Capstone Project - 4

Netflix Movies and TV Shows Clustering

Submitted by
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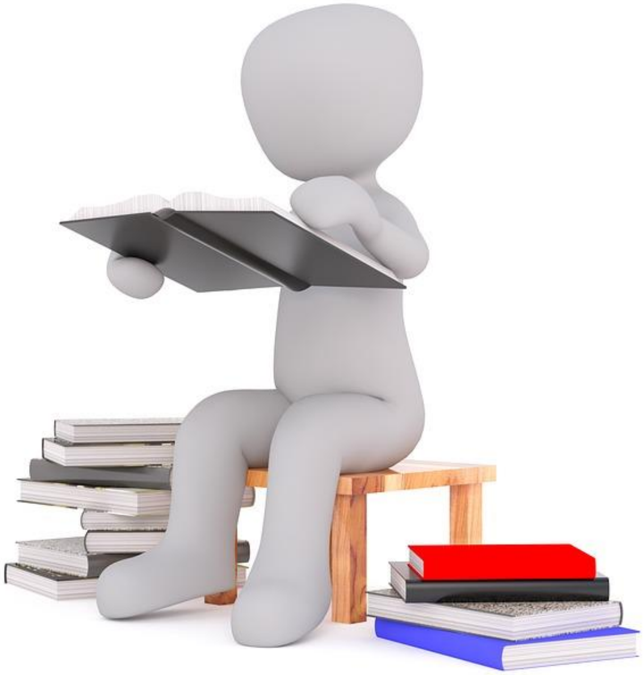
Agenda

- Problem Statement
- Data Summary
- Data Cleaning
- Exploratory Data Analysis (EDA)
- Feature Engineering
- Dimensionality Reduction
- Clustering
- Word cloud on Clusters
- Content Based Recommender System
- Challenges Faced
- Conclusions



Abstract

- Netflix is a popular streaming service and production firm.
- According to Statista, Netflix had approximately **220.67** million paid subscribers worldwide as of the second quarter of 2022.
- It is crucial that they effectively cluster the shows that are hosted on their platform in order to enhance the user experience for its subscribers.

Problem Statement

- The goal of this project is to cluster the shows on Netflix such that the shows within a cluster are similar to each other and the shows in different clusters are dissimilar to each other.
- These clusters may be later leveraged to offer the consumers **personalized show recommendations** based on their interests.
- The dataset contains **7787** records, and **11** attributes

Data Summary

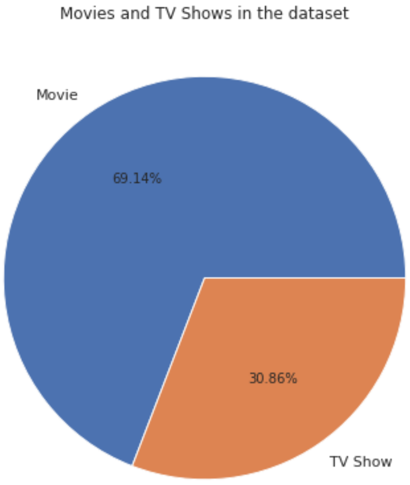
- **Show ID**
- **Type** – Movie / TV show
- **Title** – Show title
- **Director** – Name of the director
- **Cast** – Name of the cast
- **Country** – Production country
- **Date added**
- **Release year**
- **Rating** – Show age rating
- **Duration** – Minutes / seasons
- **Listed in** - Genre
- **Description**

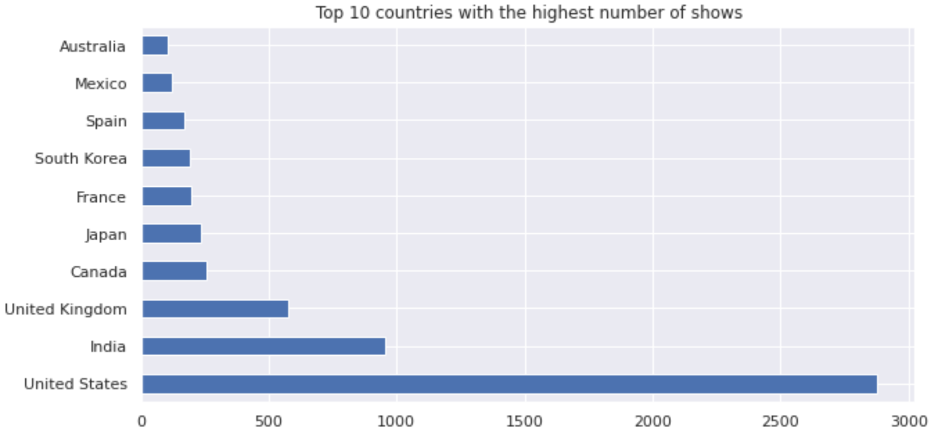
Data Cleaning

- Handling missing values:
  - Director (2389), cast (718), and country (507) – replace with **'Unknown'**
  - Date added (10) - **dropped**.
  - Rating (7) – **mode** imputation.
- Only primary genre and country were selected to simplify the EDA
- The dataset contained separate age ratings for movies and TV shows, and were replaced with values of: 'Adults', 'Teens', 'Young Adults', 'Older Kids', 'Kids'

Exploratory Data Analysis (EDA)

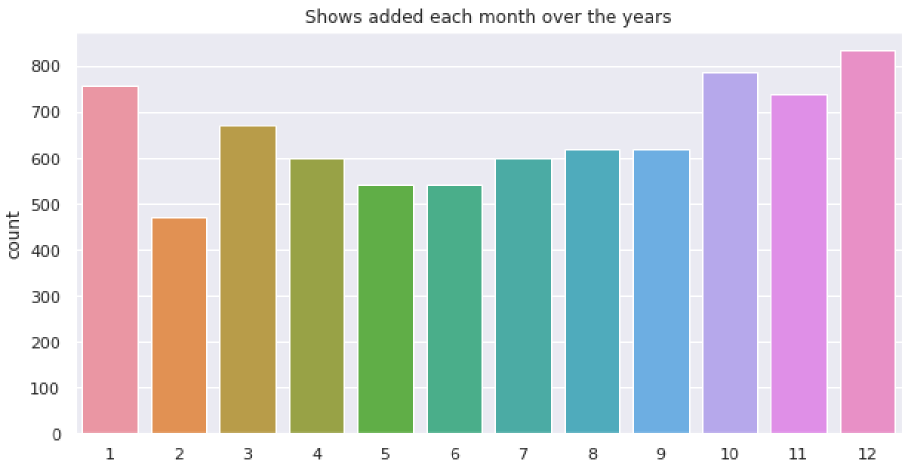
- **69.14%** of the shows on Netflix are movies, and **30.86%** TV shows.
- The top 3 countries together account for about **56%** of all movies and TV shows in the dataset.
- This value increases to about **78%** for top ten countries.

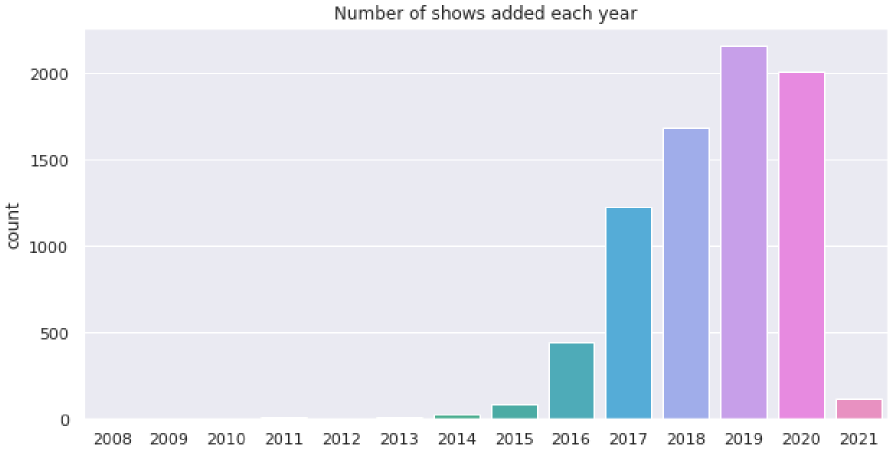




EDA (Contd.)

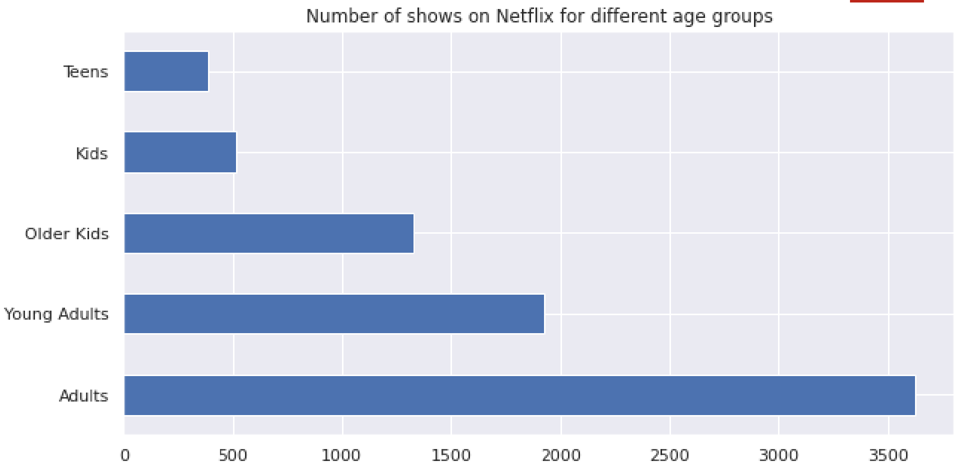
- More shows are added in the months of **October, November, December, and January**.
- There is a **decrease** in the number of shows added in the year **2020**, which might be attributed to the **Covid-induced lockdowns**, which halted the creation of shows.
- There are very few shows added in the year **2021**, since the data is available only up to 16th January.

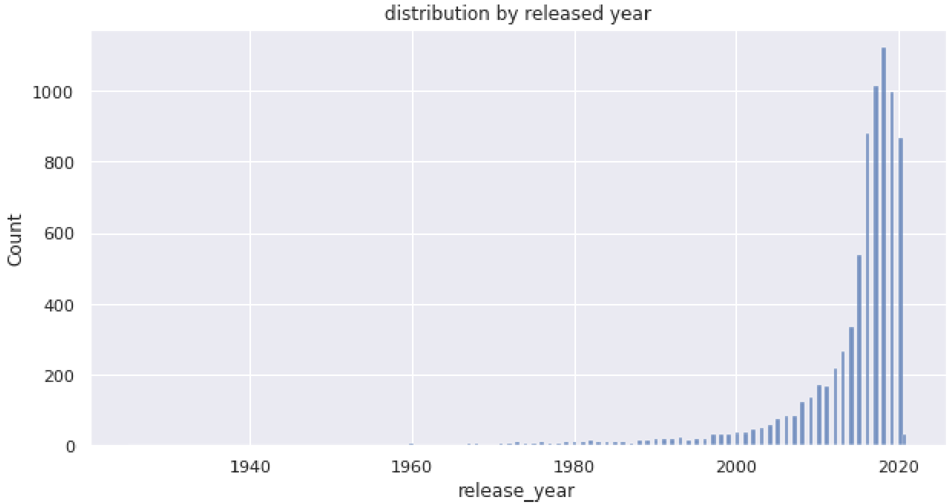




EDA (Contd.)

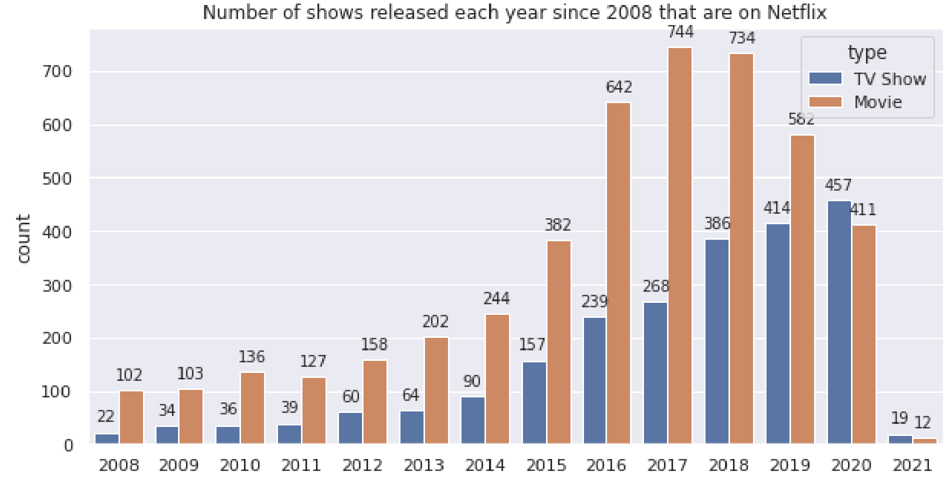
- The majority of the shows on Netflix are catered to the needs of **adult** and **young adult** population.
- Netflix has greater number of **new** movies / TV shows than the old ones.

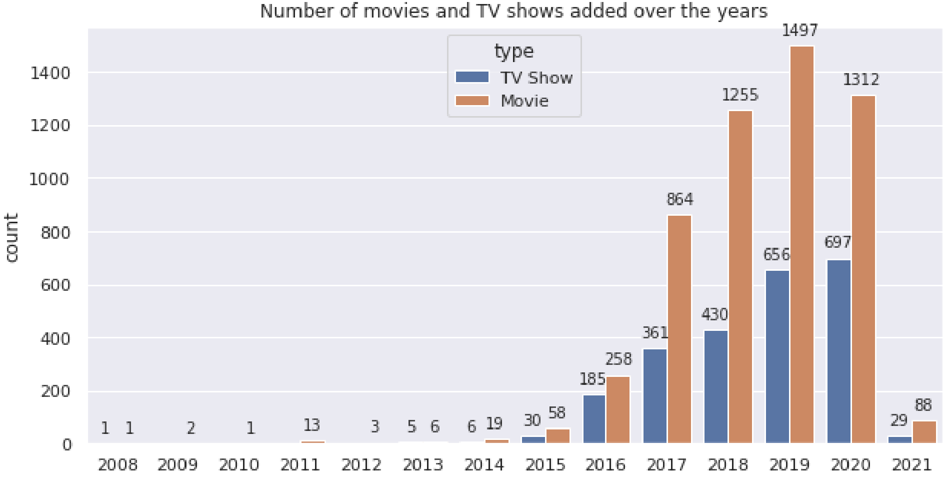




EDA (Contd.)

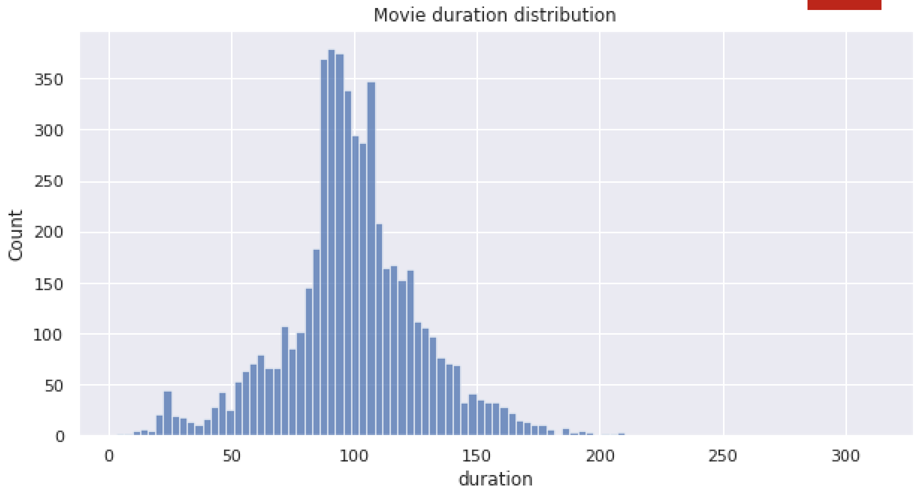
- Though there was a decrease in the number of movies added in **2020**, this pattern did not exist in the number of TV shows added in the same year.
- This might signal that **Netflix is increasingly concentrating on introducing more TV series** to its platform rather than movies.

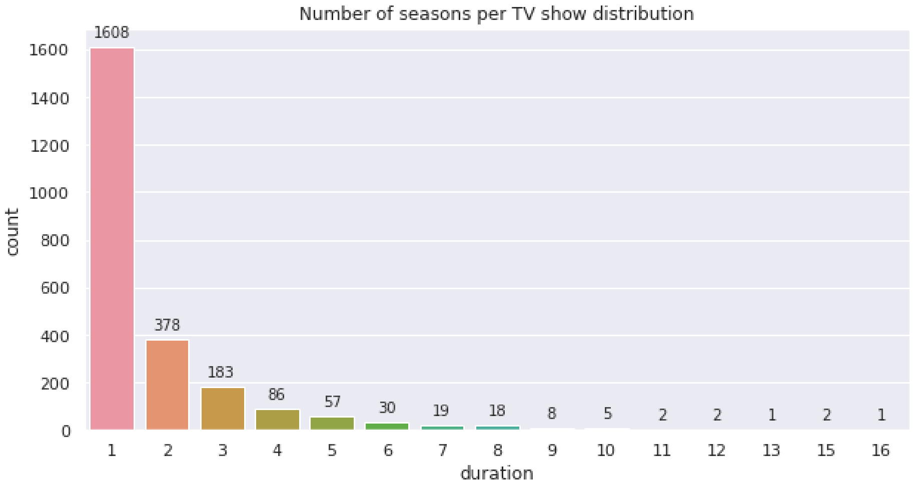


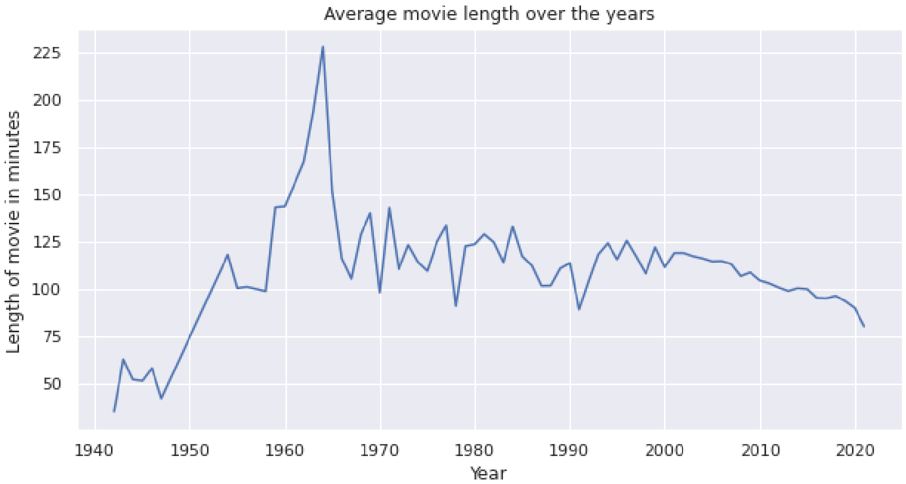


EDA (Contd.)

- The length of movies in the are almost **normally distributed**.
- Majority of the TV shows are still in the **1st season**.

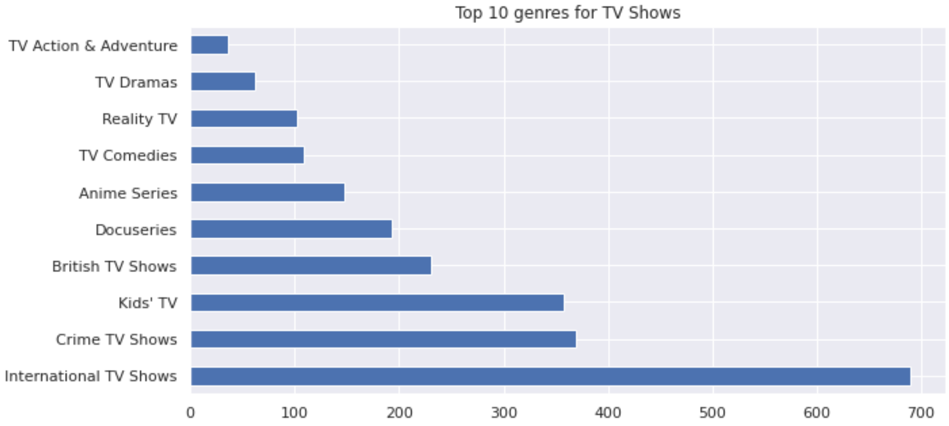


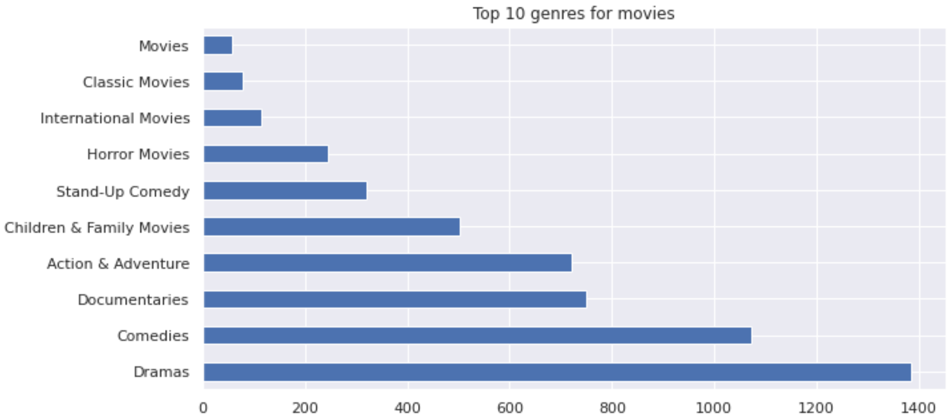




EDA (Contd.)

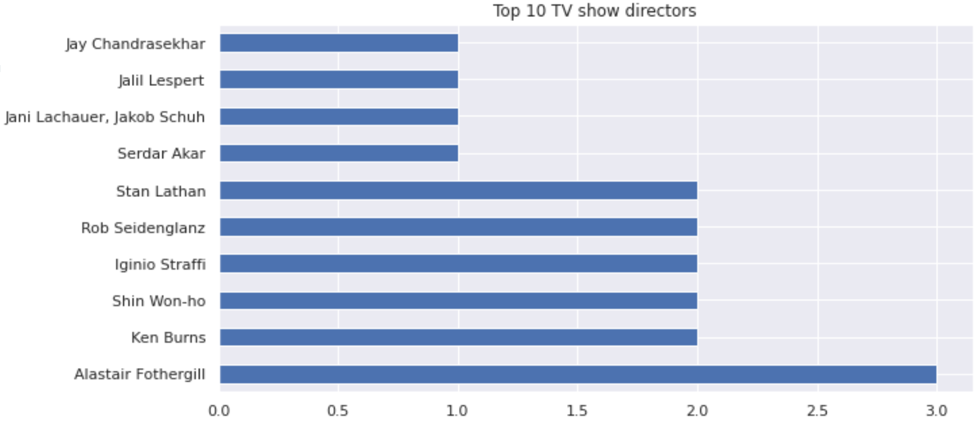
- **Dramas**, **comedies**, and **documentaries** are the most popular genre for the **movies** on Netflix.
- **International**, **crime**, and **kids** are the most popular genre for **TV shows** on Netflix.

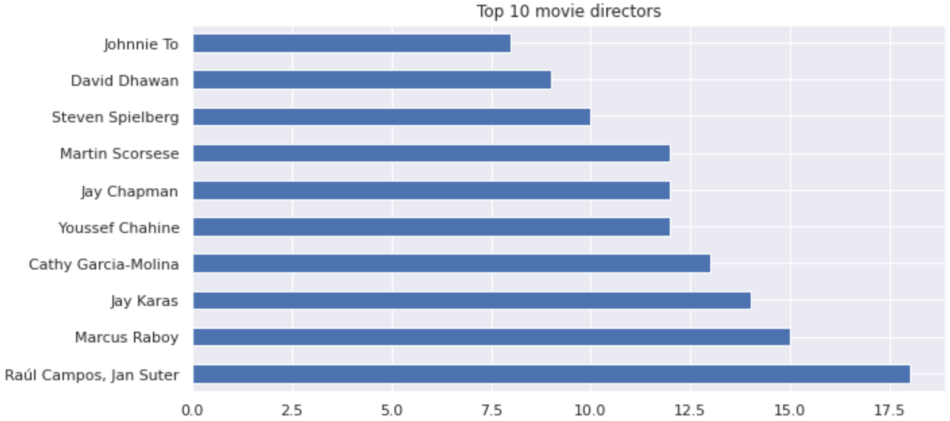




EDA (Contd.)

- **Raul Campos** and **Jan Suter** have directed **18** movies, higher than anyone yet.
- **Alastair Fothergill** has directed three TV shows, higher than anyone yet.
- Only **six** directors have directed more than one television show.





Feature Engineering

- **Clusters are built based on the attributes:** Director, Cast, Country, Listed in (genres), and Description
- **Steps involved in data pre-processing:**
  - Removing non-ascii characters
  - Removing stop words and converting to lowercase
  - Removing punctuation marks
  - Lemmatization, tokenization and text vectorization
  - Dimensionality reduction using PCA

Feature Engineering (Contd.)

- **TFIDF** (Term Frequency Inverse Document Frequency) vectorizer was used to vectorize the corpus.

$$TF = \frac{\textbf{Number of times term t appears in a document}}{\textbf{Total number of terms in the document}}$$

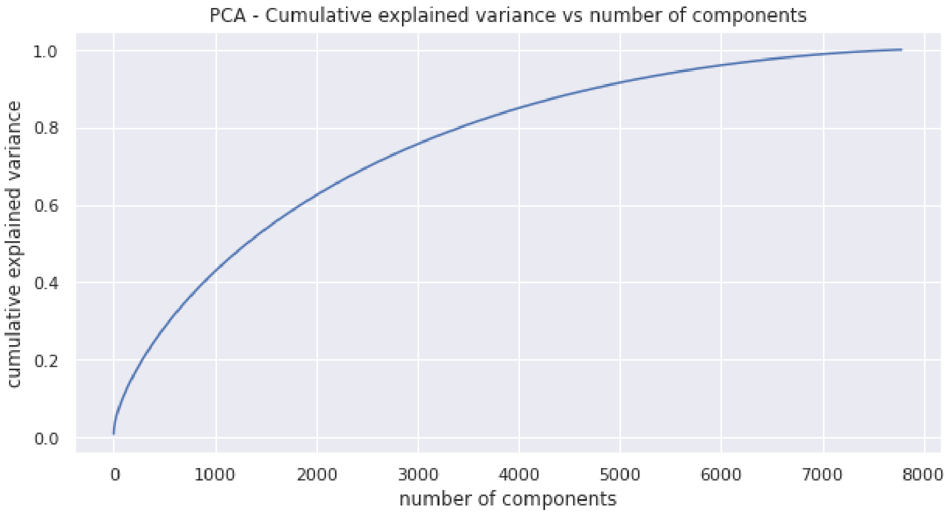
$$IDF = \log_e\left(\frac{\textbf{Total number of documents}}{\textbf{Number of documents with term t in it}}\right)$$

$$TFIDF = TF \times IDF$$

- Maximum number of features were taken as **20000**.

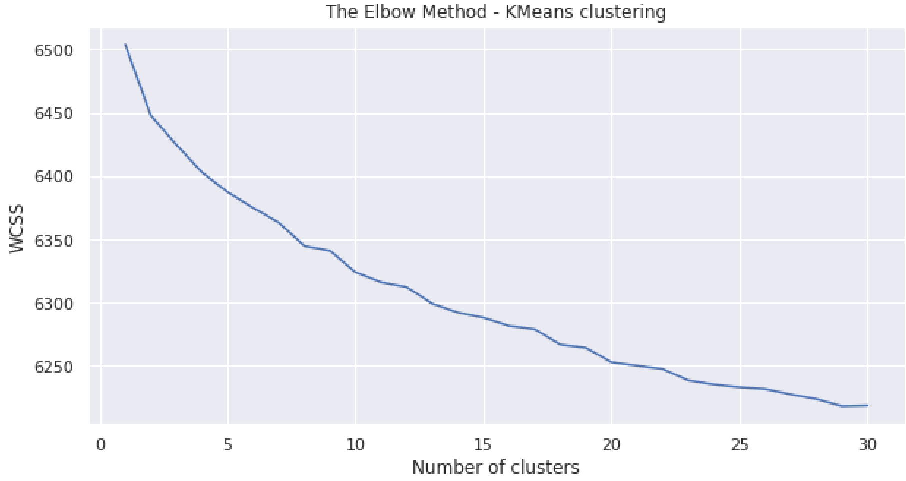
Dimensionality Reduction

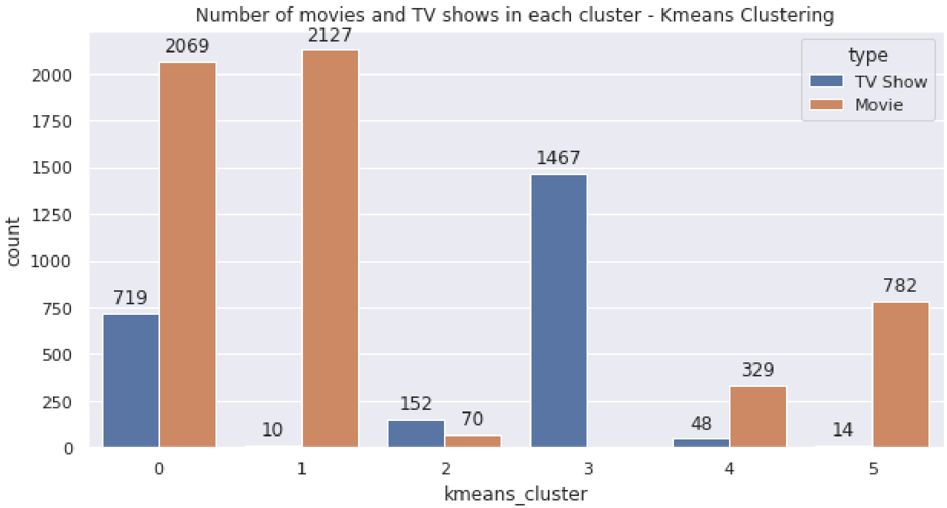
- **100%** of the variance in data is explained by about **~7500** components.
- To reduce dimensionality, only the top **4000** components were taken, which will still be able to capture more than **80%** of variance in the data.

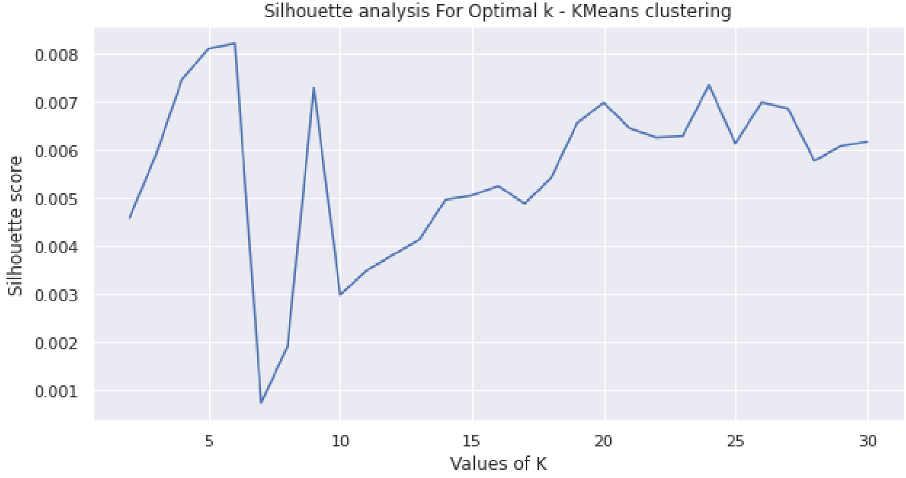


K Means Clustering

- Distortion: 6374.78
- Silhouette score: 0.0082
- Number of clusters: 6





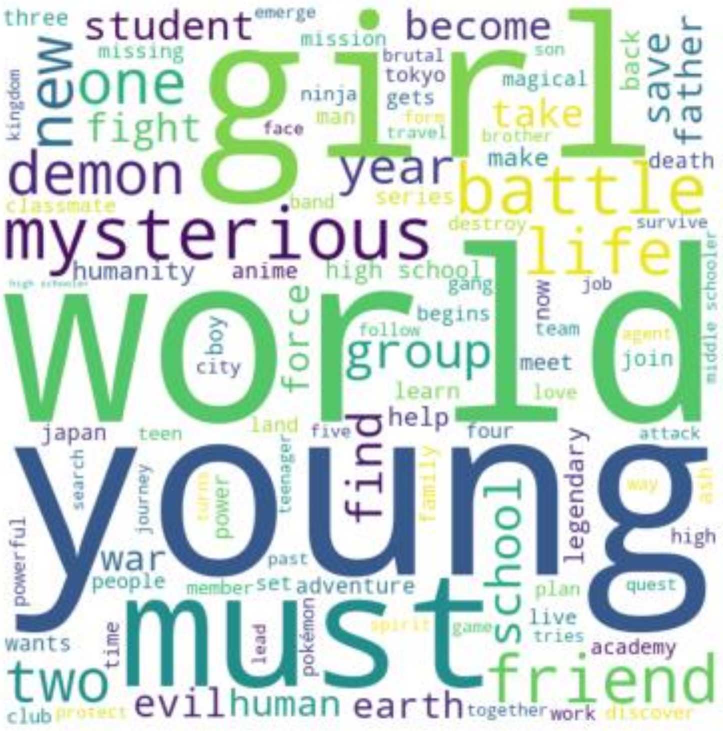


Word Clouds: K Means Clusters

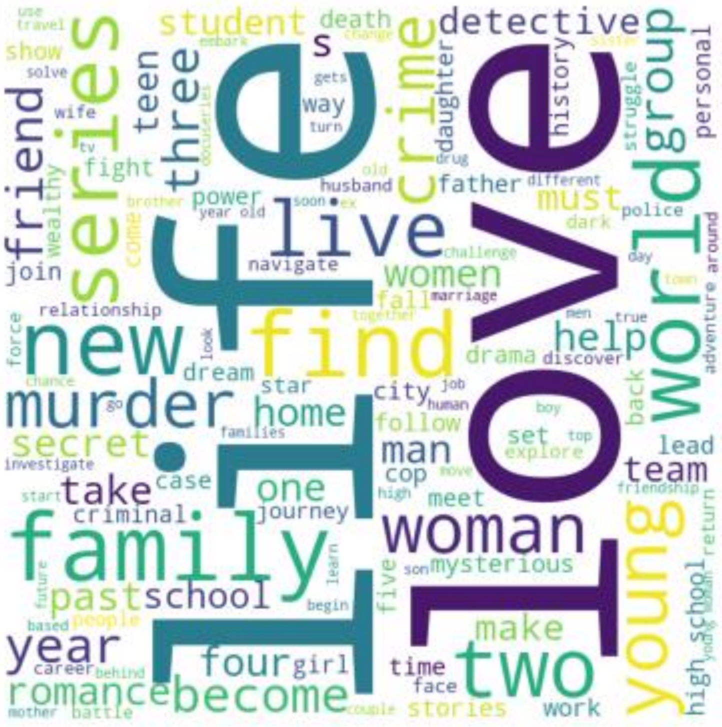
K Means Cluster - 0

K Means Cluster - 1

Word Clouds: K Means Clusters (Contd.)



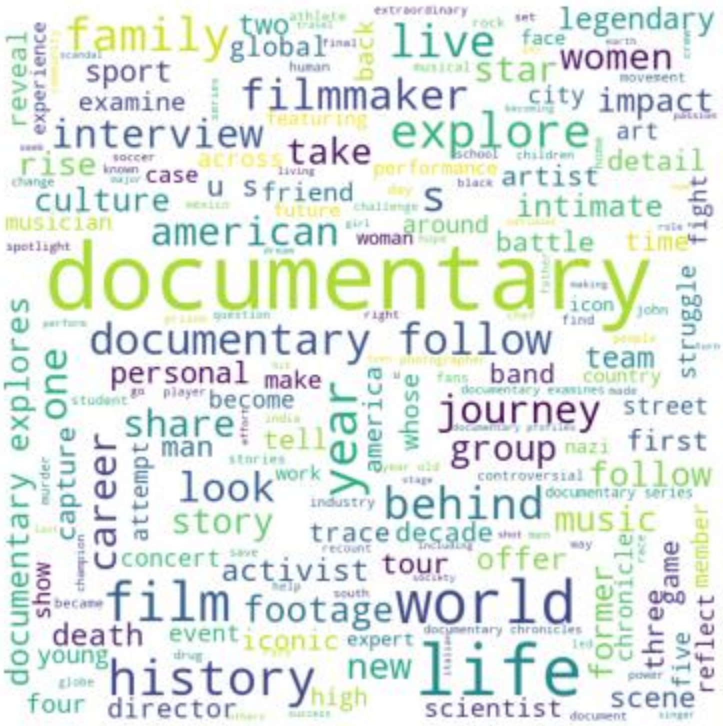
K Means Cluster - 2



K Means Cluster - 3

Word Clouds: K Means Clusters (Contd.)

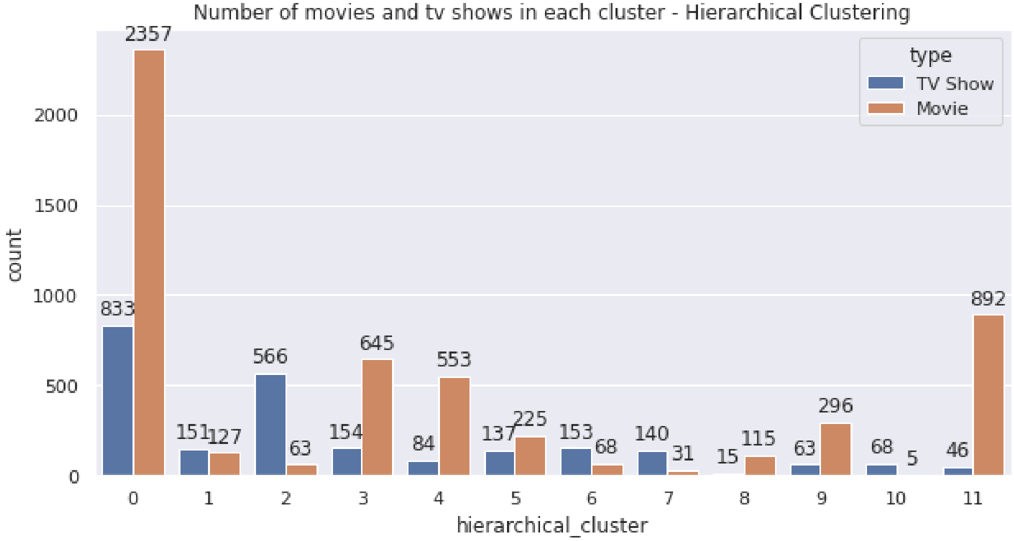
K Means Cluster - 4

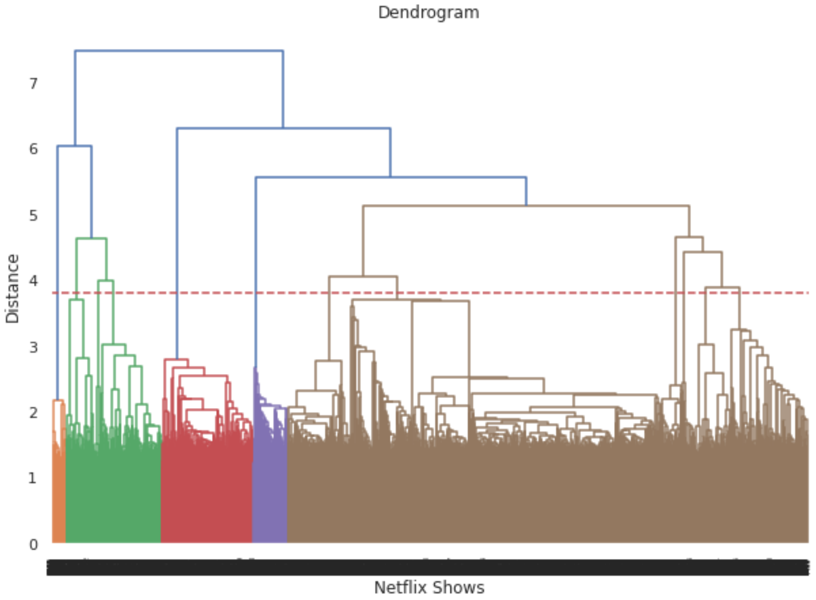


K Means Cluster - 5

Hierarchical Clustering

- Agglomerative clustering.
- Distance: Euclidean
- Linkage: Ward
- Number of clusters: 12



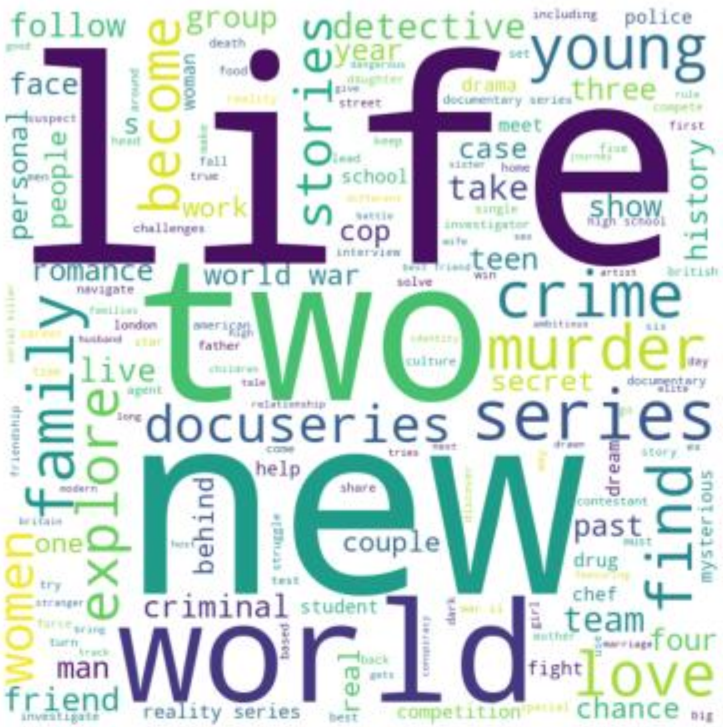


Word Clouds: Hierarchical Clusters

Hierarchical Cluster - 0

Hierarchical Cluster - 1

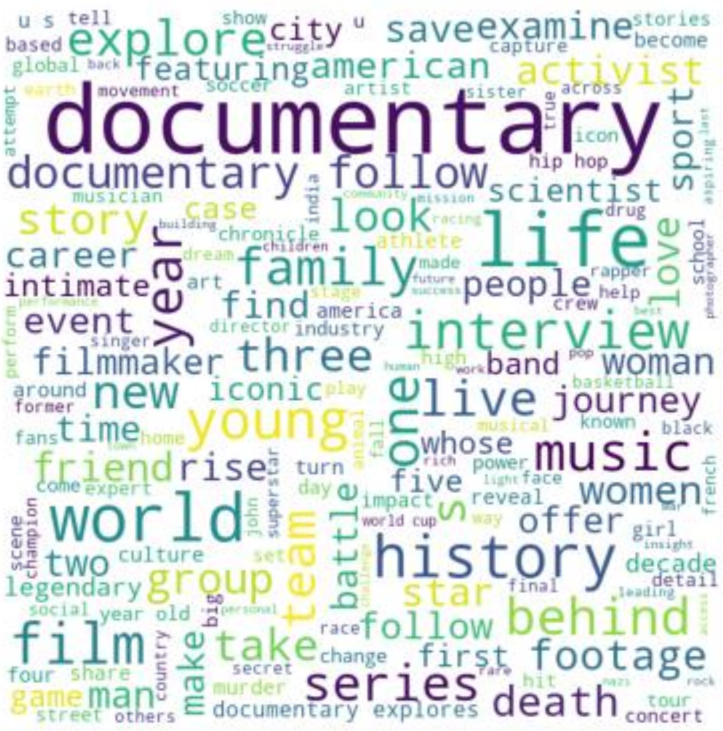
Word Clouds: Hierarchical Clusters (Contd.)



Hierarchical Cluster - 2

Hierarchical Cluster - 3

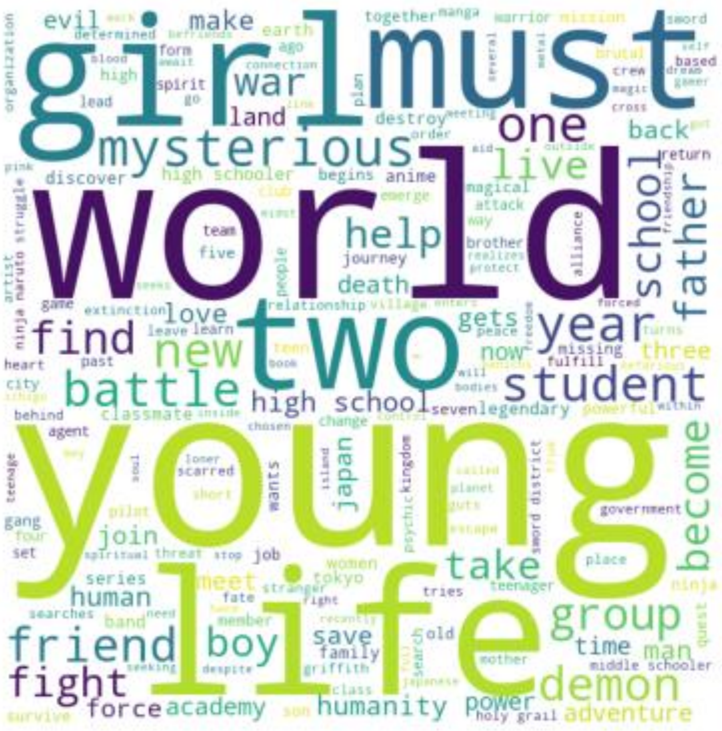
Word Clouds: Hierarchical Clusters (Contd.)



Hierarchical Cluster - 4

Hierarchical Cluster - 5

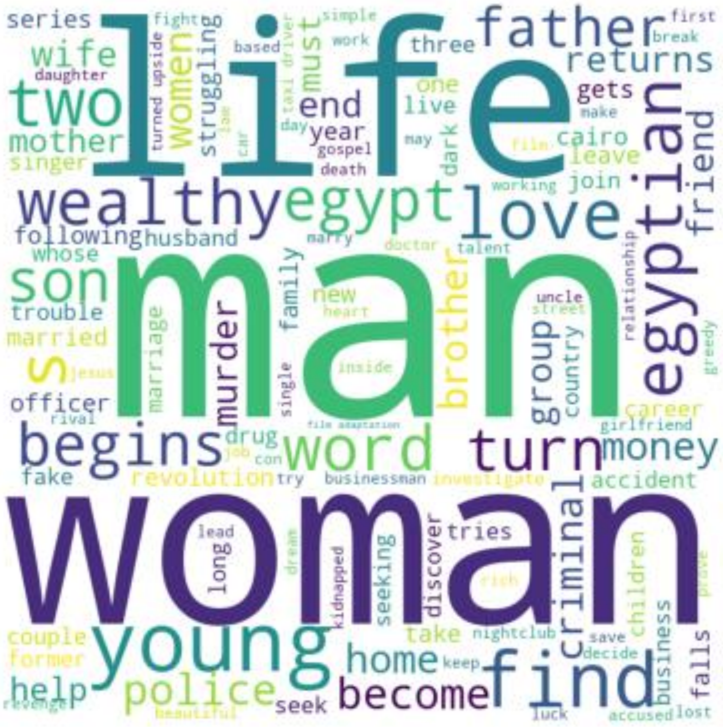
Word Clouds: Hierarchical Clusters (Contd.)



Hierarchical Cluster - 6

Hierarchical Cluster - 7

Word Clouds: Hierarchical Clusters (Contd.)

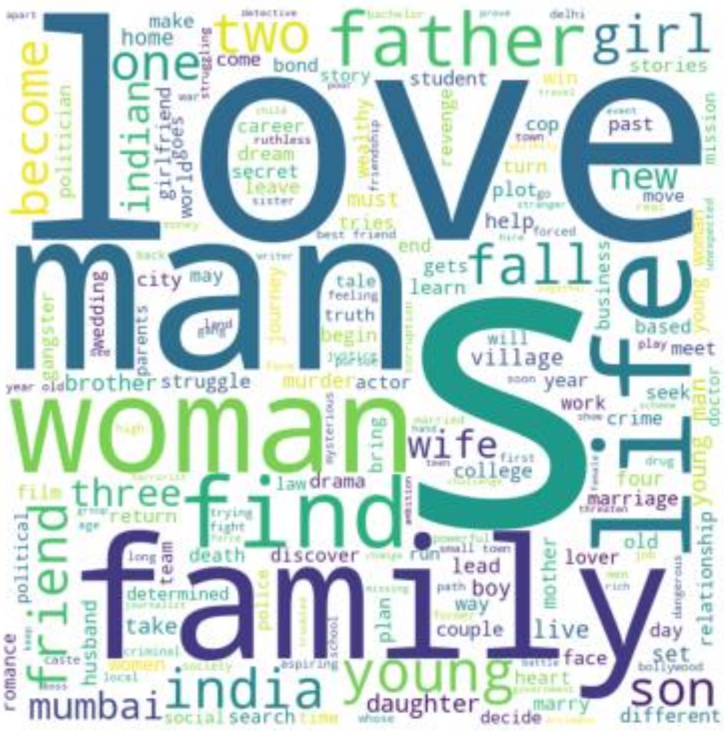


Hierarchical Cluster - 8

Hierarchical Cluster - 9

Word Clouds: Hierarchical Clusters (Contd.)

Hierarchical Cluster - 10



Hierarchical Cluster - 11

Content Based Recommender System

- We can build a simple content based recommender system based on the **similarity** of the shows.
- If a person has watched a show on Netflix, the recommender system must be able to recommend a list of similar shows that s/he likes.
- To get the similarity score of the shows, we can use **cosine similarity**
- The Cosine Similarity score of two vectors increases as the angle between them decreases.

$$\mathbf{Cos}\,\boldsymbol{\theta} = \frac{\boldsymbol{A} \, . \, \boldsymbol{B}}{|\boldsymbol{A}| . |\boldsymbol{B}|}$$

Content Based Recommender System (Contd.)

- 10 recommendations for the show **“A Man Called God”** and **“Stranger Things”**

```
If you liked 'A Man Called God', you may also enjoy:

['Mr. Sunshine',
 'One Spring Night',
 'Rugal',
 'The King: Eternal Monarch',
 'My Mister',
 'My Little Baby',
 'Reply 1994',
 'Extracurricular',
 'My Secret Romance',
 'Chef & My Fridge']
```

```
If you liked 'Stranger Things', you may also enjoy:

['Beyond Stranger Things',
 'Prank Encounters',
 'The Umbrella Academy',
 'Haunted',
 'Scream',
 'Warrior Nun',
 'Nightflyers',
 'Zombie Dumb',
 'Kiss Me First',
 'The Vampire Diaries']
```

Content Based Recommender System (Contd.)

- 10 recommendations for the show **“Peaky Blinders”** and **“Lucifer”**

```
If you liked 'Peaky Blinders', you may also enjoy:

['Kiss Me First',
 'Happy Valley',
 'London Spy',
 'The Frankenstein Chronicles',
 'Paranoid',
 'Get Even',
 'Giri / Haji',
 'My Hotter Half',
 'The Murder Detectives',
 'I AM A KILLER: RELEASED']
```

```
If you liked 'Lucifer', you may also enjoy:

['Rica, Famosa, Latina',
 'Get Shorty',
 'The Good Cop',
 'Jack Taylor',
 'Better Call Saul',
 'Dramaworld',
 'Father Brown',
 "Marvel's Iron Fist",
 'Young Wallander',
 'No Good Nick']
```

Challenges Faced

- Deciding the attributes on which we can build the clusters
- Feature engineering – deciding on the features to be dropped/kept/transformed
- Choosing the best visualization to show the trends clearly in the EDA phase
- Deciding on ways to handle the missing values
- Deciding on the attributes to be considered for clustering the dataset
- High computation time

Conclusions

- In this project, we worked on a **text clustering problem** wherein we had to cluster the Netflix shows such that the shows within a cluster are similar to each other and the shows in different clusters are dissimilar to each other.
- The dataset contained about **7787** records, and **11** attributes.
- We began by dealing with the dataset's missing values and doing exploratory data analysis (EDA).
- It was found that Netflix hosts **more movies** than TV shows on its platform, and the total **number of shows added on Netflix is growing exponentially**. Also, majority of the shows were produced in the **United States**, and the majority of the shows on Netflix were created for **adults** and **young adults** age group.

Conclusions (Contd.)

- It was decided to cluster the data based on the attributes: **director**, **cast**, **country**, **genre**, and **description**. The values in these attributes were **pre-processed**, **tokenized** and then **vectorized** using **TFIDF vectorizer**.
- Through TFIDF Vectorization, we created a total of **20000** attributes.
- We used **Principal Component Analysis (PCA)** to handle the curse of dimensionality. **4000** components were able to capture more than **80%** of variance, and hence, the number of components were restricted to **4000**.
- We first built clusters using the **k-means clustering algorithm**, and the optimal number of clusters came out to be **6**. This was obtained through the **elbow method** and **Silhouette score analysis**.

Conclusions (Contd.)

- **Hierarchical clustering** model was built using the **Agglomerative clustering algorithm**, and the optimal number of clusters came out to be **12**. This was obtained after visualizing the **dendrogram**.
- A **content-based recommender system** was built using the **Cosine Similarity score**. This recommender system will make **10** recommendations to the user based on the type of show they watch.

Thank You!