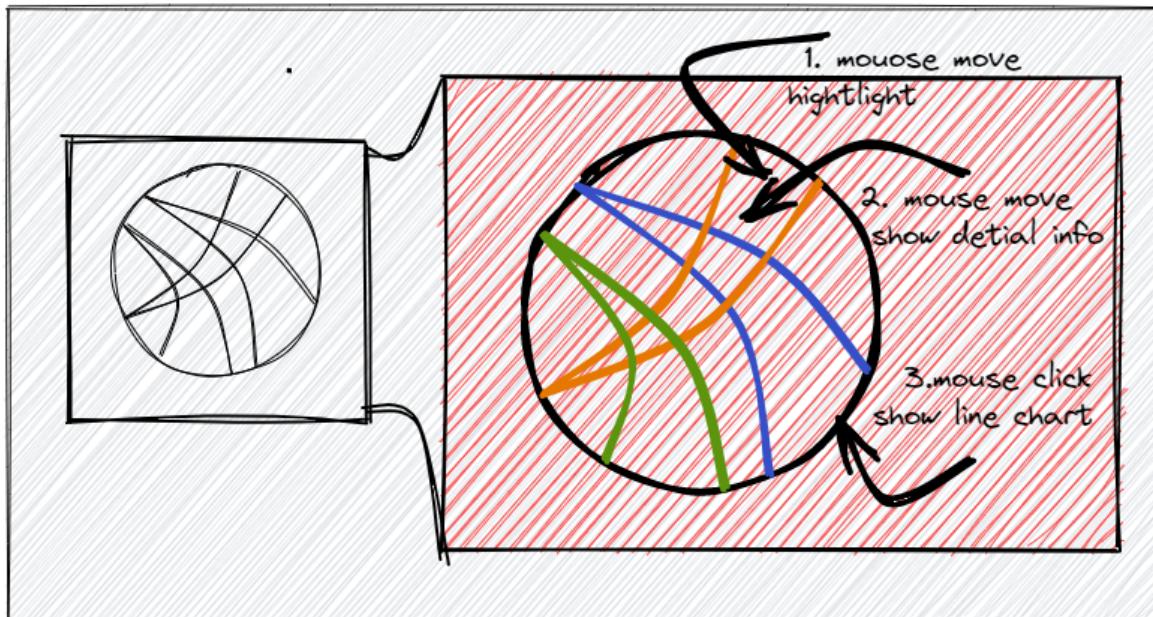


### Milestone progress:

This image shows the current implementation at the milestone. We have successfully processed the data and passed in data into our chart class. The top two chord charts show the importing section and exporting section of top 10 trading partners in the world. The button line charts show the trading amount of different trading partners across the years. The default country is China. We are considering adding widgets and other interactions in the future. In the right side, we add the three different interactive elements, including select, button and slider.

Final :

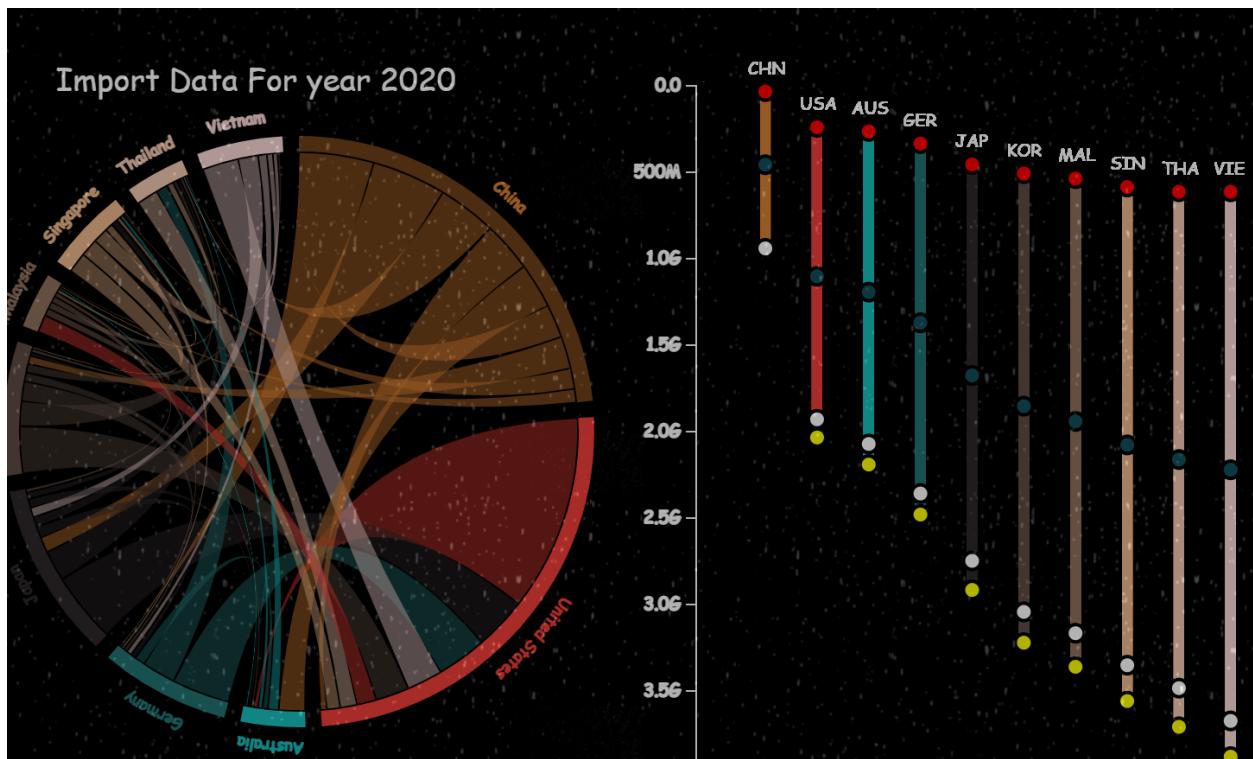
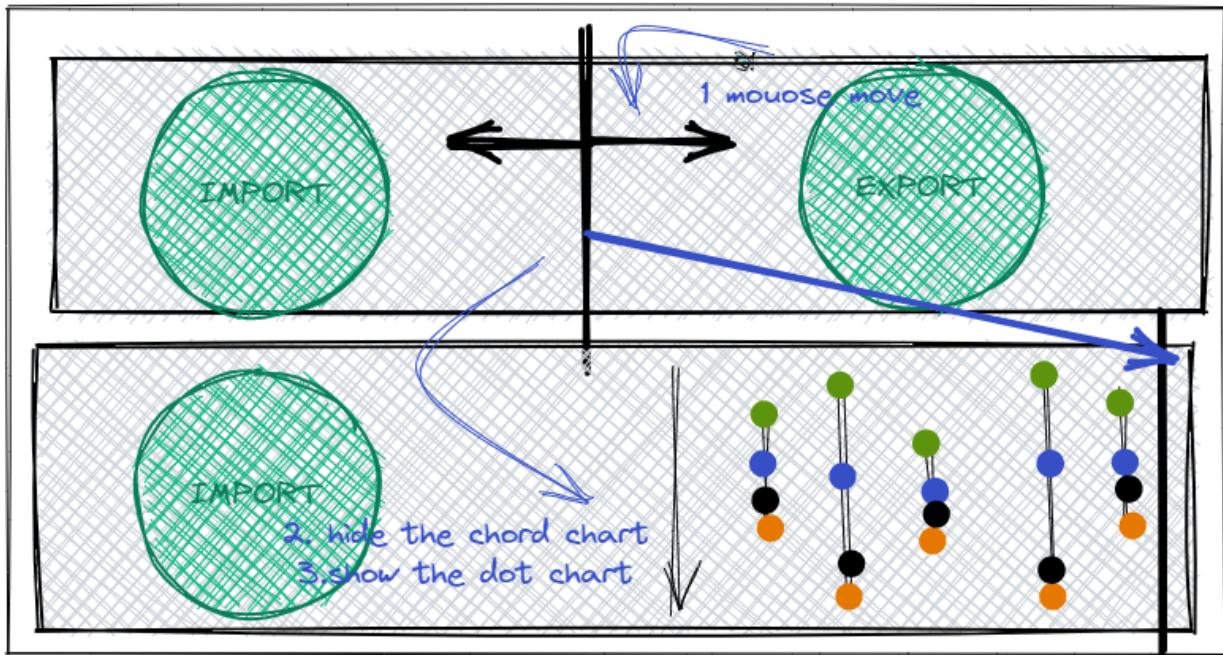
## CHORD CHART



At the end of our project, we adapted some major changes, adding more graphs and functionalities. First, we added some animations. We took the suggestions from the peer review. By clicking the country tag in the chord, we are able to do a graph switch. The view will zoom in and zoom out. After a short animation, the chord chart will remain the same but the button parts will come out with a text description and the line chart. Our original design is four charts at the same time.

But we thought it may be confusing for the user: which country is displayed for the line charts. So we revise the logic of demonstrating line charts. Once the user clicks one of the country tags, the line chart will display the trading data for that country. The importing graph and exporting graph will show at the same time.

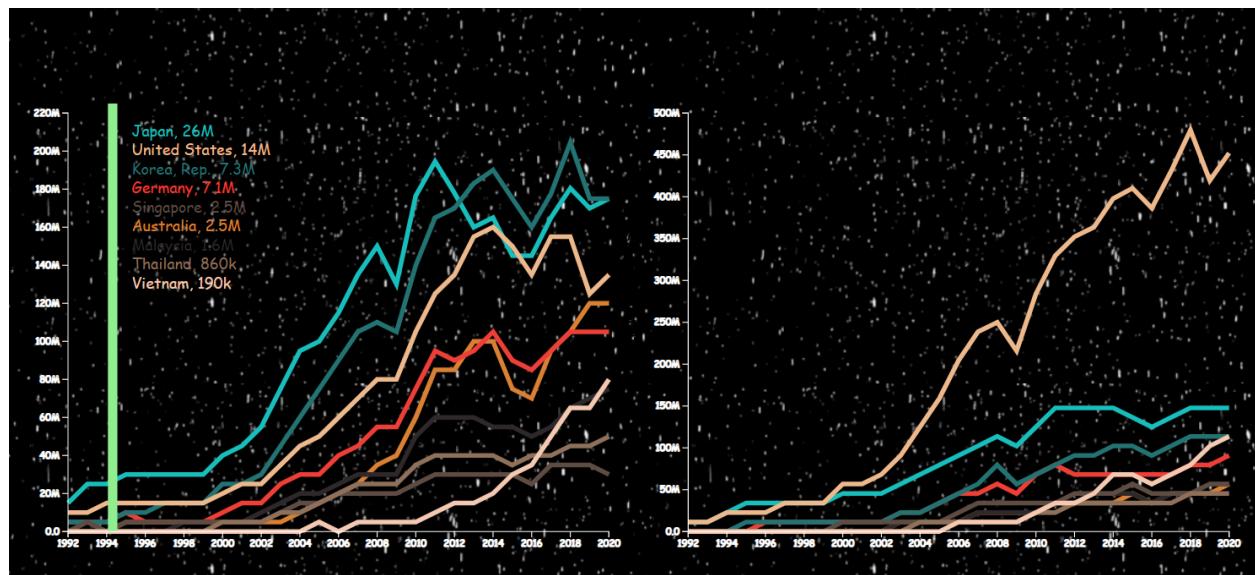
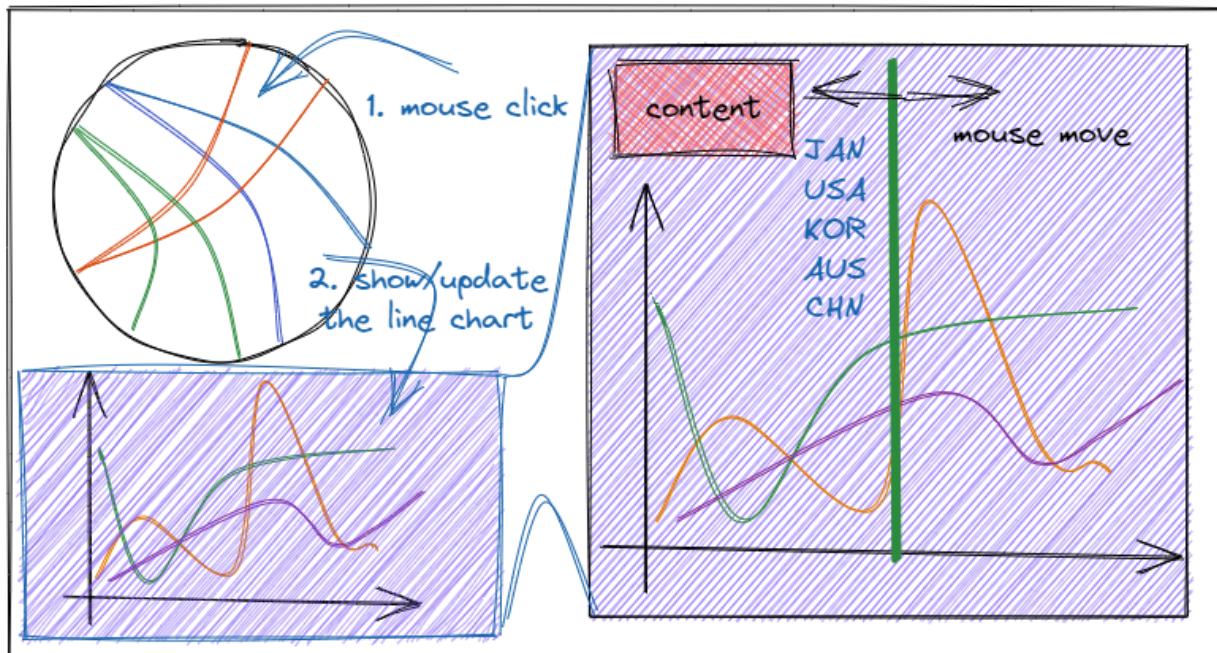
## DOT CHART:



Other than the animation, we added a separate dot chart to demonstrate the changes over the year. Compared with milestones, we have added a new graph, which we call a dot chart. And an interaction is added. when the user moves the mouse. It will gradually hide the left or right chord chart and display the dot chart. The dot chart shows that the import and export trade value of each country in a certain year has a relationship with its maximum value, minimum value and average value. We think this is beneficial because it just complements the chord chart. Provide more information to users.

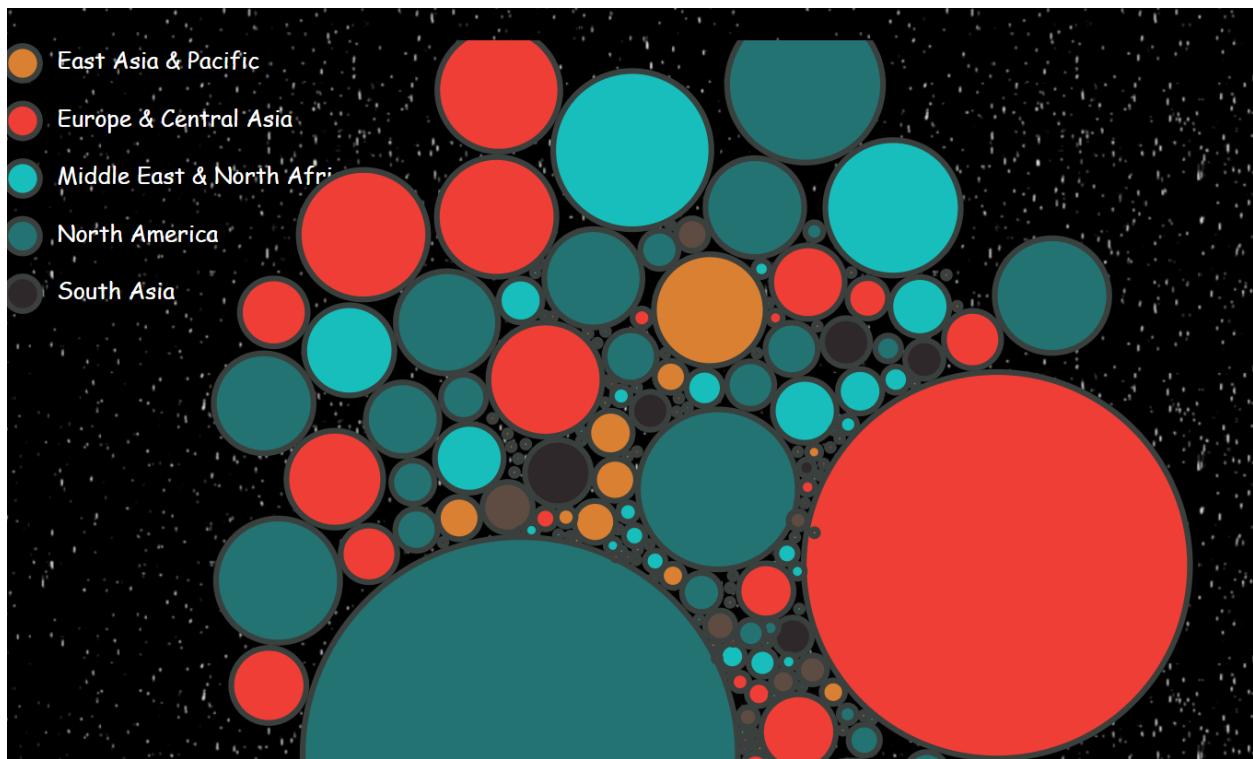
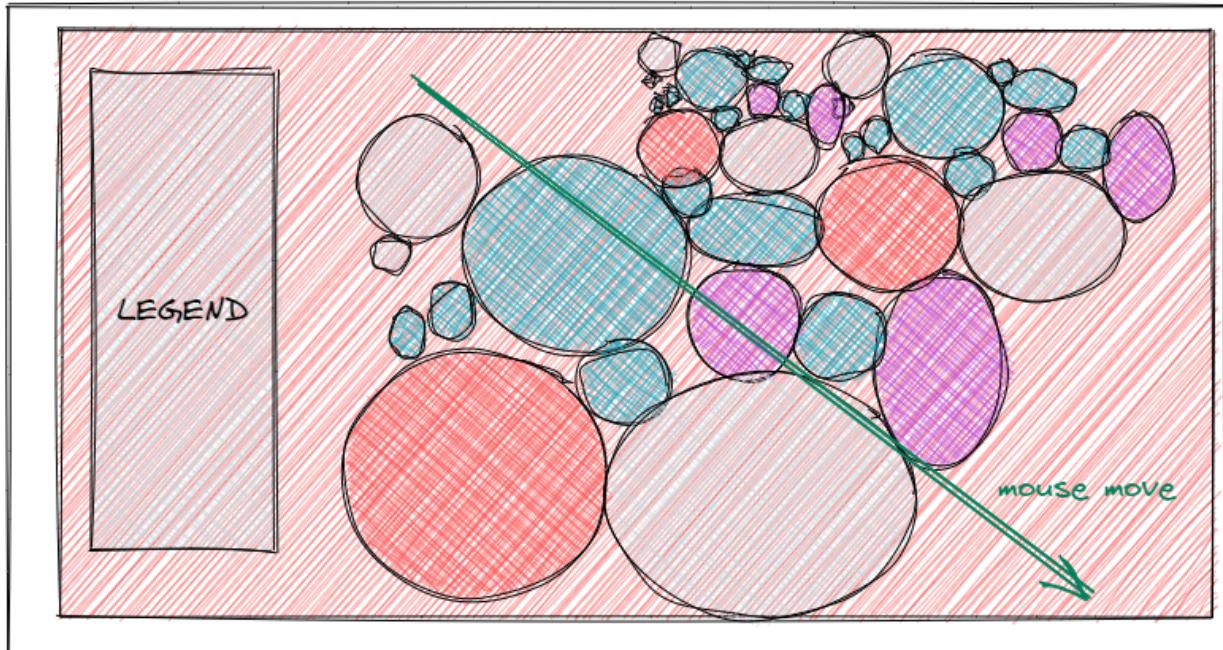
Of course, this dot chart can also be affected by the slider. User can pull the slider to change the time.

## LINE CHART:



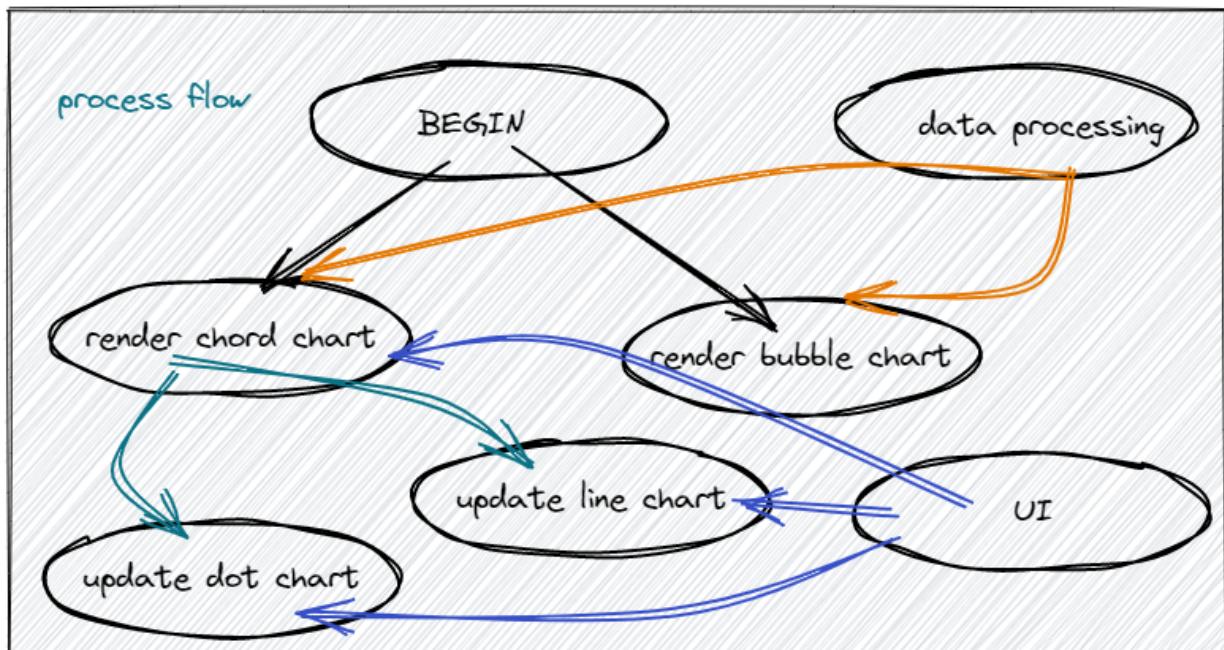
The line chart we added is precisely the same as in the HW3 visualization. When the user clicks on the graph, the chart will display a green bar to indicate the mouse position and all the trading data. After completing the line chart, we added storytelling to the space above the line chart. In order to facilitate the management of these storytelling, we use tools.js to manage. And put all the content you want to display into foo.txt to facilitate future maintenance and updates.

## BUBBLE CHART:



We also added a new bubble chart. Each bubble represents a country, and the countries in the same continents are marked as the same color. The bubble charts are different from the normal bubble chart we programmed in the early homework. The user can drag the bubble, and a physic-based animation exists. The user could push the smaller bubble with the large bubble. However, a large bubble can't be pushed by a smaller bubble. We think there could still exist some improvements in the bubble charts. The Bubble chart should display the country name on each bubble. After a bubble is dragged, the bubble is fixed at the final place and can't be pushed. The bubble charts give a more straightforward way to demonstrate the trading difference between different countries, and it also provided a cool visualization effect.

Here is our project's process flow:



## **Evaluation:**

### ***Milestone progress:***

Currently we are able to see the portion of worldwide trading. Clearly, China and the US occupy almost half of the world's trading volume. Based on the GDP of the two countries, China provides cheap industrial products to the world (mainly the US). From 1992 to 2020, China's trading volume kept increasing (both importing and exporting). Covid-19 didn't affect the Chinese economy too much. The importing and exporting volume is still increasing. Currently we are only able to visualize one country. We will see how the other countries trading stats once we finish our interactions functionality.

### ***Final progress:***

We finalized our visualization with the chord charts in the first place. Then the other charts will come out by clicking certain elements. We adapted the menu layout we talked about in the lecture. Adding storytelling section (mainly text), dot charts, and bubble charts. Overall we overpass the expectation of our initial though and reach the final goal. There still exist some minor bugs which will be fixed in the future. But our final visualization looks great and we are satisfied with it.

## **Peer Review Comments:**

Our peer review partner Jack Wilburn and Max Lisnic. Comments for our purpose:

1. Include some bad charts in our final report. Those bad charts are the ones we want to improve in our visualizations.
2. Our visualizations didn't tell an interesting story. We should demonstrate our visualize result (lacking of storytelling).
3. We didn't plan any animation. We may add some line chart animations in our implementation.
4. How do we handle the bin percentage less than 1 percent? Are we going to collect all the countries? The answer is no. We realized there are hundreds of countries in the world, but not all of them are actively involved into the global trading system. So we only pick top 10 training countries for our visualization.