INF 552 Report

Data Visualization for Netflix TV Shows and Movies

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1 Introduction

Digital streaming platforms such as Netflix captivate audiences from worldwide with a diverse array of content. As we navigate through the vast expanse of Netflix's content library, we noticed that their are data are stored as tabular data, covering a wild range of information about TV shows and movies. However, the tabular data is only a raw representation of data, without any global or statistical description of the data and it is hard to interpret the connection between different data attributes or different entries of the dataset, this requires to involve data visualization method to provide potential for description the data attributes, such as the distribution of genres and release years, as well as global viewing of data statistics information associated to their geological location.

For our project, we chose to visualise data about the topic that is familiar to most people nowadays: online streaming. Netflix is the most popular movie streaming platform in the world, with more than 240 million subscribers in over 190 countries. It hosts existing movies and creates its own. Netflix dataset [1] is available on Kaggle. The advantage of this dataset is its collection of variety of data on the movies and TV shows available on Netflix.

The objective of this project is to analyse this dataset and to provide different types of visualisations, including maps, scatter plots, histograms, graphs, etc. We choose to use d3 Javascrip library for the visualizations for its flexibility and power. It is suitable for any kind of data visualization, from simple charts and graphs to complex maps and networks.

1.1 The Dataset

This dataset has 5489 rows for unique movie title IDs and 15 variables containing their information. It includes information about the genre, score on IMDB, the release year and production countries, etc. It also over 77000 credits of actors and directors on Netflix titles with 5 variables containing their information, including the actor or director's name. This dataset was acquired in July 2022 containing data available in the United States. The raw data are provided in csv files.

1.2 Motivation and Major Challenges

Motivation. Our motivation for undertaking this project comes from the drawbacks of tabular data that the raw data remains a narrative way to present numbers or categories, rather than using raw data, we propose to integrate visualization method to provide a vivid description the data attributes, such as their statistical distribution, the correlation between data, and to project the data statistics on the corresponding geological location. The design of our visualizations is realized using d3 JavaScript library.

We believe that visualizing the statistical information of these attributes will not only provide a comprehensive overview of Netflix's content but will also offer insights into the evolution of entertainment industry over time. By employing data visualization methods with d3 library, we aim to transform these distributions into interactive, intuitive representations that allow our readers to navigate the vast expanse of these attributes effortlessly.

In addition, we are motivated to plot a global map of streaming content production country by associating data statistics with geographical locations. Understanding how content producted across different regions is a also key aspect of our project. Through geological visualization, we want to show different ways for viewing aggregated numerical data. This is aimed at providing a understanding of how Netflix content are produced throughout world.

Besides, our motivation extends beyond the confines of data analysis, it is also rooted in the belief that visual exploration of the data can give insights to the readers. In this project, we also offer an interactive platform where users can personalize their exploration of Netflix data attributes.

Furthermore, we are motivated by unrevealing the hidden dependencies and correlations within the dataset, we recognized the dynamic relationships between the data entries in the Netflix dataset through our work on visualization. Our project brings these discovered connections to diverse forms of data visualization. Connected graphs and hierarchical graphs illustrates the relationships between actors and directors, and the connection between different genres. Scatter plots captures the correlations between scores Heatmap provides a vivid representation of the correlation among different attributes.

Challenge. The first challenge is aggregating the diverse array of information in each row of the CSV file. With each entry representing a unique movie or TV show, we want aggregate data by different attributes such as release year, genre, country and then load the data to the d3 visualization element.

[1] https://www.kaggle.com/datasets/victorsoeiro/netflix-tv-shows-and-movies

The second challenge is projecting aggregated data into a visual representation on a world map. While the raw data resides in a structured CSV file, the geographical mapping for an intuitive and meaningful mapping system adds complexity of our project, we chose TopoJSON library for the data projection on a world map.

To enhance the user's experience and provide a better understanding of the data, our third challenge is the incorporation of animation into visualizations. Implementing animations will not only make the visualizations good-looking, but also enable users to gain insights at different scales and resolutions.

The final challenge is to add interaction. We want to provide personalized exploration of Netflix data. This involves the implementation of interactive methods that allow users to adjust parameters, choose specific attributes. The challenge here is to find balance between flexibility and accuracy of the data representation, ensuring that the interactive features enhance user experience without loosing accuracy on the data statistics.

1.3 Outline of Visualizations

In a short summary, the following visualizations were created in our project, and the detailed explanation are given in Section 2 of this report.

1. **World map of the number of movies:** Visualisation of the number of movies produced per country on an a world map.
2. **Collaborative relationships visualization:** Visualization of collaborative relationships between actors and directors by the nodes and links in a graph.
3. **Most popular actors:** A simple but interesting metric to look at is the most popular actors on the platform.
4. **Review score distribution visualization:** A ridgeline plot visualizing review score distributions, with an interactive feature allowing users to filter genres based on specific criteria.
5. **Correlation between review score and popularity:** A scatterplot analyzing the correlation between popularity and review scores, incorporated a comparison mode for users to select and compare different media types or years side-by-side.
6. **Interactive histogram for numerical features:** Histograms for presenting the statistics of numerical attributes, incorporated with a drop-down list and a slider bar for users to personalize the parameter of this histogram.
7. **Bar charts for categorical features:** Bar charts for presenting the statistics of categorical attributes, showing the top 30 countries with the most number of productions and genres distributions.
8. **Treemap for genres counts:** A visualization for displaying count of each genre in a treemap, the area of each node represent the number of production in this genre.
9. **Area charts for genres throughout time:** Using a stacked area chart, showing the percentage of production for each genre throughout time.
10. **Chord diagram for genre overlaps:** Providing information on co-appearance of different genres, and presenting the connections in a chord diagram.
11. **Heatmap for Feature Correlations:** Visualizing the correlation between data attributes using a heatmap.

2 Visualizations

2.1 World map of the number of movies

For the visualisation of the number of movies per country, we used an interactive world map. When hovering over a country, the user can see its name and the total number of Netflix movies produced there. We chose to use a blue and red color scheme to make the countries that produce few movies stand out from the countries for which there is no data. This was more difficult to achieve with a one-color scheme. A special library was used for this map, namely TopoJSON.

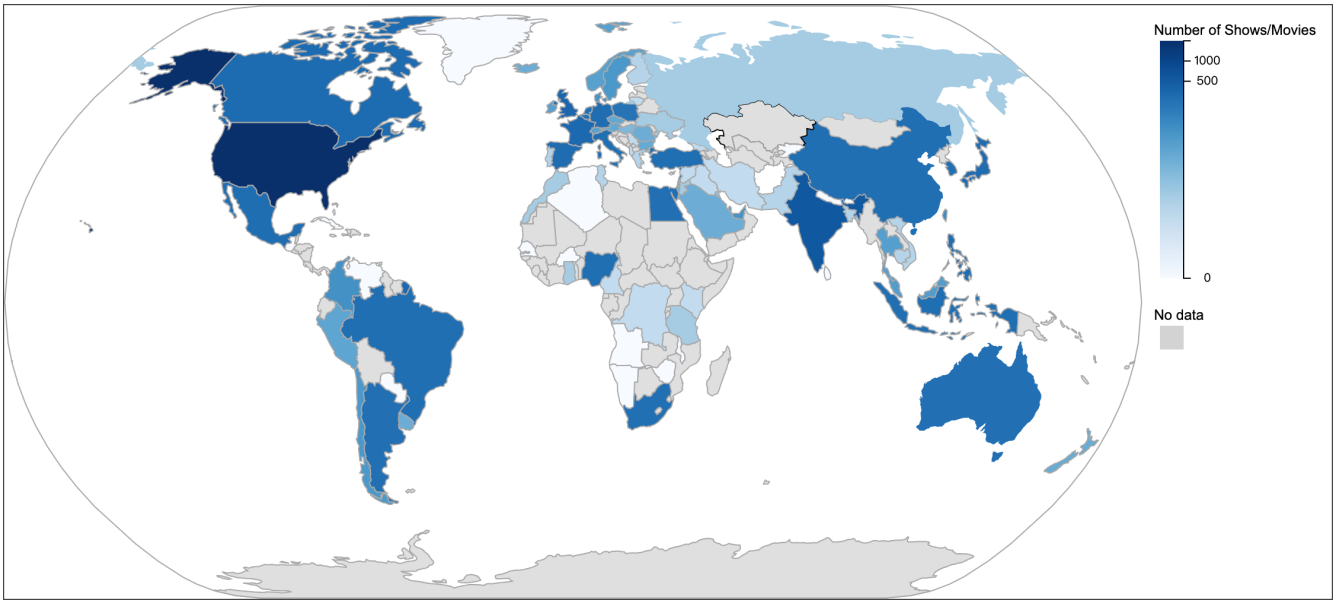


Figure 1: Number of Netflix movies per country

2.2 Collaborative Relationships Visualization

For the visualization of collaborative relationships between actors and directors, we have integrated additional features to enhance user experience and comprehension. Beyond representing actors and directors as nodes, we have introduced varying node sizes proportional to the total number of projects an individual has participated in. This size differentiation allows for immediate visual recognition of the most prolific individuals in the network.

Additionally, we employ color gradients on the edges to signify the timeline of collaborations. Edges begin with a lighter hue, indicating earlier projects, and gradually darken towards the latest project. This chronological representation provides insights into the evolution of collaborations over time.

We also implement a search function, enabling users to input the name of an actor or director. The network dynamically adjusts to highlight the searched individual, along with their direct collaborations. This feature allows for a targeted exploration of the network, particularly useful in large datasets with numerous nodes and connections.

2.3 Most Popular Actors

A simple but interesting metric to look at is the most popular actors on the platform. Because the United States is the country where most Netflix productions originate, it could be reasonable to assume that the most popular actors would be American. As can be seen in the following visualisation, they are all Indian.

2.4 Review Score Distribution Visualization

For the ridgeline plot visualizing review score distributions, we have added a feature that allows users to filter genres based on specific criteria such as the number of films or average box office earnings. This filtering capability aids in a more focused analysis of genres that meet certain thresholds, offering a tailored view of the data.

Moreover, the ridgeline plot includes an animation feature. On loading, the plot gradually transitions from a simple distribution curve to a fully interactive ridgeline plot. This animated introduction to the data serves not only as a visually appealing element, but also as an educational tool, guiding users through the evolution of the distribution shapes.

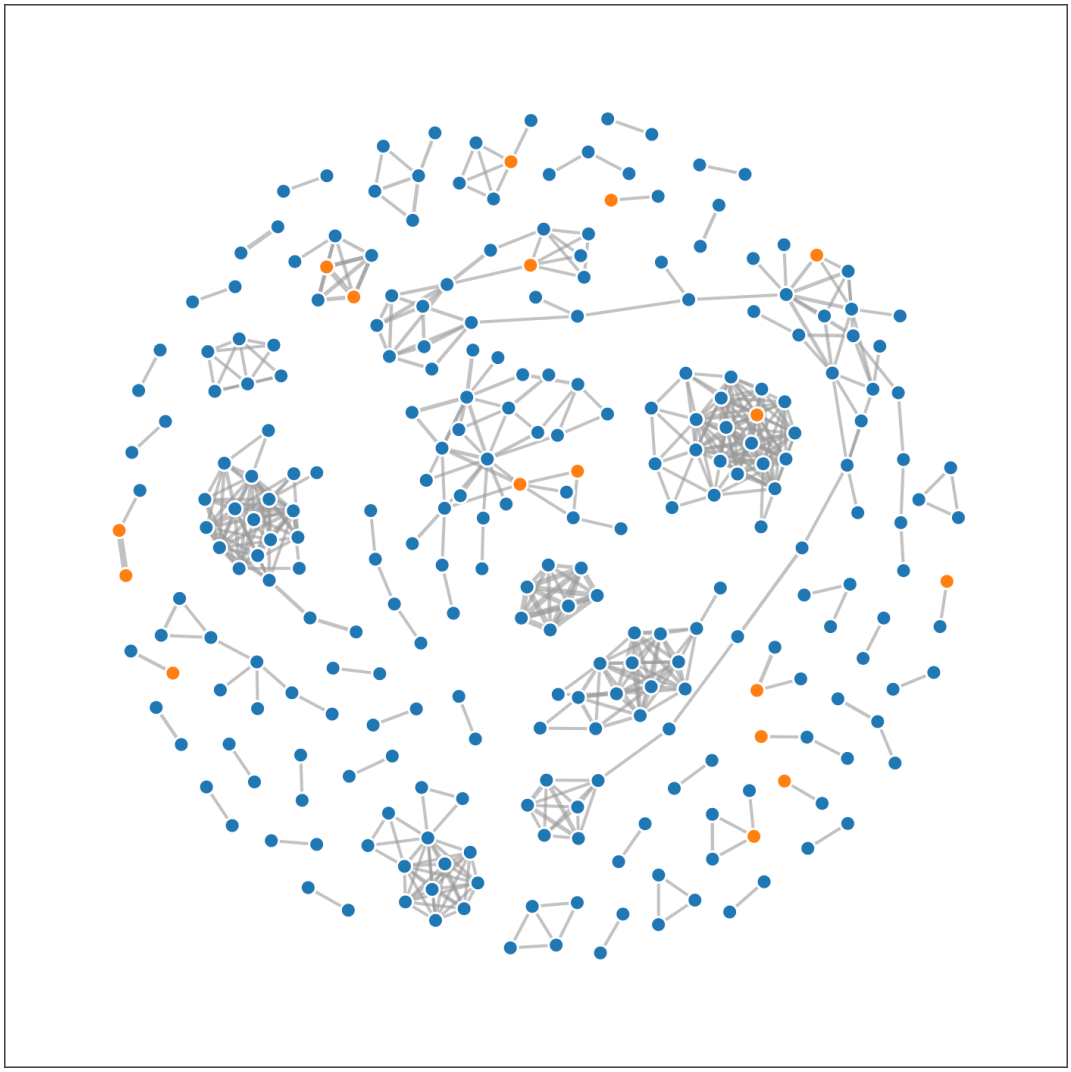


Figure 2: Collaboration

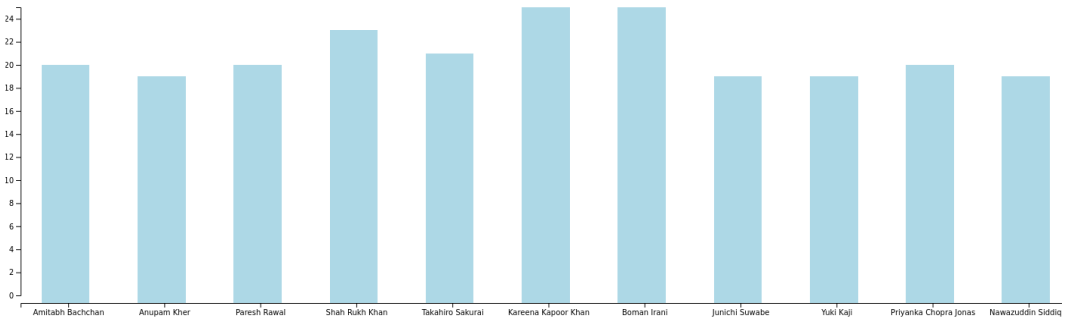


Figure 3: Most popular actors
The y axis is the number of movies per actor.

2.5 Advanced Features in Correlation Analysis: Correlation between Review Score and Popularity

In the scatterplot analyzing the correlation between popularity and review scores, we incorporate a comparison mode. This mode allows users to select and compare different media types or years side-by-side. Users can drag

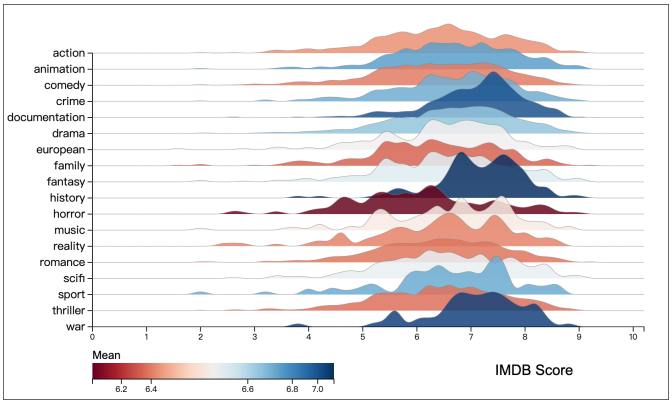


Figure 4: Ridgeline plot on IMDB score distribution, ordered by mean score

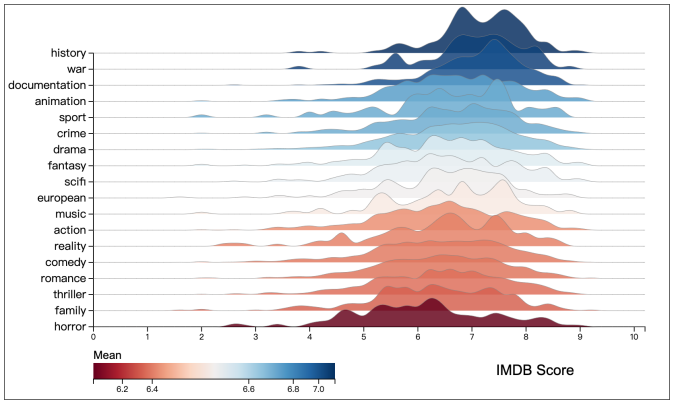


Figure 5: Ridgeline plot on IMDB score distribution, ordered by alphabet

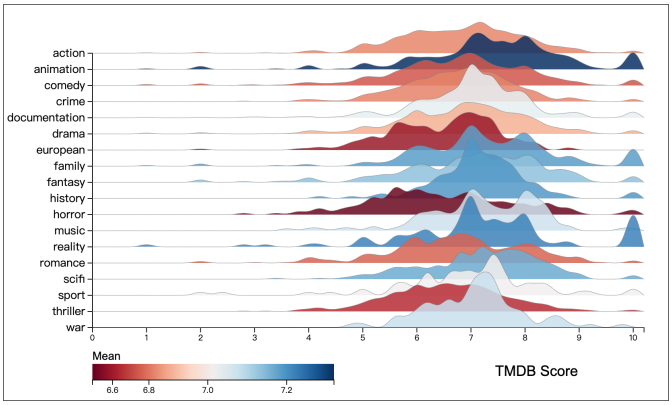


Figure 6: Ridgeline plot on TMDB score distribution, ordered by mean score

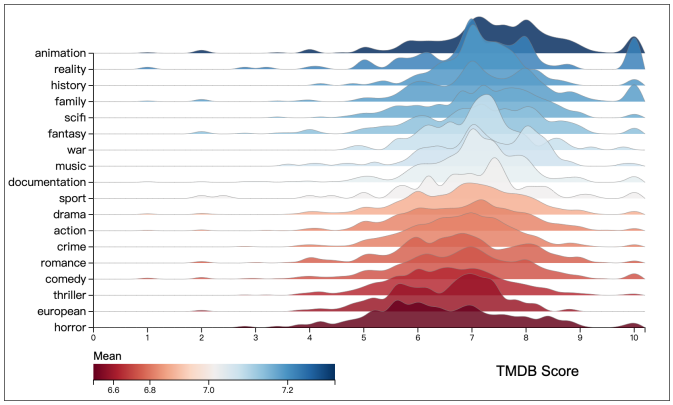


Figure 7: Ridgeline plot on TMDB score distribution, ordered by alphabet

and select a specific area in the scatterplot, and a new window pops up showing a zoomed-in view of the selected area for detailed analysis.

Furthermore, for the histogram beneath the scatterplot, we introduce a time-slider feature. This slider enables users to observe changes over time in the distribution of media types. As the slider is adjusted, the histogram and scatterplot update in real-time, providing a dynamic view of trends over the years.

These enhancements are designed to make the visualizations not only more interactive but also more insightful, enabling users to uncover deeper trends and relationships within the data. The use of D3.js in creating these sophisticated visual elements exemplifies the powerful capabilities of this library in crafting rich, interactive data visualizations.

2.6 Interactive Histogram for numerical features

Netflix dataset contains both numerical attributes and categorical attributes, in order to study the showing general distributional features for those attributes, we proposed to create histograms for numerical attributes. Histograms reflects the count of occurrences in the dataset for each logical range or bins.

To deal with numerical attributes, the visualization for histogram is created with d3.histogram() for setting the parameters and with d3 “rect” element for building the chart. The height of rectangles represents the count of occurrence and the width represents the value of the attribute. The video on Netflix could be TV shows or movies and the different natures of shows and movies, such as different runtimes, our histogram is designed in an interactive way by varying the colors of the rectangles representing each type, when chosen one type of the video, the corresponding histograms’ color can be highlighted. Also, by stacking the bars of histogram, this visualization could provide a global description for the numerical attributes in this dataset. In addition, we integrated a slider

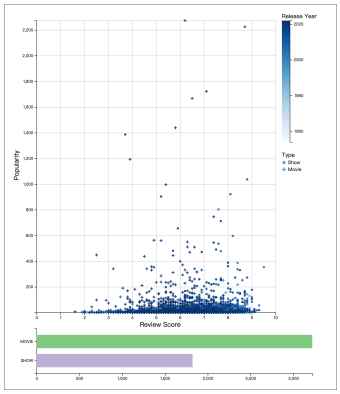


Figure 8: scatterplot, linear scale

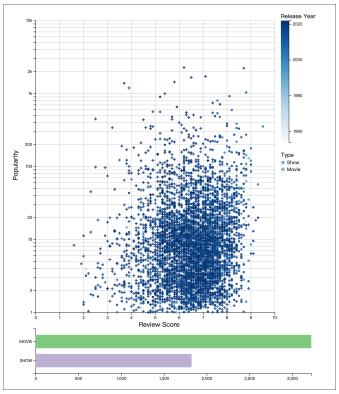


Figure 9: scatterplot, log scale

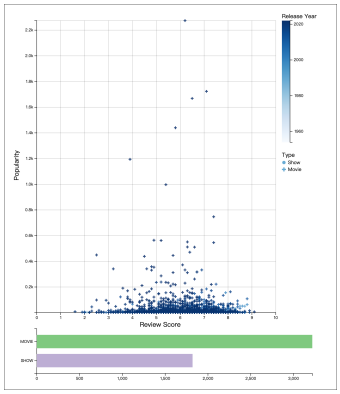


Figure 10: scatterplot of movie type, linear scale

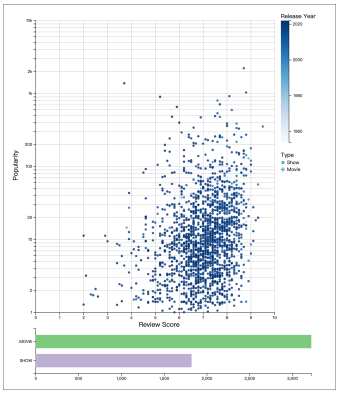


Figure 11: scatterplot of show type, log scale

and a drop-down menu list for users to choose the attribute and choose the desired number of bins in the histograms.

Fig. 12 illustrate the histogram for runtime for different types content.Netflix offer two kinds of streaming content, namely movies and TV shows. Distribution of the content on this platform is skewed towards to movies, which occupy 64% of all the contents, two times more than the number of TV shows. This may due to its users prefer spend limited amount of time rather than bench watching episodes of TV shows. This feature might be important while analysing other features.

In general, movies have longer runtime than TV episodes. From the histogram, it is noticed that most movies are longer than 80 minutes while most TV shows are around 30 minutes or around 50 minutes, this is due to the fact that TV shows are often within 30 minute and hour show is within one hour, in Netflix dataset, they are both categorized as TV shows.

Fig. 13 present the histogram of season, imdb score and release year. In Netflix database, only TV shows have seasons, most of them are less than 3 seasons. Release of contents was happening from way back in 1945, and the number of productions increased through time. Since 2019, entertainment industry significantly produced more than past decades. For imdb score, most of the productions get 5 to 7 points, indicating that the contend in Netflix is generally appreciated by the public.

2.7 Bar Charts for Categorical Features

For the categorical attributes, bar charts are plotted to show the count of occurrences in Netflix dataset for each category. To deal with categorical attributes, the visualization is realized by creating a bar chart using d3 "rect" element, with the height representing the count of occurrences of different categories. The position of each bar is ordered by their count in descending order. This sorted bar chart allow us to know which category has the most count, and provide a comparison between different categories.

We calculated the number of productions in each country and show the top 30 countries in terms of their number of productions (Fig. 14a). The united states produced most, more than 3 times than the second one (India), and

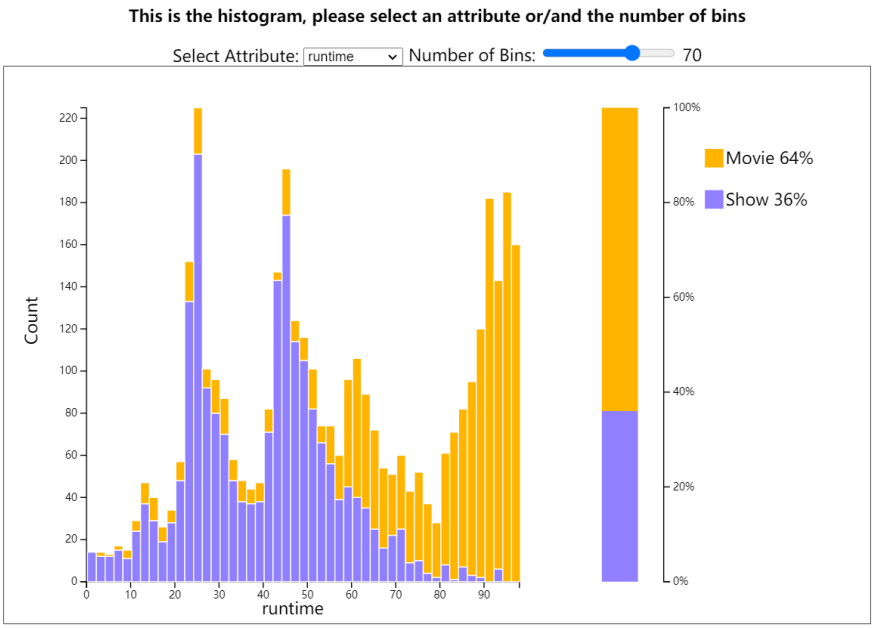


Figure 12: Histogram of runtime for different types of production

United Kingdom (Great Britain) ranked number 3. Since Netflix is an American company, it is expected that it covers more productions from US and English-speaking countries.

Fig. 14b presents the number of productions in each genres. The most popular genres of productions are comedy and drama, both of them have more than 2000 production in our Netflix datasest. The genres with least number of productions are war, sports and western, it can be concluded that Netflix is more focused on comedy or drama rather than western, war and sport type of content. This could be the result of the influence from costumers' interest and from the producers' working field.

2.8 Treemap for Genres Counts

Treemap is a visualization method for displaying hierarchical data. It uses nested rectangles to represent the branches of a tree diagram. Each rectangle has an area proportional to the amount of data it represents. In our case, we have limited hierarchical structure in our dataset, as a result, each genre is represented as one leaf node and they all have the same level of hierarchy, all of them are connected to the root node in this graph (shown in Fig. 15).

The rectangles are filled with different colors to differentiate each genre. With a text element on each rectangle showing the genre and its count, treemap allows to easily identify the most and the least popular genres. Some genre with a very small count is represented by a very small rectangle, and the text will exceed the border of the rectangle, therefore, a clip function is used to constrain the location of the text element. This type of could be even more useful when illustrating hierarchical data.

The results on counts for each genres in this treemap is the same as is detailed explained in bar charts for genre counts.

2.9 Area Charts for Genres throughout Time

Stacked area chart displays the evolution of the value of several groups on the same graphic. The values of each group are displayed on top of each other, which allows to check on the same figure the evolution of the importance of each group.

In this figure, the percentage of production of each genre throughout time is analysed. The fully-stacked height of the topmost line corresponds to the total when summing across all genres, in our case is 100%. Comparing the heights of each segment of the curve provides a general idea of how each genre compares to the other in their

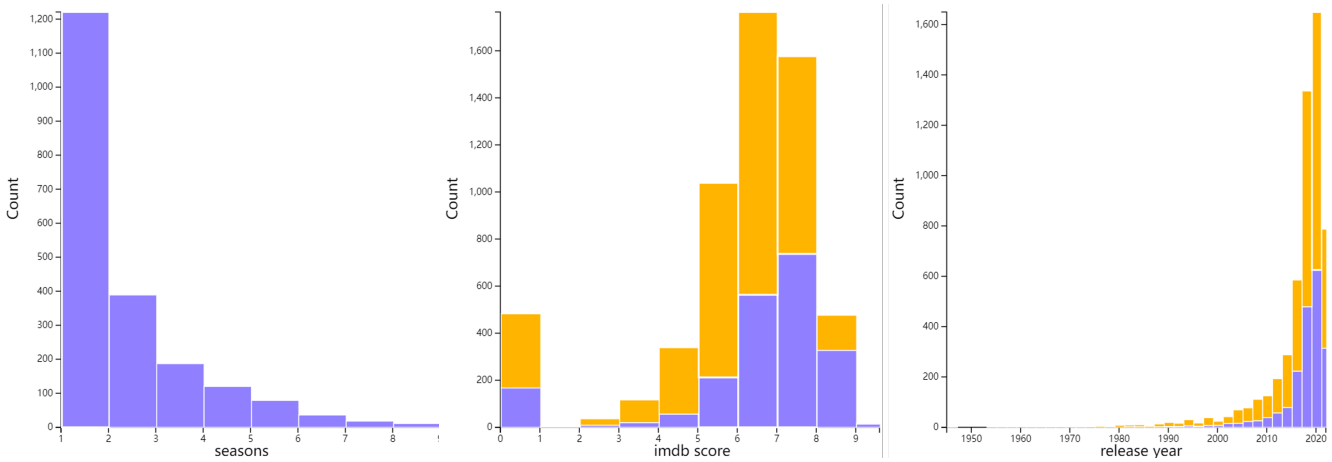


Figure 13: Histogram of season, imdb score and release year

contributions to the total. In practice, this chart loses information about the trend of the absolute counts but helps to bring out the comparison of relative contributions between genres. The data are prepossessed before plotting the chart. Firstly, an aggregating by genre is performed, then we compute the sum of each time period and obtain the percentage of each genre during this period. Secondly, area charts are generated with d3.stack() and d3.area() function draw the area and stack areas together. At last, each genre is assigned with a different color by a customed color scale to differentiate them between each other.

The horizontal-axis shows time period. Time range is from 1953 to 2021, since there isn't any data for 1949 to 1953 this period is ignored when we process the data. Some genres are not very visible because they only take up very small proportion, as a result, we decided to highlight the color and corresponding area when mouse pointer moves on this area.

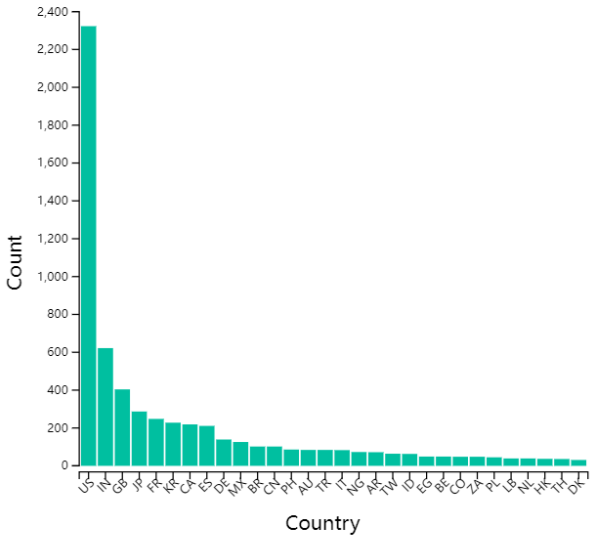
Results are given in Fig 16. Some genres has been produced throughout time, such as crime or drama; some genres started to be produced later, such as animation or science fictions, they begins to make this type of productions after the application of computers in film industry or TV series studios. Some genres only appears during some specific time period, for example, most western genres are added to Netflix database around 1960s due to their representation of cultural sentiments.

2.10 Chord Diagram for Genre Overlaps

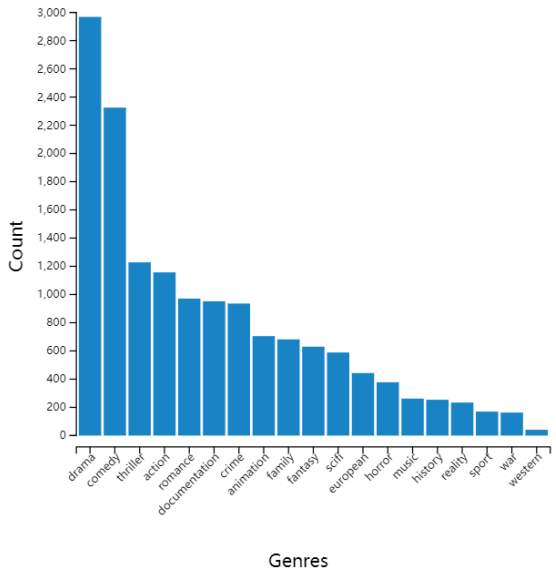
The co-appearance of different genres is also studied. One movie or one TV show may belongs to several genres at the same time. For this kind of analysis, we propose to use chord diagram. A chord diagram represents connections between several nodes. In our case, each genre is represented by a node. And it is shown as a fragment on the outer part of the circular layout. The length of this circular fragment corresponds to the percentage of the count for this genre among the summation of all counts. And each genre has a different color, which makes them distinguished from each other. Then, arcs are drawn between each nodes. The width of the arc is proportional to the count of co-appearance the between two genres.

The data is processed by d3.chord() function to set parameters for our chord diagram, the circular fragment and connected arcs between nodes are created with d3.arc() d3.ribbonArrow() function respectively.

From Fig 17, it is noticed that comedy and drama, romance and drama or action and crimes are often appears together, while some genres (for example, horror) are less overlapped with other genre. This is due to the nature of content. Take drama as an instance, dramatic movies often provide a heightened emotional experience, and it could be categorized both as drama and romance at a time. Besides, multi-labelled contents are more likely to be recommended to the users since a genre information is an important feature for recommender systems.



(a) Count of production for top 30 countries



(b) Count of genres

Figure 14: Bar charts for categorical attributes

2.11 Heatmap for Feature Correlations

Some attributes are correlated with each other, in order to show this kind of correlation, we use Pearson correlation coefficient to describe the correlation. Pearson correlation coefficient is computed by Eq. 1

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} \tag{1}$$

It is a number between –1 and 1 that measures the relationship between two variables. Negative values suggest a negative correlation while positive values suggest a positive correlation. We proposed to use a heatmap to visualize the correlation coefficients. Heatmaps show relationships between two variables, one plotted on each axis. By observing how cell colors change across each axis, we can observe if there are any patterns in value for one or both variables. In our visualization, we studied 6 different attributes, and the correlation coefficients are represented by squares with different color. The squares are created using d3 "rect" element. The color scale defined as darkblue for -1, grey for 0 and dark red for 1.

The heatmap is presented in Fig. 18. Release year is slightly negatively correlated to both IMBD score and runtimes. It is reasonable that consumers prefer recently released films or shows, and due to the technical constraints, very old films and show has less runtime than recent productions.

3 Conclusion

This project deals with Netflix dataset, the aim is to use various visualization method to present the statistical distribution and the connections among attributes in this dataset, the objectives has been achieved by delving into data visualization techniques.

Through the creation of scatter plots, histograms, bar charts, and area charts, we've not only presented data but also provided users of our webpage with the ability to interact and adjust these visualizations to meet their specific requirements.

In addition, the advanced graphical representations, such as graphs, treemaps, and chord diagrams, has allowed us to present data connections in a visual manner. These visualizations could serve as powerful tools for users to extract meaningful patterns from complex datasets.

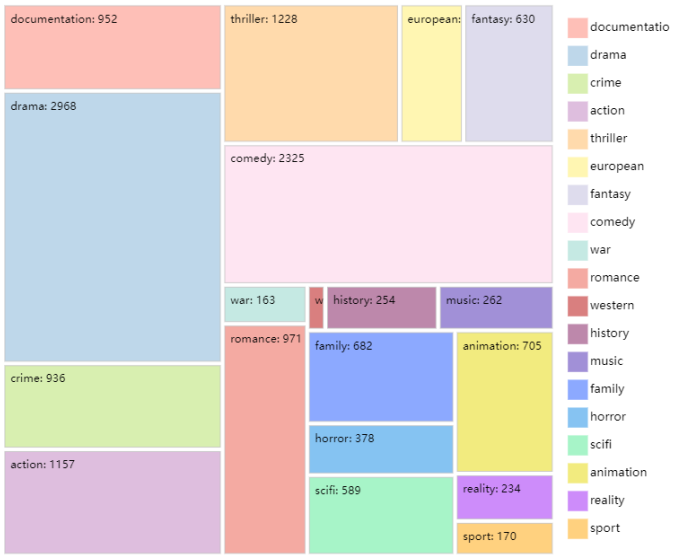


Figure 15: Treemap for Genres

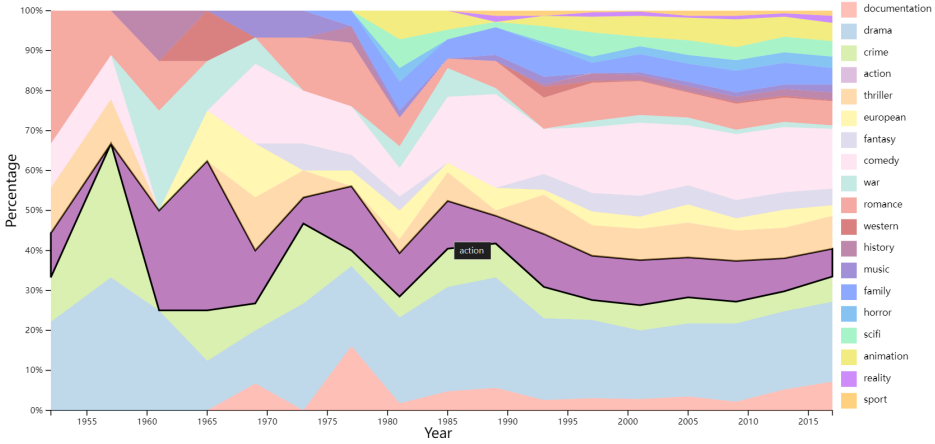


Figure 16: Stacked Area Chart for Genres over Time

Besides, the inclusion of a world map to present data geographically adds an extra layer of richness to our visualizations.

Another important highlight of our project is the integration of interactive features into the webpage. Users now have the flexibility to adjust parameters of the charts, providing a personalized experience. This not only enhances user engagement but also ensures that our visualizations are adaptable for a wide range of applications and purposes.

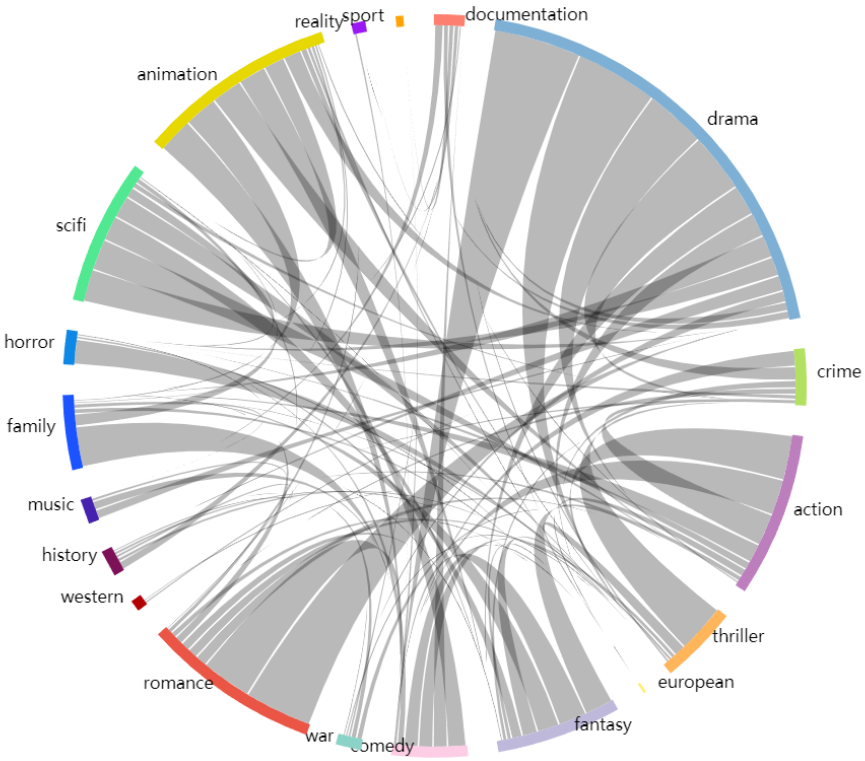


Figure 17: Chord Diagram for Genres

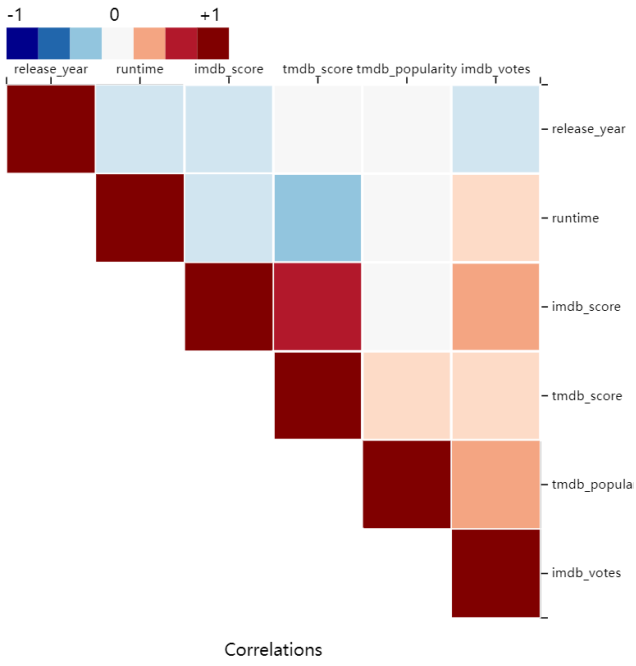


Figure 18: Stacked Area Chart for Genres over Time

A Complete dataset description

"Titles" dataset :

- a unique id
- title
- type (movie or series)
- description
- release year
- age certification
- duration
- genre
- production countries
- number of seasons (if applicable)
- imdb identifier
- imdb score
- imdb votes
- tmdb popularity
- tmdb score

"Credits" dataset :

- unique identifier
- movie identifier
- name of the actor
- name of the character
- role