Problem Statement

We are being provided with the neflix movies data and our goal is to analyze the dataset to find insights and give recommendations backed by data.

In [1]:
```python
# Loading all the necessary libraries

import numpy as np                # for multidimensional array processing
import pandas as pd               # for working with structured dataset
import matplotlib.pyplot as plt   # for basic plotting functionalities
import seaborn as sns             # for plotting advanced graphs
import warnings                   # to supress any warnings coming out
warnings.filterwarnings("ignore")
```

In [2]:
```python
netflix = pd.read_csv('netflix.csv')
netflix.head()
```

Out[2]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...

1. Basic Exploratory Data Analysis

In [3]:
```python
netflix.shape
```

Out[3]:
```
(8807, 12)
```

In the netflix dataset there are 8807 rows and 12 columns present

In [4]:
```python
netflix.isnull().sum()
```

Out[4]:
```
show_id            0
type               0
title              0
director        2634
cast             825
country          831
date_added        10
release_year       0
rating             4
duration           3
listed_in          0
description        0
dtype: int64
```

In [5]:
```python
netflix.describe()
```

Out[5]:

	release_year
count	8807.000000
mean	2014.180198
std	8.819312
min	1925.000000
25%	2013.000000
50%	2017.000000
75%	2019.000000
max	2021.000000

Attribute Information of Netflix Data

Information about each column and it range

- **Show_id :** Unique ID for every Movie / Tv Show
- **Type:** It contains value either Movie or TV Show
- **Title:** Title of the Movie / Tv Show
  There are distinct values in this column
- **Director:** Director of the Movie
  There are distinct values in this column
- **Cast:** Actors involved in the movie/show
  There are distinct values in this column
- **Country:** Country where the movie/show was produced
  There are distinct values in this column
- **Date_added:** Date it was added on Netflix
  Different dates as it contains dates added by Netflix employees
- **Release_year:** Actual Release year of the movie/show
  Minimum value is 1925 and maximum value is 2021 and average value is 2014 if we round off. We can say that most movies are produced post 2010 since mean is towards 2014
- **Rating:** TV Rating of the movie/show
- **Duration:** Total Duration - in minutes for movies or number of seasons in case of TV shows
- **Listed_in:** Genre of the movie
  This contains several genres as each movie can be of more than one genre
- **Description:** The summary description or movie plot what movie is all about

We can see that there are Null Values present in the column **director, cast, country, date_added, ratings** and **duration** columns. Rest other columns contain all entries.

Null Values Treatment

For columns **director, rating, country, duration** and **cast** we can make a scrapper (pulling data from web) to fill these null values while for column **date_added** we cannot comment and it is better to drop them because Netflix is manually filling these entries.

For this, analysis we will simply drop null values in each row for a general understanding of data

In [6]:
```python
netflix[netflix['duration'].isna()]
```

Out[6]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
5541	s5542	Movie	Louis C.K. 2017	Louis C.K.	Louis C.K.	United States	April 4, 2017	2017	74 min	NaN	Movies	Louis C.K. muses on religion, eternal love, gi...
5794	s5795	Movie	Louis C.K.: Hilarious	Louis C.K.	Louis C.K.	United States	September 16, 2016	2010	84 min	NaN	Movies	Emmy-winning comedy writer Louis C.K. brings h...
5813	s5814	Movie	Louis C.K.: Live at the Comedy Store	Louis C.K.	Louis C.K.	United States	August 15, 2016	2015	66 min	NaN	Movies	The comic puts his trademark hilarious/thought...

If we look at Null values in duration then we can see that movies produced by director **Louis C.K.** contain all Null Values in the duration column

In [7]:
```python
netflix[netflix['director'].isna()].head()
```

Out[7]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...
10	s11	TV Show	Vendetta: Truth, Lies and The Mafia	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, Docuseries, International TV S...	Sicily boasts a bold "Anti-Mafia" coalition. B...
14	s15	TV Show	Crime Stories: India Detectives	NaN	NaN	NaN	September 22, 2021	2021	TV-MA	1 Season	British TV Shows, Crime TV Shows, Docuseries	Cameras following Bengaluru police on the job ...

In [8]:
```python
total_null_in_director = netflix[netflix['director'].isna()].shape[0]
docuseries_count = netflix[netflix['director'].isna()]['listed_in'].str.contains('Docuseries').sum()
kids_tv = netflix[netflix['director'].isna()]['listed_in'].str.contains("Kids' TV").sum()

print(total_null_in_director, docuseries_count + kids_tv)
```

```
2634 768
```

If we look at Null values in director then we can see that movies which are mostly Docuseries and are Kids_TV are having Nulls in director column. It isn't always true but it is happening most of the time like almost 30% of the time.

In [9]:
```python
netflix.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8807 entries, 0 to 8806
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   show_id       8807 non-null   object
 1   type          8807 non-null   object
 2   title         8807 non-null   object
 3   director      6173 non-null   object
 4   cast          7982 non-null   object
 5   country       7976 non-null   object
 6   date_added    8797 non-null   object
 7   release_year  8807 non-null   int64
 8   rating        8803 non-null   object
 9   duration      8804 non-null   object
 10  listed_in     8807 non-null   object
 11  description   8807 non-null   object
dtypes: int64(1), object(11)
memory usage: 825.8+ KB
```

If we look at the dataset information then we can conclude that all columns are **object** meaning that they have string datatype except **release_year** which is integer since it has year of the movie released

2. Graphical Analysis

As their is only one numerical column i.e. **release_year** hence plotting heatmaps and correlation graphs won't be a good choice. We can convert

In [10]:
```python
categorical = pd.DataFrame(netflix)
categorical.dropna(inplace = True)    # dropping null values for simplicity
categorical.head()
```

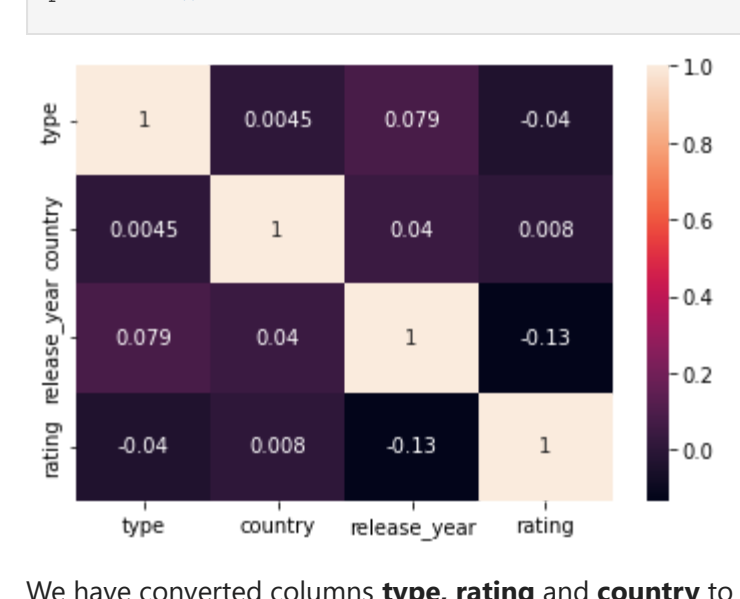
Out[10]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
7	s8	Movie	Sankofa	Haile Gerima	Kofi Ghanaba, Oyafunmike Ogunlano, Alexandra D...	United States, Ghana, Burkina Faso, United Kin...	September 24, 2021	1993	TV-MA	125 min	Dramas, Independent Movies, International Movies	On a photo shoot in Ghana, an American model s...
8	s9	TV Show	The Great British Baking Show	Andy Devonshire	Mel Giedroyc, Sue Perkins, Mary Berry, Paul Ho...	United Kingdom	September 24, 2021	2021	TV-14	9 Seasons	British TV Shows, Reality TV	A talented batch of amateur bakers face off in...
9	s10	Movie	The Starling	Theodore Melfi	Melissa McCarthy, Chris O'Dowd, Kevin Kline, T...	United States	September 24, 2021	2021	PG-13	104 min	Comedies, Dramas	A woman adjusting to life after a loss contend...
12	s13	Movie	Je Suis Karl	Christian Schwochow	Luna Wedler, Jannis Niewöhner, Milan Peschel, ...	Germany, Czech Republic	September 23, 2021	2021	TV-MA	127 min	Dramas, International Movies	After most of her family is murdered in a terr...
24	s25	Movie	Jeans	S. Shankar	Prashanth, Aishwarya Rai Bachchan, Sri Lakshmi...	India	September 21, 2021	1998	TV-14	166 min	Comedies, International Movies, Romantic Movies	When the father of the man she loves insists t...

In [11]:
```python
categorical_column_names = ['type', 'rating', 'country']

for col in categorical_column_names:
    uniqueValues = categorical[col].unique()
    counter = 1
    uniqueDict = {}
    for val in uniqueValues:
        uniqueDict[counter] = val
        counter += 1
    categorical[col] = categorical[col].replace(uniqueValues, list(uniqueDict.keys()))
```

In [12]:
```python
sns.heatmap(categorical.corr(), annot = True)
plt.show()
```



We have converted columns **type, rating** and **country** to numerical column by mapping value to a number.
We can see that their is no significant correlation between any column.

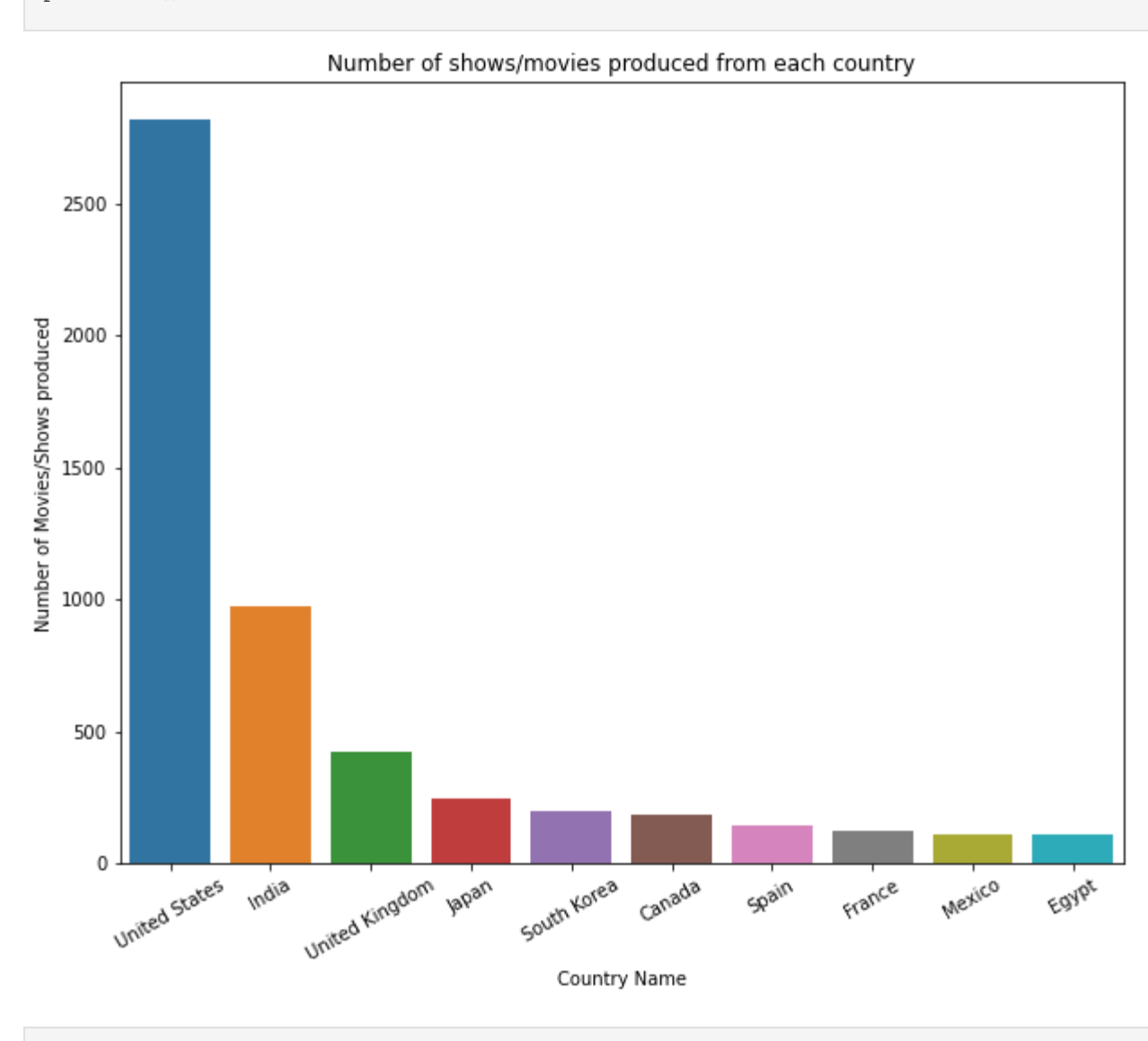
In [13]:
```python
netflix.head()
```

Out[13]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...

In [14]:
```python
top10countries = netflix['country'].value_counts().head(10)

fig = plt.figure(figsize = (10, 8))
sns.barplot(top10countries.index.tolist(), top10countries.values.tolist())
plt.xticks(rotation = 30)
plt.xlabel('Country Name')
plt.ylabel('Number of Movies/Shows produced')
plt.title('Number of shows/movies produced from each country')
plt.show()
```



In [15]:
```python
top10countries
```

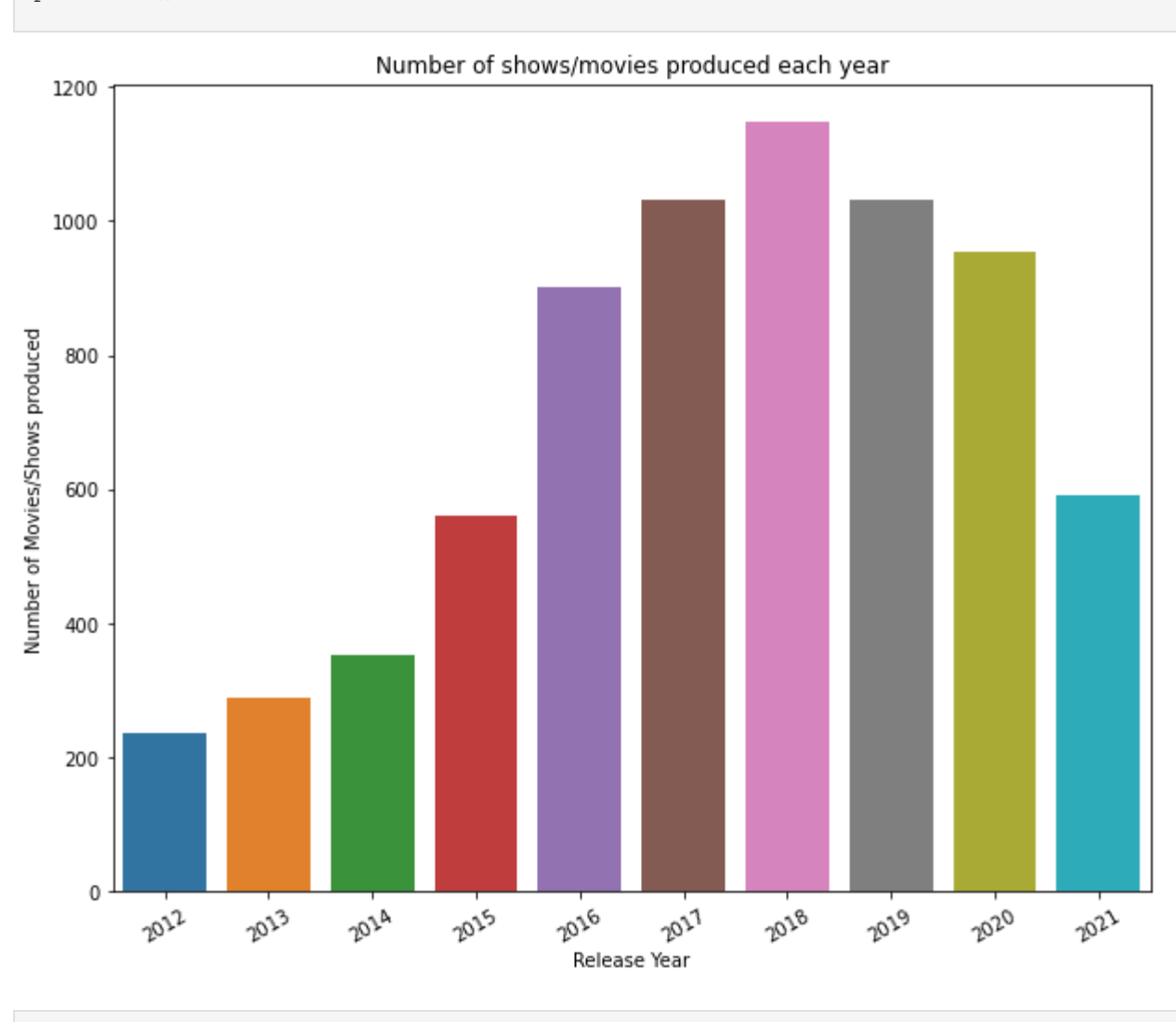
Out[15]:
```
United States     2818
India              972
United Kingdom     419
Japan              245
South Korea        199
Canada             181
Spain              145
France             124
Mexico             110
Egypt              106
Name: country, dtype: int64
```

If we look at above plot then we can see that most movies or TV shows produced are from United States country which is 2818 and then from India which is 972. But overall US is leading in production of movies and TV shows.

Recommendation : Netflix can produce more TV shows or Movies which are United States based or India based since, their fan base is high and surely it will attract more users.

In [16]:
```python
top10years = netflix['release_year'].value_counts().head(10)

fig = plt.figure(figsize = (10, 8))
sns.barplot(top10years.index.tolist(), top10years.values.tolist())
plt.xticks(rotation = 30)
plt.xlabel('Release Year')
plt.ylabel('Number of Movies/Shows produced')
plt.title('Number of shows/movies produced each year')
plt.show()
```



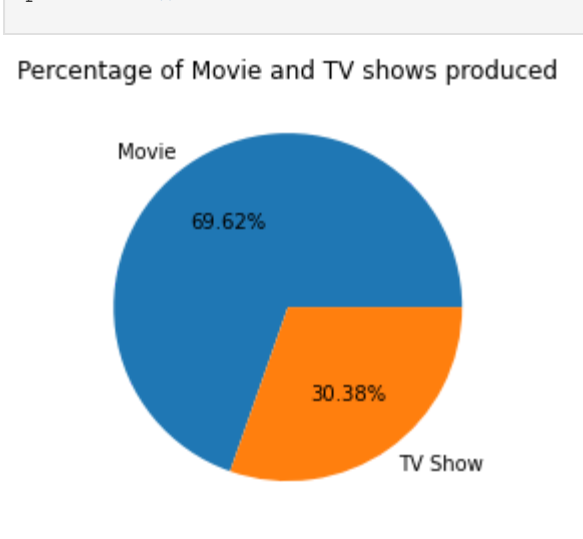
In [17]:
```python
top10years
```

Out[17]:
```
2018    1147
2017    1032
2019    1030
2020     953
2016     902
2021     592
2015     560
2014     352
2013     288
2012     237
Name: release_year, dtype: int64
```

If we look at above plot then most TV shows and movies are produced in the year 2018 i.e. 1147 followed by 2017 and 2019.

In [18]:
```python
TvorMovie = netflix['type'].value_counts()

plt.pie(x = TvorMovie.values.tolist(),
        labels = TvorMovie.index.tolist(),
        autopct = '%.2f%%')
plt.title('Percentage of Movie and TV shows produced')
plt.show()
```



In [19]:
```python
TvorMovie
```

Out[19]:
```
Movie      6131
TV Show    2676
Name: type, dtype: int64
```

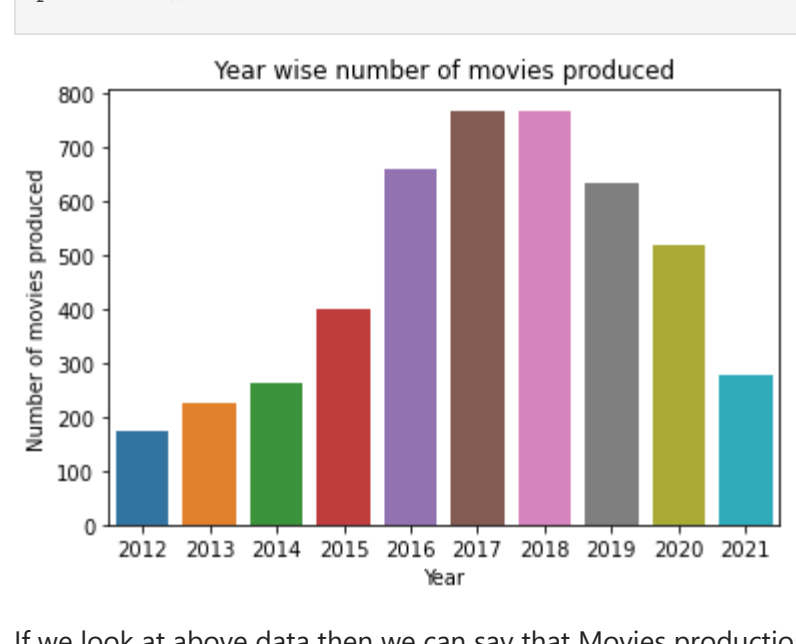
If we look at above plot then we can say that mostly Movies are being produced and less TV Shows are being produced. Since, producing TV show requires lot of cost due to several seasons and most directors try to avoid this.

In [20]:
```python
yearwisetype = netflix.groupby(['release_year', 'type']).count().title.reset_index().tail(20)
yearwisetype
```

Out[20]:

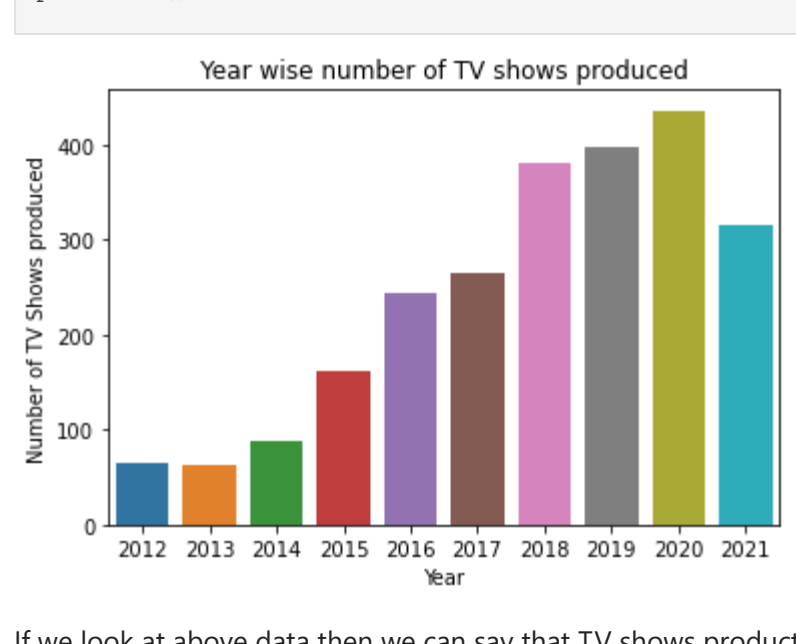
	release_year	type	title
99	2012	Movie	173
100	2012	TV Show	64
101	2013	Movie	225
102	2013	TV Show	63
103	2014	Movie	264
104	2014	TV Show	88
105	2015	Movie	398
106	2015	TV Show	162
107	2016	Movie	658
108	2016	TV Show	244
109	2017	Movie	767
110	2017	TV Show	265
111	2018	Movie	767
112	2018	TV Show	380
113	2019	Movie	633
114	2019	TV Show	397
115	2020	Movie	517
116	2020	TV Show	436
117	2021	Movie	277
118	2021	TV Show	315

In [21]:
```python
sns.barplot(yearwisetype[yearwisetype['type'] == 'Movie'].release_year.values.tolist(),
            yearwisetype[yearwisetype['type'] == 'Movie'].title.values.tolist())
plt.xlabel('Year')
plt.ylabel('Number of movies produced')
plt.title('Year wise number of movies produced')
plt.show()
```



If we look at above data then we can say that Movies production has increased till 2017 then it got stable at 2018 and then it started decreasing which means that users are not liking movies to watch in free time.

In [22]:
```python
sns.barplot(yearwisetype[yearwisetype['type'] == 'TV Show'].release_year.values.tolist(),
            yearwisetype[yearwisetype['type'] == 'TV Show'].title.values.tolist())
plt.xlabel('Year')
plt.ylabel('Number of TV Shows produced')
plt.title('Year wise number of TV shows produced')
plt.show()
```



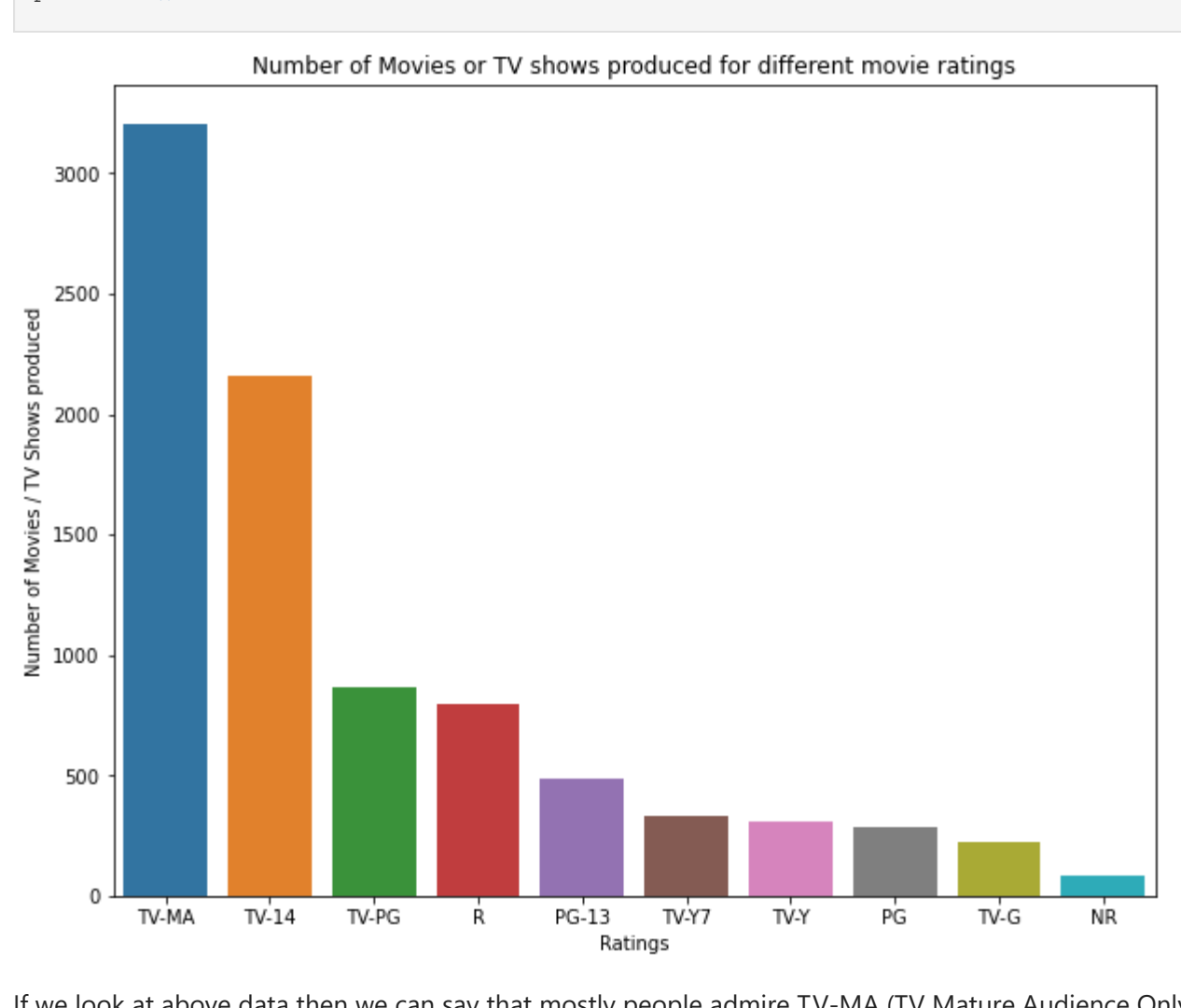
If we look at above data then we can say that TV shows production has an increasing trend i.e. each year more number of TV shows are being produced. This is true till year 2020 since for 2021 we have data till September (month when netflix have uploaded it).

Recommendation : Netflix can produce more TV shows as it is mostly liked by customers on contrary to Movies because there is always a curiosity that what will happen next in a TV show as compared to a movie which requires Sequels. In recent times, people are mostly shifting to watch TV shows which can bind them more as compared to Movies

In [23]:
```python
top10ratedmovies = netflix['rating'].value_counts().head(10)
top10ratedmovies
```

Out[23]:
```
TV-MA     3207
TV-14     2160
TV-PG      863
R          799
PG-13      490
TV-Y7      334
TV-Y       307
PG         287
TV-G       220
NR          80
Name: rating, dtype: int64
```

In [24]:
```python
fig = plt.figure(figsize = (10, 8))
sns.barplot(top10ratedmovies.index.tolist(), top10ratedmovies.values.tolist())
plt.xlabel('Ratings')
plt.ylabel('Number of Movies / TV Shows produced')
plt.title('Number of Movies or TV shows produced for different movie ratings')
plt.show()
```



If we look at above data then we can say that mostly people admire TV-MA (TV Mature Audience Only) rated movies or TV shows and on second number TV - 14 (Parents Strongly Cautioned. Some Material May Be Inappropriate For Children Under 14) movies or TV shows

Recommendation : Netflix can produce more TV shows or Movies which are of below ratings as these are mostly admired by the audiences.

- TV-MA (TV Mature Audience Only)
- TV-14 (Parents Strongly Cautioned. Some Material May Be Inappropriate For Children Under 14)
- TV-PG (Parental Guidance Suggested)
- R (Restricted)
- PG-13 (Parents Strongly Cautioned. Some Material May Be Inappropriate For Children Under 13)

3. Director Wise Analysis

In [25]:
```python
netflix.head()
```

Out[25]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...

Since, director contains multiple entries hence we will try to convert this data into 1NF form i.e. for each director we will have one row

Example

Before conversion
DA, DB 2019

After conversion
DA 2019
DB 2019

In [26]:
```python
directors = pd.DataFrame(netflix)
directors = directors[~directors['director'].isna()]
directors.head()
```

Out[26]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
5	s6	TV Show	Midnight Mass	Mike Flanagan	Kate Siegel, Zach Gilford, Hamish Linklater, H...	NaN	September 24, 2021	2021	TV-MA	1 Season	TV Dramas, TV Horror, TV Mysteries	The arrival of a charismatic young priest brin...
6	s7	Movie	My Little Pony: A New Generation	Robert Cullen, José Luis Ucha	Vanessa Hudgens, Kimiko Glenn, James Marsden, ...	NaN	September 24, 2021	2021	PG	91 min	Children & Family Movies	Equestria's divided. But a bright-eyed hero be...
7	s8	Movie	Sankofa	Haile Gerima	Kofi Ghanaba, Oyafunmike Ogunlano, Alexandra D...	United States, Ghana, Burkina Faso, United Kin...	September 24, 2021	1993	TV-MA	125 min	Dramas, Independent Movies, International Movies	On a photo shoot in Ghana, an American model s...

In [27]:
```python
directors['director'] = directors['director'].str.split(', ')
directors = directors.explode('director')
```

In [28]:
```python
directors.head()
```

Out[28]:

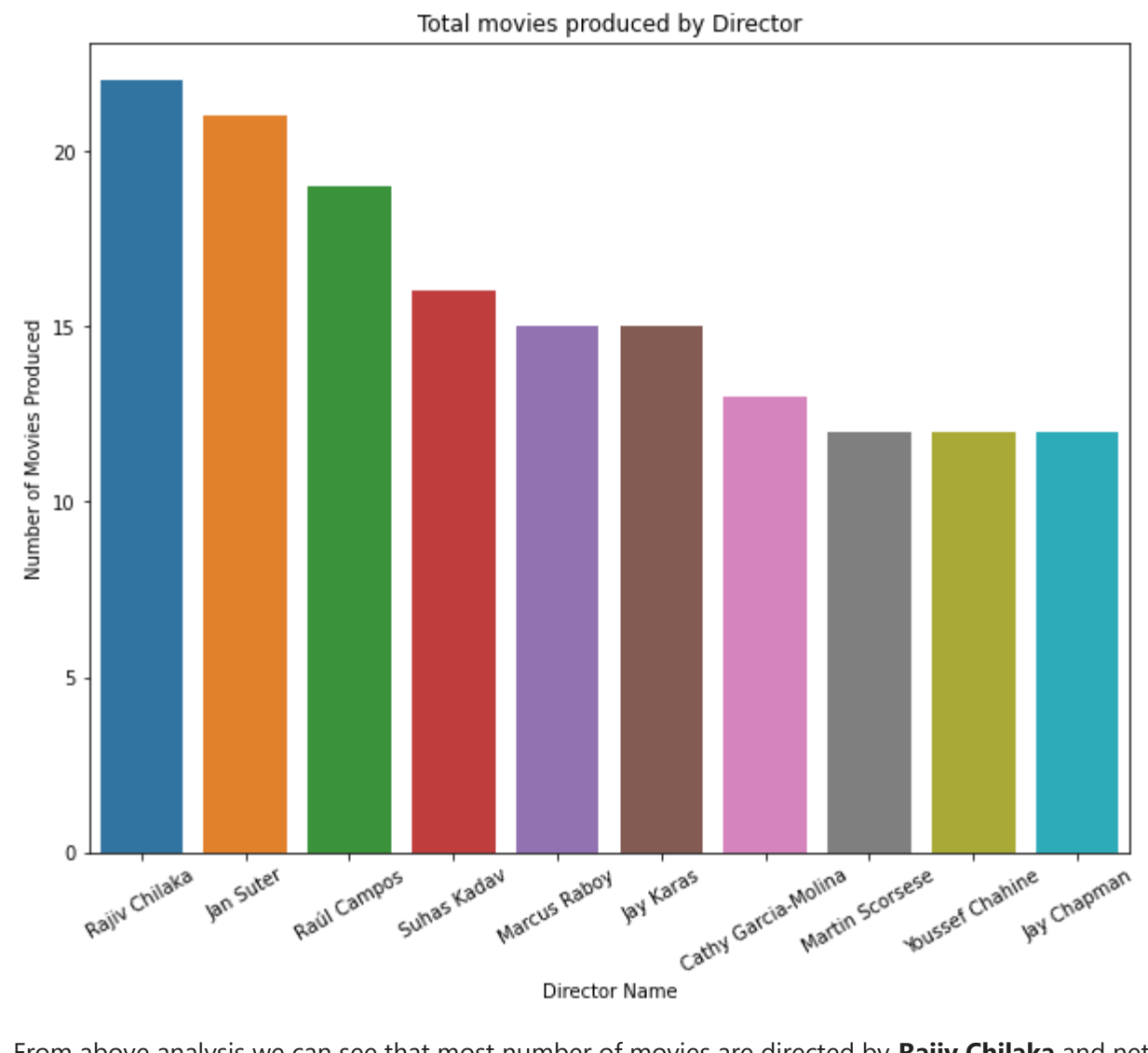
	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
5	s6	TV Show	Midnight Mass	Mike Flanagan	Kate Siegel, Zach Gilford, Hamish Linklater, H...	NaN	September 24, 2021	2021	TV-MA	1 Season	TV Dramas, TV Horror, TV Mysteries	The arrival of a charismatic young priest brin...
6	s7	Movie	My Little Pony: A New Generation	Robert Cullen	Vanessa Hudgens, Kimiko Glenn, James Marsden, ...	NaN	September 24, 2021	2021	PG	91 min	Children & Family Movies	Equestria's divided. But a bright-eyed hero be...
6	s7	Movie	My Little Pony: A New Generation	José Luis Ucha	Vanessa Hudgens, Kimiko Glenn, James Marsden, ...	NaN	September 24, 2021	2021	PG	91 min	Children & Family Movies	Equestria's divided. But a bright-eyed hero be...

Now, the column **director** is in 1NF form i.e. there are no multiple entries in this column. We can use it to for further analysis.

In [29]:
```python
top10moviedirectors = directors[directors['type'] == 'Movie']['director'].value_counts().head(10)
top10moviedirectors
```

Out[29]:
```
Rajiv Chilaka          22
Jan Suter              21
Raúl Campos            19
Suhas Kadav            16
Marcus Raboy           15
Jay Karas              15
Cathy Garcia-Molina    13
Martin Scorsese        12
Youssef Chahine        12
Jay Chapman            12
Name: director, dtype: int64
```

In [30]:
```python
fig = plt.figure(figsize = (10, 8))
sns.barplot(top10moviedirectors.index.tolist(), top10moviedirectors.values.tolist())
plt.xlabel('Director Name')
plt.ylabel('Number of Movies Produced')
plt.title('Total movies produced by Director')
plt.xticks(rotation = 30)
plt.show()
```



From above analysis we can see that most number of movies are directed by **Rajiv Chilaka** and netflix can collaborate with him to produce more movies.

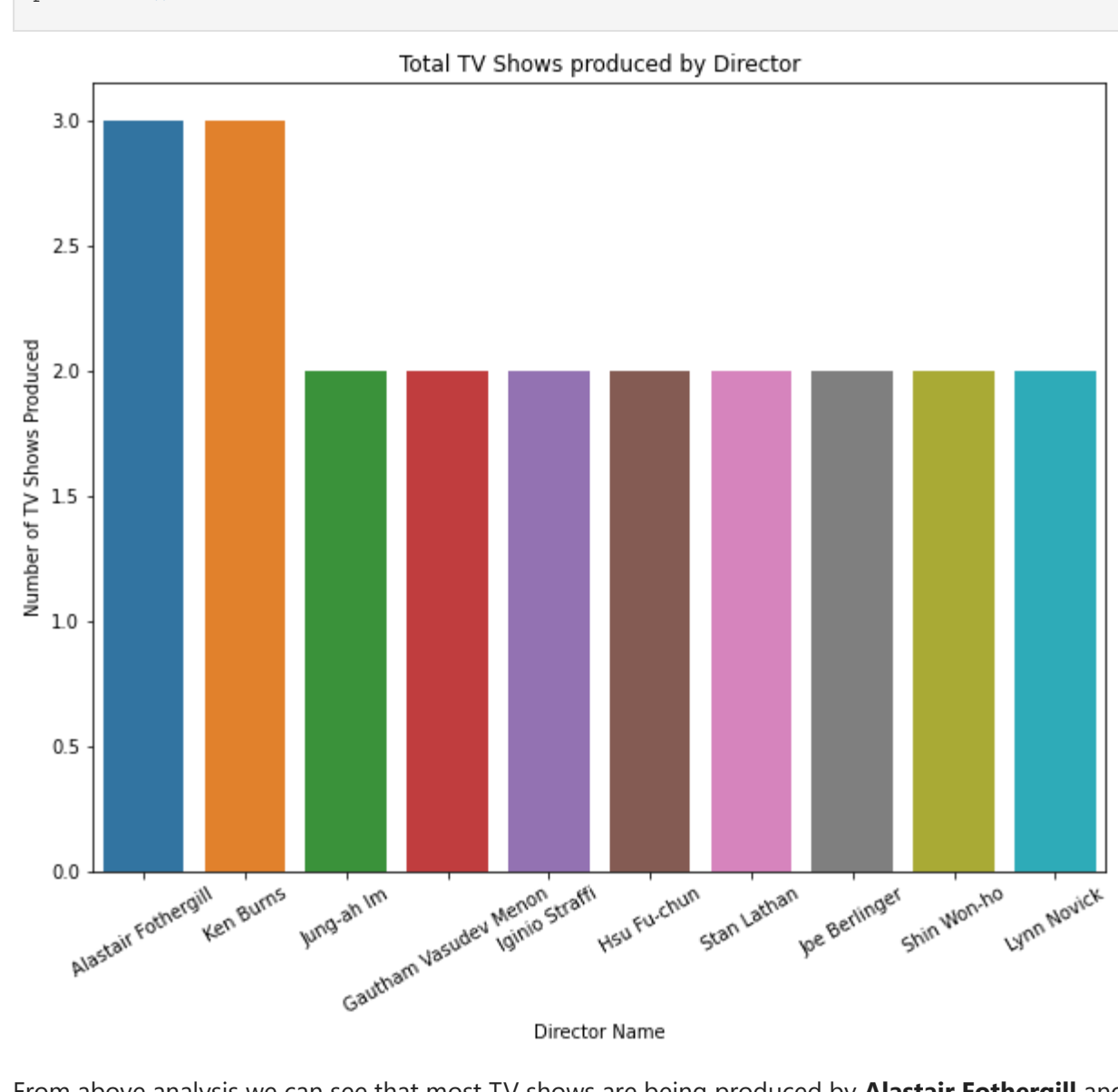
Recommendation : Netflix can collaborate with below 5 directors to produce more movies as these are mostly liked by user.

- Rajiv Chilaka
- Jan Suter
- Raul Campos
- Suhas Kadav
- Marcus Raboy

In [31]:
```
top10showdirectors = directors[directors['type'] == 'TV Show']['director'].value_counts().head(10)
top10showdirectors
```

Out[31]:
```
Alastair Fothergill      3
Ken Burns                3
Jung-ah Im               2
Gautham Vasudev Menon    2
Iginio Straffi           2
Hsu Fu-chun              2
Stan Lathan              2
Joe Berlinger            2
Shin Won-ho              2
Lynn Novick              2
Name: director, dtype: int64
```

In [32]:
```
fig = plt.figure(figsize = (10, 8))
sns.barplot(top10showdirectors.index.tolist(), top10showdirectors.values.tolist())
plt.xlabel('Director Name')
plt.ylabel('Number of TV Shows Produced')
plt.title('Total TV Shows produced by Director')
plt.xticks(rotation = 30)
plt.show()
```



From above analysis we can see that most TV shows are being produced by **Alastair Fothergill** and **Ken Burns** and netflix can collaborate with them for future shows

Recommendation : Netflix can collaborate with below 2 directors to produce more TV shows as these are mostly liked by user.

- Alastair Fothergill
- Ken Burns

In [33]:
```
yearwisedirector = directors.groupby(['release_year', 'director']).count().title.reset_index()
yearwisedirector = yearwisedirector[yearwisedirector['release_year'] > 2018]
yearwisedirector
```

Out[33]:

	release_year	director	title
5035	2019	A. L. Vijay	1
5036	2019	Aaron Lieber	1
5037	2019	Aaron Woodley	1
5038	2019	Abba T. Makama	1
5039	2019	Abhijit Kokate	1
...	...	...	...
6626	2021	Yin Chen-hao	1
6627	2021	Yulene Olaizola	1
6628	2021	Zack Snyder	1
6629	2021	Zhang Chong	1
6630	2021	Zhao Ji	1

1596 rows × 3 columns

In [34]:
```
yearwisedirector = pd.pivot_table(values = 'title', index = 'director', columns = 'release_year', data = yearwi
yearwisedirector
```

Out[34]:

release_year	2019	2020	2021
director			
A. L. Vijay	1.0	0.0	0.0
A. Raajdheep	0.0	1.0	0.0
Aaron Lieber	1.0	0.0	0.0
Aaron Moorhead	0.0	1.0	0.0
Aaron Sorkin	0.0	1.0	0.0
...	...	...	...
Zuko Nodada	1.0	0.0	0.0
Àlex Pastor	0.0	1.0	0.0
Ángel Gómez Hernández	0.0	1.0	0.0
Ángeles Reiné	0.0	1.0	0.0
Şenol Sönmez	1.0	0.0	0.0

1512 rows × 3 columns

In [35]:
```
yearwisedirector['ratio19-20'] = yearwisedirector[2020] / yearwisedirector[2019]
yearwisedirector['ratio20-21'] = yearwisedirector[2021] / yearwisedirector[2020]
yearwisedirector['ratio19-20'] = yearwisedirector['ratio19-20'].replace(np.inf, 0)
yearwisedirector['ratio20-21'] = yearwisedirector['ratio20-21'].replace(np.inf, 0)
yearwisedirector['overallgrowth'] = yearwisedirector['ratio20-21'] * 100 / yearwisedirector['ratio19-20']
yearwisedirector['overallgrowth'] = yearwisedirector['overallgrowth'].replace(np.inf, 0)
yearwisedirector = yearwisedirector.fillna(0)
```

In [36]:
```
yearwisedirector[(yearwisedirector['ratio19-20'] >= 1) & (yearwisedirector['ratio20-21'] > 1)]
```

Out[36]:

release_year	2019	2020	2021	ratio19-20	ratio20-21	overallgrowth
director						
Bruno Garotti	1.0	1.0	2.0	1.0	2.0	200.0
Troy Miller	1.0	1.0	2.0	1.0	2.0	200.0

From above analysis we can say that **Bruno Garotti** and **Troy Miller** have done really well in past 3 years and they have increased movies produced. Hence, Netflix can also collaborate with them since, they are producing more shows with respect to year.

Recommendation : Netflix can collaborate with below 2 directors for future since, they have increased movie production within last 3 years.

- Bruno Garotti
- Troy Miller

In [37]:
```
yearwisedirector.sort_values('overallgrowth', ascending = True).head(3)
```

Out[37]:

release_year	2019	2020	2021	ratio19-20	ratio20-21	overallgrowth
director						
A. L. Vijay	1.0	0.0	0.0	0.0	0.0	0.0
Nizar Shafi	1.0	0.0	0.0	0.0	0.0	0.0
Niyi Akinmolayan	1.0	0.0	0.0	0.0	0.0	0.0

From above analysis we can say that **A. L. Vijay, Nizar Shafi** and **Niyi Akinmolayan** have less movies as year progresses.

Recommendation : For below 3 directors netflix can choose to discontinue with them since, they have produced movies in 2019 but no single movie has been produced by them in year 2020 and 2021.

- A. L. Vijay
- Nizar Shafi
- Niyi Akinmolayan

4. Movie Cast Wise Analysis

In [38]:
```
netflix.head()
```

Out[38]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...

Since, cast contains multiple entries hence we will try to convert this data into 1NF form i.e. for each cast we will have one row

Example

Before conversion
CA, CB 2019

After conversion
CA 2019
CB 2019

In [39]:
```
cast = pd.DataFrame(netflix)
cast = cast[~cast['cast'].isna()]
cast.head()
```

Out[39]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...
5	s6	TV Show	Midnight Mass	Mike Flanagan	Kate Siegel, Zach Gilford, Hamish Linklater, H...	NaN	September 24, 2021	2021	TV-MA	1 Season	TV Dramas, TV Horror, TV Mysteries	The arrival of a charismatic young priest brin...
6	s7	Movie	My Little Pony: A New Generation	Robert Cullen, José Luis Ucha	Vanessa Hudgens, Kimiko Glenn, James Marsden, ...	NaN	September 24, 2021	2021	PG	91 min	Children & Family Movies	Equestria's divided. But a bright-eyed hero be...

In [40]:
```
cast['cast'] = cast['cast'].str.split(', ')
cast = cast.explode('cast')
cast.head()
```

Out[40]:

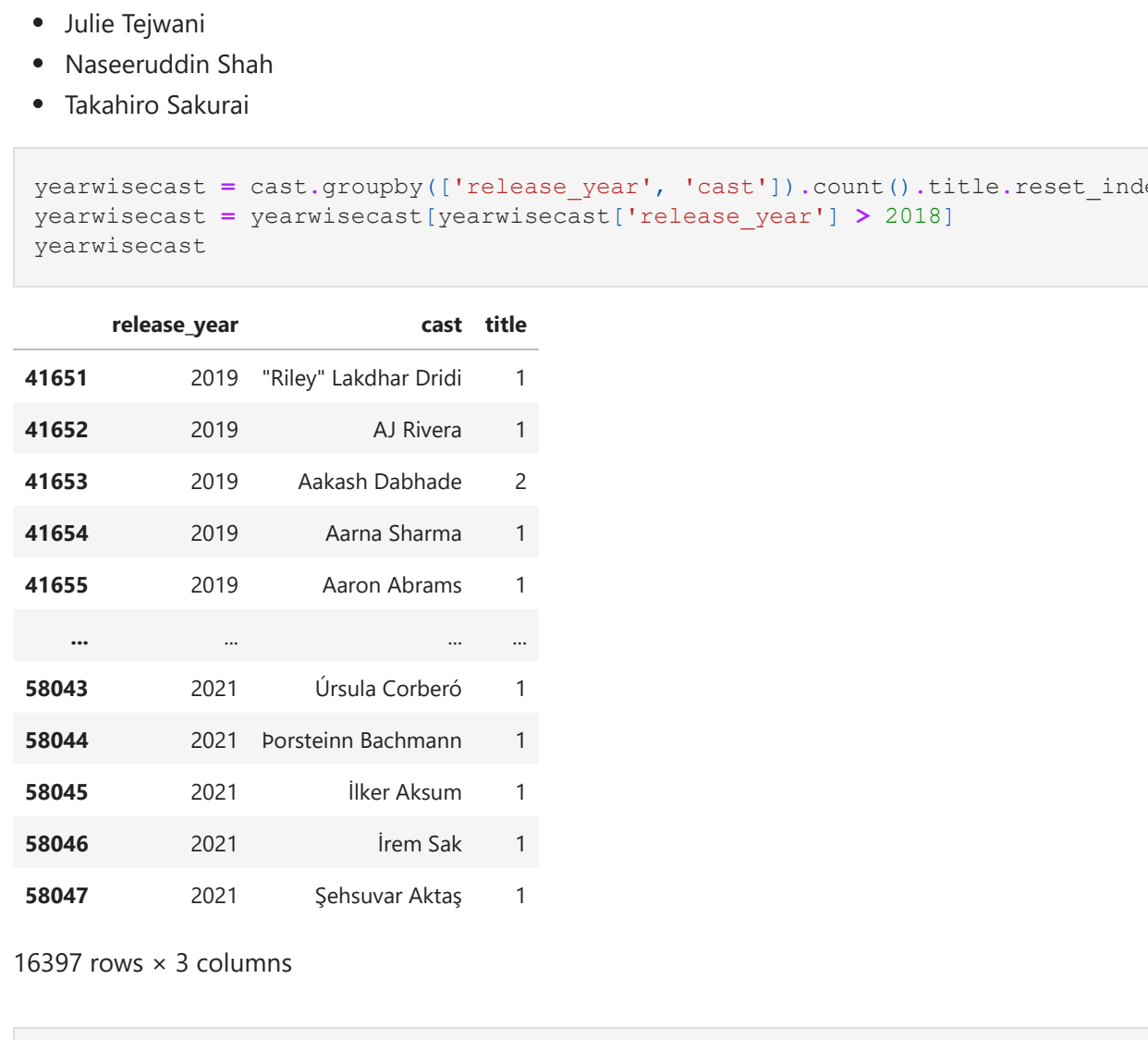
	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
1	s2	TV Show	Blood & Water	NaN	Ama Qamata	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
1	s2	TV Show	Blood & Water	NaN	Khosi Ngema	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
1	s2	TV Show	Blood & Water	NaN	Gail Mabalane	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
1	s2	TV Show	Blood & Water	NaN	Thabang Molaba	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
1	s2	TV Show	Blood & Water	NaN	Dillon Windvogel	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...

Now, the column cast is in **1NF form** i.e. there are no multiple entries in this column. We can use it to for further analysis.

In [41]:
```
top10casts = cast['cast'].value_counts().head(10)
top10casts
```

Out[41]:
```
Anupam Kher          43
Shah Rukh Khan       35
Julie Tejwani        33
Naseeruddin Shah     32
Takahiro Sakurai     32
Rupa Bhimani         31
Akshay Kumar         30
Om Puri              30
Yuki Kaji            29
Paresh Rawal         28
Name: cast, dtype: int64
```

In [42]:
```
fig = plt.figure(figsize = (10, 8))
sns.barplot(top10casts.index.tolist(), top10casts.values.tolist())
plt.xlabel('Cast Name')
plt.ylabel('Number of Movies Acted in')
plt.title('Cast wise movies they acted in')
plt.xticks(rotation = 30)
plt.show()
```



From above analysis we can see that **Anupam Kher** and **Shah Rukh Khan** are the most liked actors and the actors who have acted in most movies and TV shows

Recommendation : Netflix can collaborate with below 5 actors as they are mostly liked by public and they are trending in movies since they have acted in most movies or TV shows.

- Anupam Kher
- Shah Rukh Khan
- Julie Tejwani
- Naseeruddin Shah
- Takahiro Sakurai

In [43]:
```
yearwisecast = cast.groupby(['release_year', 'cast']).count().title.reset_index()
yearwisecast = yearwisecast[yearwisecast['release_year'] > 2018]
yearwisecast
```

Out[43]:

	release_year	cast	title
41651	2019	"Riley" Lakdhar Dridi	1
41652	2019	AJ Rivera	1
41653	2019	Aakash Dabhade	2
41654	2019	Aarna Sharma	1
41655	2019	Aaron Abrams	1
...	...	...	...
58043	2021	Úrsula Corberó	1
58044	2021	Þorsteinn Bachmann	1
58045	2021	İlker Aksum	1
58046	2021	İrem Sak	1
58047	2021	Şehsuvar Aktaş	1

16397 rows × 3 columns

In [44]:
```
yearwisecast = pd.pivot_table(values = 'title', index = 'cast', columns = 'release_year', data = yearwisecast).
yearwisecast
```

Out[44]:

release_year	2019	2020	2021
cast			
Jr.	0.0	1.0	0.0
"Riley" Lakdhar Dridi	1.0	0.0	0.0
9m88	0.0	0.0	1.0
A.D. Miles	0.0	1.0	0.0
AC Lim	0.0	0.0	1.0
...	...	...	...
İpek Filiz Yazıcı	0.0	1.0	0.0
İrem Sak	0.0	0.0	1.0
Şehsuvar Aktaş	0.0	0.0	1.0
Şennur Nogaylar	0.0	1.0	0.0
Şọpẹ́ Dìrísù	0.0	1.0	0.0

14364 rows × 3 columns

In [45]:
```
yearwisecast['ratio19-20'] = yearwisecast[2020] / yearwisecast[2019]
yearwisecast['ratio20-21'] = yearwisecast[2021] / yearwisecast[2020]
yearwisecast['ratio19-20'] = yearwisecast['ratio19-20'].replace(np.inf, 0)
yearwisecast['ratio20-21'] = yearwisecast['ratio20-21'].replace(np.inf, 0)
yearwisecast = yearwisecast.fillna(0)
```

In [46]:
```
yearwisecast[(yearwisecast['ratio19-20'] > 1) & (yearwisecast['ratio20-21'] > 1)]
```

Out[46]:

release_year	2019	2020	2021	ratio19-20	ratio20-21
cast					
Fortune Feimster	1.0	4.0	11.0	4.0	2.75
Grey Griffin	2.0	4.0	5.0	2.0	1.25

From above analysis we can say that **Fortune Feimster** and **Grey Griffin** have done really well in past 3 years and they have got more films in next year like for Fortune Feimster he got 1 film in 2019, 4 in 2020 and 11 in 2021 and for Grey Griffin got 2 films in 2019, 4 films in 2020 and 5 films in 2021.

Recommendation : Netflix can collaborate with below 2 cast as their charms have increased in past 3 years for future projects.

- Fortune Feimster
- Grey Griffin

5. Movie Genre Wise Analysis

In [47]:
```
netflix.head()
```

Out[47]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...

Since, listed_in or genre contains multiple entries hence we will try to convert this data into 1NF form i.e. for each listed_in we will have one row

Example

Before conversion
GA, GB 2019

After conversion
GA 2019
GB 2019

In [48]:
```
genre = pd.DataFrame(netflix)
genre = genre[~genre['listed_in'].isna()]
genre.head()
```

Out[48]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To protect his family from a powerful drug lor...
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	In a city of coaching centers known to train I...

In [49]:
```
genre['listed_in'] = genre['listed_in'].str.split(', ')
genre = genre.explode('listed_in')
genre.head()
```

Out[49]:

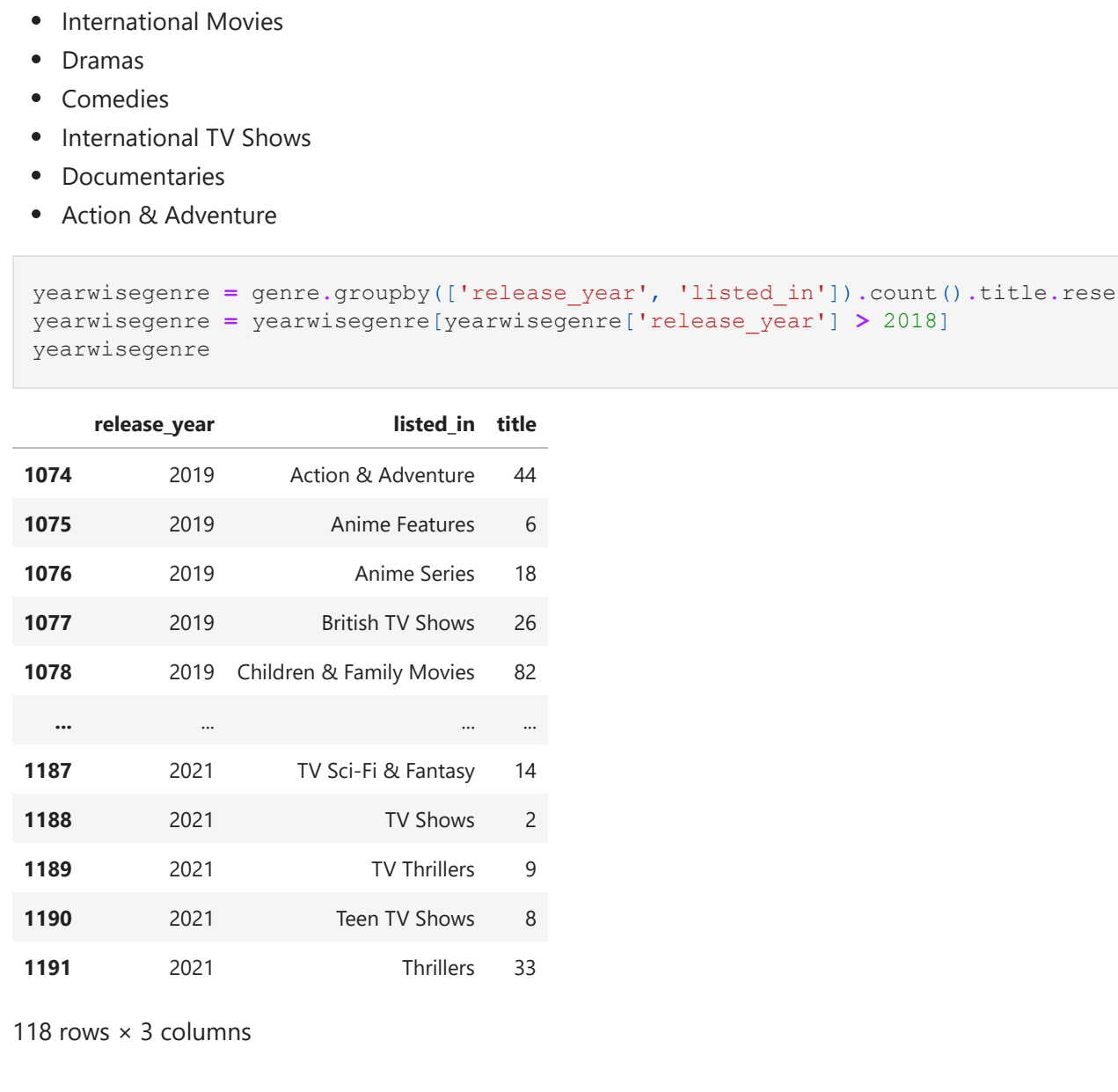
	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	description
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows	After crossing paths at a party, a Cape Town t...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	TV Dramas	After crossing paths at a party, a Cape Town t...
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	TV Mysteries	After crossing paths at a party, a Cape Town t...
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows	To protect his family from a powerful drug lor...

Now, the column **listed_in** is in 1NF form i.e. there are no multiple entries in this column. We can use it to for further analysis.

In [50]:
```
top10genres = genre['listed_in'].value_counts().head(10)
top10genres
```

Out[50]:
```
International Movies        2752
Dramas                      2427
Comedies                    1674
International TV Shows      1351
Documentaries                869
Action & Adventure           859
TV Dramas                    763
Independent Movies           756
Children & Family Movies     641
Romantic Movies              616
Name: listed_in, dtype: int64
```

In [51]:
```
fig = plt.figure(figsize = (10, 8))
sns.barplot(top10genres.index.tolist(), top10genres.values.tolist())
plt.xlabel('Genre Name')
plt.ylabel('Number of Movies')
plt.title('Genre Wise Number of Movies Made')
plt.xticks(rotation = 30)
plt.show()
```



From above analysis we can see that **International Movies** and **Dramas** are the most liked genres among audience and Netflix can continue producing them.

Recommendation : Netflix is producing movies but they can focus on below 6 genres more TV Shows and Movies and produce more for these genres as these are mostly liked by audience.

- International Movies
- Dramas
- Comedies
- International TV Shows
- Documentaries
- Action & Adventure

In [52]:
```
yearwisegenre = genre.groupby(['release_year', 'listed_in']).count().title.reset_index()
yearwisegenre = yearwisegenre[yearwisegenre['release_year'] > 2018]
yearwisegenre
```

Out[52]:

	release_year	listed_in	title
1074	2019	Action & Adventure	44
1075	2019	Anime Features	6
1076	2019	Anime Series	18
1077	2019	British TV Shows	26
1078	2019	Children & Family Movies	82
...	...	...	...
1187	2021	TV Sci-Fi & Fantasy	14
1188	2021	TV Shows	2
1189	2021	TV Thrillers	9
1190	2021	Teen TV Shows	8
1191	2021	Thrillers	33

118 rows × 3 columns

In [53]:
```
yearwisegenre = pd.pivot_table(values = 'title', index = 'listed_in', columns = 'release_year', data = yearwise
yearwisegenre.head(10)
```

Out[53]:

release_year	2019	2020	2021
listed_in			
Action & Adventure	44.0	46.0	37.0
Anime Features	6.0	3.0	6.0
Anime Series	18.0	21.0	23.0
British TV Shows	26.0	33.0	17.0
Children & Family Movies	82.0	83.0	40.0
Classic & Cult TV	3.0	3.0	0.0
Comedies	159.0	133.0	70.0
Crime TV Shows	92.0	87.0	47.0
Documentaries	104.0	77.0	53.0
Docuseries	47.0	74.0	57.0

In [54]:
```
yearwisegenre['ratio19-20'] = yearwisegenre[2020] / yearwisegenre[2019]
yearwisegenre['ratio20-21'] = yearwisegenre[2021] / yearwisegenre[2020]
yearwisegenre['ratio19-20'] = yearwisegenre['ratio19-20'].replace(np.inf, 0)
yearwisegenre['ratio20-21'] = yearwisegenre['ratio20-21'].replace(np.inf, 0)
yearwisegenre = yearwisegenre.fillna(0)
```

In [55]:
```
yearwisegenre[(yearwisegenre['ratio19-20'] > 1) & (yearwisegenre['ratio20-21'] > 1)]
```

Out[55]:

release_year	2019	2020	2021	ratio19-20	ratio20-21
listed_in					
Anime Series	18.0	21.0	23.0	1.166667	1.095238

From above analysis we can say that Anime Series craze has increased in past 3 years. In 2019 18 movies are being produced, in 2020 21 movies are being produced and in 2021 23 movies have been produced

Recommendation : Along with 6 genres listed above Netflix can also produce **Anime Series** as people are actually crazy about them and their fan base has increased in past 3 years.