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- Student pace: self paced

Netflix Moive and TV Shows Recommendation system

In this notebook, I am going to do EDA on Netflix Moives and TV Shows: https://www.kaggle.com/datasets/shivamb/netflix-shows (https://www.kaggle.com/datasets/shivamb/netflix-shows), as well as the Recommendation system

Contents of This Notebook

- EDA for different columns of the dataset using different types of visualizations
- Recommendation system:Content-based recommendation system with different combinations of features

In [11]:
```
# Import necessary libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import plotly.express as px
import plotly.graph_objects as go
import seaborn as sns
sns.set_style('whitegrid')
import warnings
warnings.filterwarnings('ignore')
```

In [12]:
```
# Load data
df = pd.read_csv('./data/netflix_titles.csv')
# The information of all data
print(df.info())
# the first 5 rows of the data
df.head()
```

```
<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
None
```

Out[12]:

	show_id	type	title	director	cast	country	date_added	release_year	rating	d
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	S
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	

	show_id	type	title	director	cast	country	date_added	release_year	rating	d
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	S

- It has a total of 8807 entries and 12 columns.
- There are some null values in 6 columns

Deal with missing data

In [13]:
```
for column in df.columns:
    missing_rate = df[column].isna().sum() / df.shape[0]*100
    if missing_rate > 0 :
        print("missing rate for '{}': {}%".format(column,round(missing_rate,2)))
```

```
missing rate for 'director': 29.91%
missing rate for 'cast': 9.37%
missing rate for 'country': 9.44%
missing rate for 'date_added': 0.11%
missing rate for 'rating': 0.05%
missing rate for 'duration': 0.03%
```

In [14]:
```
# There are six columns have missing values
# director:account for 1/3, this one is important
#          since people may like the movie/TV show from the same director,
#          Therefore, I replace it with nodata
# cast: same as director, replace it with nodata
# country: this one is also important, instead of replacing with nodata,
#          I will replace it with the most common country
# data_added, rating, duration: just drop these entries
df['director'].replace(np.nan,'nodata',inplace=True)
df['cast'].replace(np.nan,'nodata',inplace=True)
df['country'] = df['country'].fillna(df['country'].mode()[0])
df.dropna(inplace=True)
# Just in case, drop duplicates if exist
df.drop_duplicates(inplace=True)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 8790 entries, 0 to 8806
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   show_id       8790 non-null   object
 1   type          8790 non-null   object
 2   title         8790 non-null   object
 3   director      8790 non-null   object
 4   cast          8790 non-null   object
 5   country       8790 non-null   object
 6   date_added    8790 non-null   object
 7   release_year  8790 non-null   int64
 8   rating        8790 non-null   object
 9   duration      8790 non-null   object
 10  listed_in     8790 non-null   object
 11  description   8790 non-null   object
dtypes: int64(1), object(11)
memory usage: 892.7+ KB
```

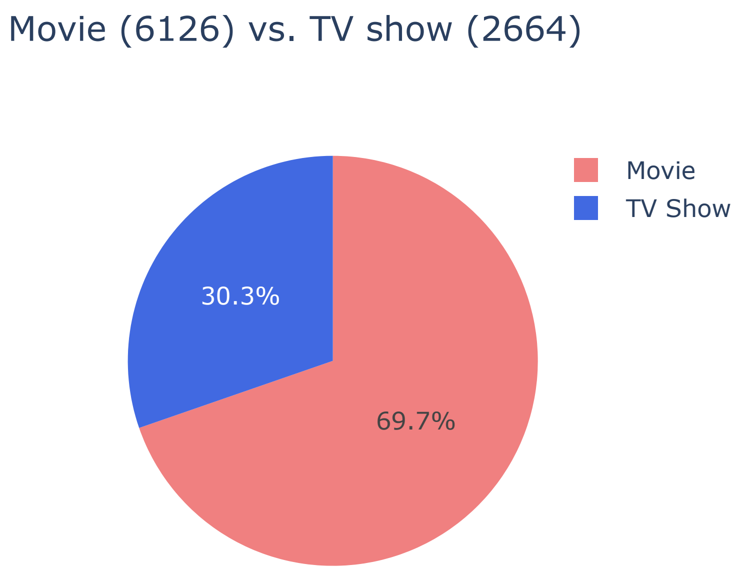
Go through each column one by one

In [15]:
```
# The column: show_id
print(len(df['show_id'].unique()))
# It seems show_id in each entry is different but uninformative.
# Therefore, I just remove it
df = df.iloc[:,1:]
df.info()
```

```
8790
<class 'pandas.core.frame.DataFrame'>
Int64Index: 8790 entries, 0 to 8806
Data columns (total 11 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   type          8790 non-null   object
 1   title         8790 non-null   object
 2   director      8790 non-null   object
 3   cast          8790 non-null   object
 4   country       8790 non-null   object
 5   date_added    8790 non-null   object
 6   release_year  8790 non-null   int64 
 7   rating        8790 non-null   object
 8   duration      8790 non-null   object
 9   listed_in     8790 non-null   object
 10  description   8790 non-null   object
dtypes: int64(1), object(10)
memory usage: 824.1+ KB
```

In [16]:
```
# The column: type
colors_movietv = {'Movie' : 'Lightcoral',
                  'TV Show': 'Royalblue'}

df_notypes = df['type'].value_counts()
print(df_notypes.head())
# Visualization of number of TV show and Movies in pie chart
fig= px.pie(df, names = df_notypes.index,
       values = df_notypes.values,
       color_discrete_sequence = [colors_movietv['Movie'],colors_movietv['TV Show
       title = 'Movie ({}) vs. TV show ({})'.format(df_notypes.values[0],df_notyp
fig.update_layout(
    autosize=False,
    width=400,
    height=400)
fig.show()
fig.write_image("figures/notypes.png")
```

```
Movie      6126
TV Show    2664
Name: type, dtype: int64
```



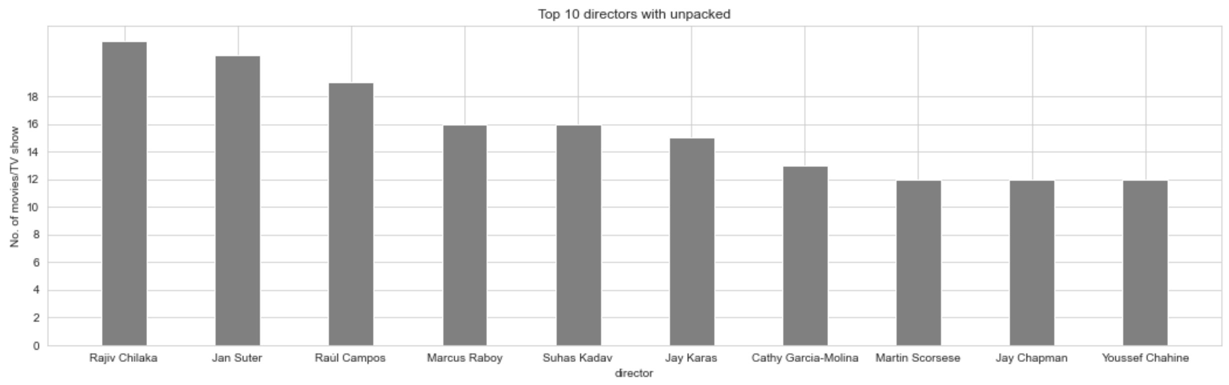
In [17]:
```
# The column: title
print("Unique values in 'title': {}".format(len(df['title'].unique())))
print('The titles with top 10 movie/tv shows:\n')
print(df['title'].value_counts()[1:11])
# They are all different
```

```
Unique values in 'title': 8790
The titles with top 10 movie/tv shows:

Glowing Embers                                1
The Love Affair                               1
A Private War                                 1
He-Man and the Masters of the Universe        1
Two Fathers                                   1
Yes or No                                     1
Game Over (Tamil Version)                     1
David Cross: Making America Great Again!      1
Three                                         1
For Your Own Good                             1
Name: title, dtype: int64
```

In [18]:
```
# I noticed there are some entries have ',', therefore, I create a function to ur
def getunpackedvals(df,colname):
    # Get the unpacked values from a column in a dataframe, which
    # may have ',' and need to be splitted into multiple items
    collist = df[colname].tolist()
    col_uq = []
    for val in collist:
        if val.find(',')>0:
            vals = val.split(', ')
#             print("'{}' split into {}".format(val,vals))
            for valii in vals:
                if valii.find(',') > 0 or valii.find(' , ') > 0:
                    valiis = valii.split(',')
                    #print("'{}' split into {}".format(valii,valiis))
                    for valiii in valiis:
                        if len(valiii) > 0:
                            col_uq.append(valiii)

                else:
                    col_uq.append(valii)
        else:
             col_uq.append(val)
    df_colname = pd.DataFrame()
    df_colname[colname] = col_uq
    print('number of missing values {}\n'.format(df_colname.isnull().sum()))
    if len(df_colname[df_colname[colname].str.contains(',')]) >0:
        print(df_colname[df_colname[colname].str.contains(',')])
        # replace ', '
    return df_colname
```

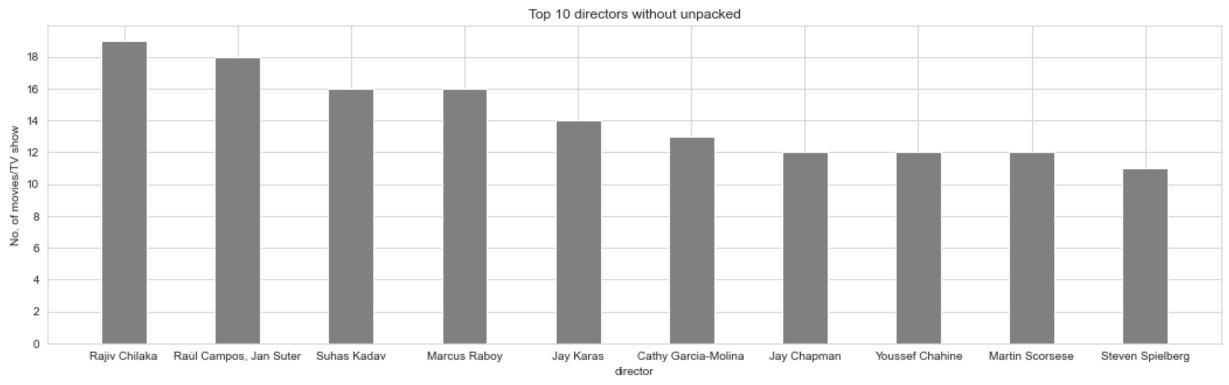
In [19]:
```
# The column: director, with unpacked
colname = 'director'
df_tmp = getunpackedvals(df,colname)
print("Unique values in '{}': {}\n".format(colname,len(df_tmp[colname].unique()))
print('The directors with top 10 movie/tv shows:\n')
# bar plot for the top 10 directors
fig = plt.figure(figsize = (18, 5))
rowidx = range(1,11)
plt.bar(df_tmp[colname].value_counts()[rowidx].index, df_tmp[colname].value_count
        width = 0.4)
plt.yticks(np.arange(0, 20, 2))
plt.xlabel(colname)
#plt.xticks(rotation=45)
plt.ylabel("No. of movies/TV show")
plt.title("Top 10 " + colname + 's with unpacked')
plt.show()
fig.savefig('figures/top10'+colname + 'unpacked.png')
```

```
number of missing values director    0
dtype: int64

Unique values in 'director': 4992

The directors with top 10 movie/tv shows:
```



In [20]:
```
# The column: director, without unpacked
print("Unique values in '{}': {}\n".format(colname,len(df[colname].unique())))
print('The directors with top 10 movie/tv shows:\n')
# bar plot for the top 10 directors
fig = plt.figure(figsize = (18, 5))
plt.bar(df[colname].value_counts()[rowidx].index, df[colname].value_counts()[rowi
        width = 0.4)
plt.yticks(np.arange(0, 20, 2))
plt.xlabel(colname)
#plt.xticks(rotation=45)
plt.ylabel("No. of movies/TV show")
plt.title("Top 10 " + colname + 's without unpacked')
plt.show()
fig.savefig('figures/top10'+colname+'wounpacked.png')
```

```
Unique values in 'director': 4527

The directors with top 10 movie/tv shows:
```



In [21]:
```
# The column: cast
colname = 'cast'
print("Unique values in '{}': {}\n".format(colname,len(df[colname].unique())))
print('The ' + colname + ' with top 10 movie/tv shows:')
print(df[colname].value_counts()[1:11])
# examine one set of cast:
df[df[colname]== df[colname].value_counts().index[2]]
```

```
Unique values in 'cast': 7679

The cast with top 10 movie/tv shows:
David Attenborough
19
Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jigna Bhardwaj, Rajesh Kava, Mousam, 
Swapnil                                    14
Samuel West
10
Jeff Dunham
7
Kevin Hart
6
Michela Luci, Jamie Watson, Eric Peterson, Anna Claire Bartlam, Nicolas Aqui, C
ory Doran, Julie Lemieux, Derek McGrath     6
Craig Sechler
6
David Spade, London Hughes, Fortune Feimster
6
Iliza Shlesinger
5
Jim Gaffigan
5
Name: cast, dtype: int64
```

Out[21]:

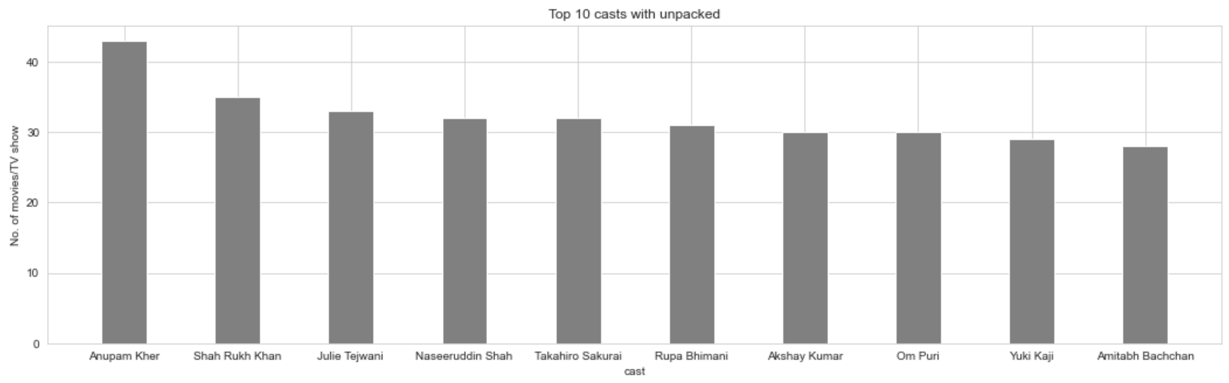
	type	title	director	cast	country	date_added	release_year	rating	duration
39	TV Show	Chhota Bheem	nodata	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	India	September 16, 2021	2021	TV-Y7	3 Seasons
406	Movie	Chhota Bheem - Neeli Pahaadi	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2013	TV-Y7	64 min
407	Movie	Chhota Bheem & Ganesh	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2009	TV-Y7	68 min

	type	title	director	cast	country	date_added	release_year	rating	duration
408	Movie	Chhota Bheem & Krishna: Mayanagari	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2011	TV-Y7	67 min
410	Movie	Chhota Bheem And The Broken Amulet	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	India	July 22, 2021	2013	TV-Y7	64 min
411	Movie	Chhota Bheem And The Crown of Valhalla	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2013	TV-Y7	64 min
412	Movie	Chhota Bheem and the Incan Adventure	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2013	TV-Y7	65 min
413	Movie	Chhota Bheem and The ShiNobi Secret	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2013	TV-Y7	64 min
414	Movie	Chhota Bheem Aur Hanuman	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2012	TV-Y7	68 min
416	Movie	Chhota Bheem aur Krishna vs Zimbara	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2013	TV-Y7	64 min
419	Movie	Chhota Bheem: Bheem vs Aliens	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2010	TV-Y7	69 min

	type	title	director	cast	country	date_added	release_year	rating	duration
420	Movie	Chhota Bheem: Dholakpur to Kathmandu	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2012	TV-Y7	70 min
421	Movie	Chhota Bheem: Dus Pe Dus	Rajiv Chilaka, Owll Mina	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2014	TV-Y7	63 min
424	Movie	Chhota Bheem: The Rise of Kirmada	Rajiv Chilaka	Vatsal Dubey, Julie Tejwani, Rupa Bhimani, Jig...	United States	July 22, 2021	2012	TV-Y7	68 min

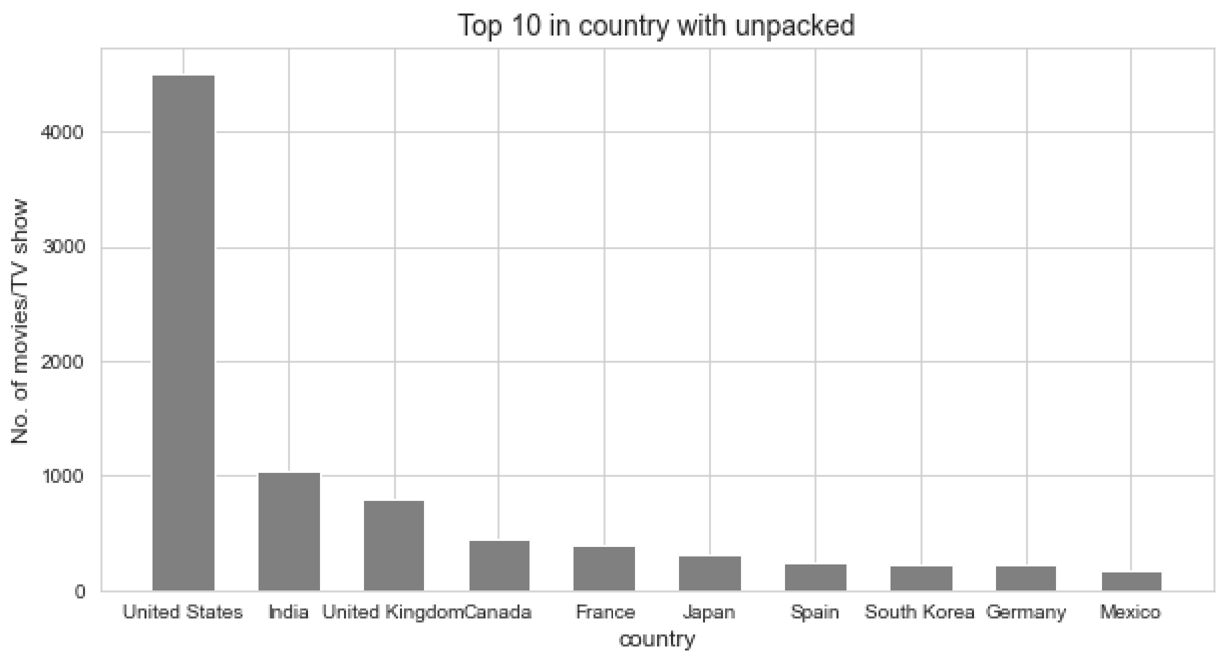
In [22]:
```
# cast have more than one actors/actress, unpack them and plot the top 10
df_tmp = getunpackedvals(df,colname)
print("Unique values in '{}': {}\n".format(colname,len(df_tmp[colname].unique()))
print('The ' + colname +' with top 10 movie/tv shows:\n')
# bar plot for the top 10 directors
fig = plt.figure(figsize = (18, 5))
rowidx = range(1,11)
plt.bar(df_tmp[colname].value_counts()[rowidx].index, df_tmp[colname].value_count
        width = 0.4)
#plt.yticks(np.arange(0, 20, 2))
plt.xlabel(colname)
#plt.xticks(rotation=45)
plt.ylabel("No. of movies/TV show")
plt.title("Top 10 " + colname + 's with unpacked')
plt.show()
fig.savefig('figures/top10' + colname +'unpacked.png')
# the results seems quite different as compared to the data without unpack
```

```
number of missing values cast    0
dtype: int64

Unique values in 'cast': 36393

The cast with top 10 movie/tv shows:
```



In [23]:
```
# country have more than one values, unpack them and plot the top 10
colname = 'country'
df_tmp = getunpackedvals(df,colname)
print("Unique values in '{}': {}\n".format(colname,len(df_tmp[colname].unique()))
print('The ' + colname +' with top 10 movie/tv shows:\n')
# bar plot for the top 10 directors
fig = plt.figure(figsize = (10, 5))
rowidx = range(0,10)
plt.bar(df_tmp[colname].value_counts()[rowidx].index, df_tmp[colname].value_count
        width = 0.6)
#plt.yticks(np.arange(0, 20, 2))
plt.xlabel(colname,fontsize=12)
#plt.xticks(rotation=45)
plt.ylabel("No. of movies/TV show",fontsize=12)
plt.title("Top 10 in " + colname + ' with unpacked',fontsize=14)
plt.show()
fig.savefig('figures/top10' + colname +'unpacked.png')
```

```
number of missing values country    0
dtype: int64

               country
241      , South Korea
446   , France, Algeria
Unique values in 'country': 124

The country with top 10 movie/tv shows:
```



In [24]:
```
# The column: date_added
colname = 'date_added'
df[colname + 'dt'] = pd.to_datetime(df[colname])
df['year_added'] = df[colname + 'dt'].apply(lambda x: x.year)
df.head()
```

Out[24]:

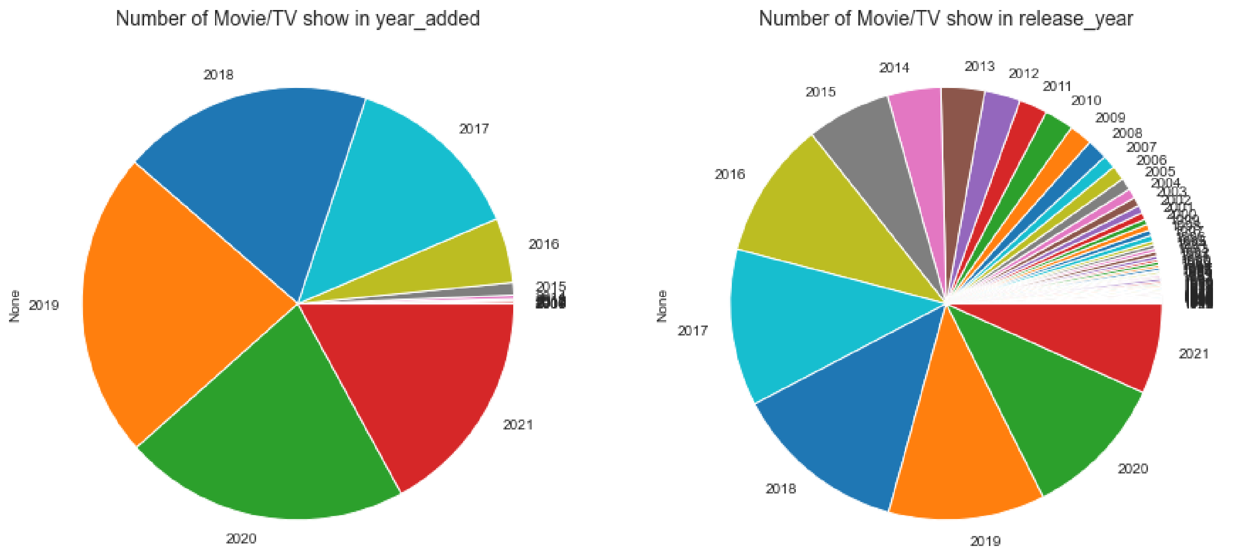
	type	title	director	cast	country	date_added	release_year	rating	duration	
0	Movie	Dick Johnson Is Dead	Kirsten Johnson	nodata	United States	September 25, 2021	2020	PG-13	90 min	Docu
1	TV Show	Blood & Water	nodata	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	In TV : D
2	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	United States	September 24, 2021	2021	TV-MA	1 Season	In TV :
3	TV Show	Jailbirds New Orleans	nodata	nodata	United States	September 24, 2021	2021	TV-MA	1 Season	D
4	TV Show	Kota Factory	nodata	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	In - Rc Sh

In [25]:
```
# the newly added column: year_added
colname = 'year_added'
print("Unique values in '{}': {}\n".format(colname,len(df[colname].unique())))
df_tmp = df[colname].value_counts()
```

```
Unique values in 'year_added': 14
```

In [26]:
```
# I will combine two columns together for visualization: 'year_added','release_ye
colnames = ['year_added','release_year']
fig,ax = plt.subplots(1,2,figsize = (15, 8))
for ii, colname in enumerate(colnames):
    df.groupby(colname).size().plot(kind = 'pie',ax=ax[ii])
    ax[ii].set_title('Number of Movie/TV show in ' + colname,fontsize=14)
df.groupby(colnames[1]).size()
```

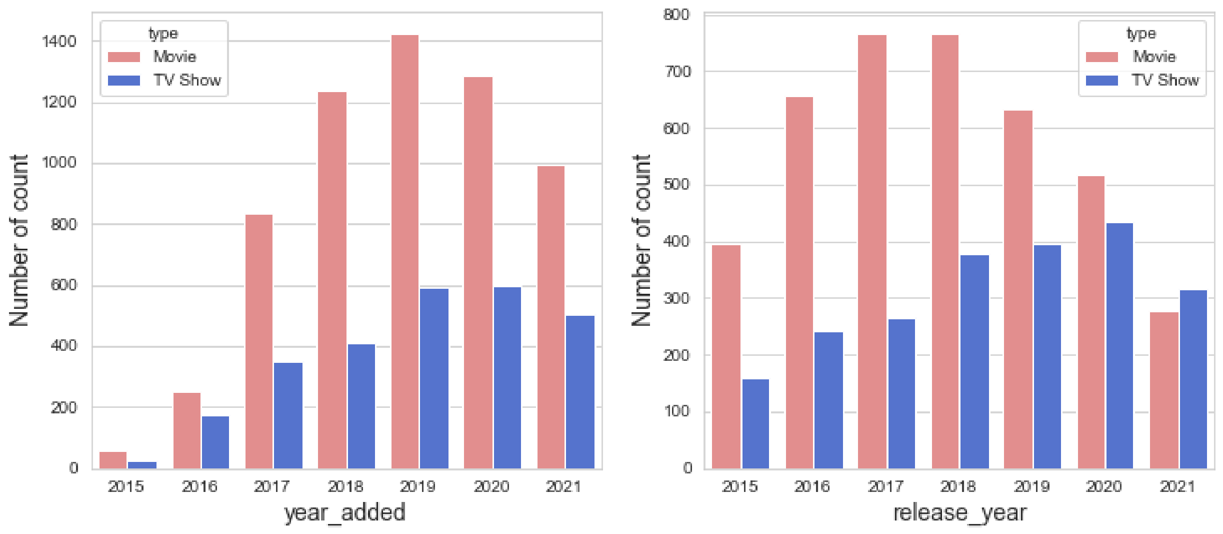
Out[26]:
```
release_year
1925       1
1942       2
1943       3
1944       3
1945       4
        ...
2017    1030
2018    1146
2019    1030
2020     953
2021     592
Length: 74, dtype: int64
```



Observations regarding year_added and release_year

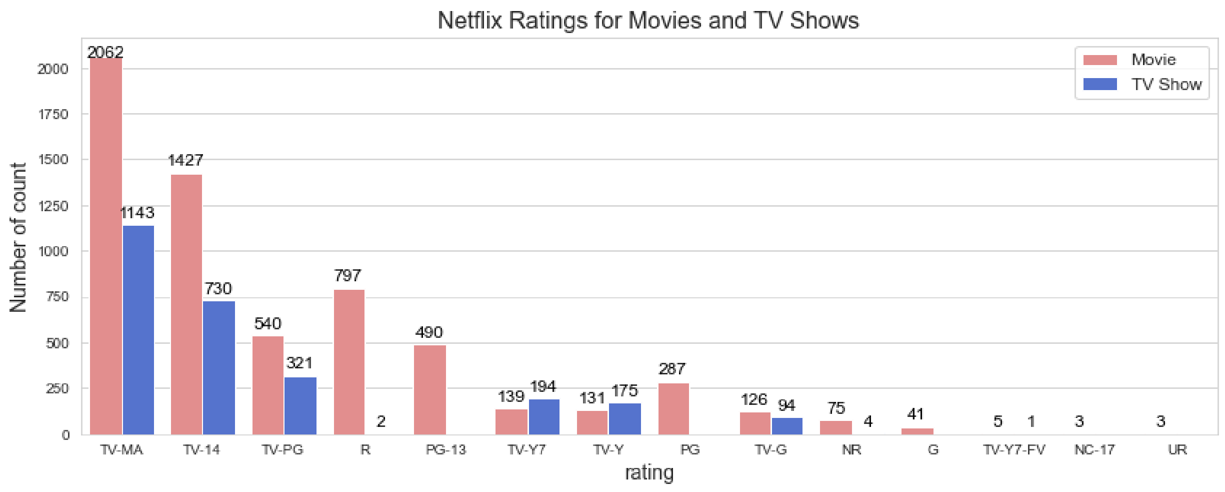
- year_added: from 2010 to 2021, years before 2015 only have a very small percentage.Therefore, I further take plot to take a look the years between 2015 and 2021 for movies and TV shows
- release_year: it has a broad range back to 1925. As a comparison, I will also take a look the years between 2015 and 2021

In [74]:
```
fig,ax = plt.subplots(1,2,figsize = (12, 5))
for ii, colname in enumerate(colnames):
    df_2015 = df[df[colname] >= 2015]
    sns.countplot(df_2015[colname],
                  hue = df_2015['type'],
                  palette = colors_movietv,ax=ax[ii])
    ax[ii].set_xlabel(colname,fontsize=14)
    ax[ii].set_ylabel('Number of count',fontsize=14)
fig.savefig('figures/numofcounts2015_2021.png')
```



In general, there are more movies than TV shows in each year

In [28]:
```
# the column: rating
colname = 'rating'
fig,ax = plt.subplots(figsize = (14, 5))
sns.countplot(df[colname],
              hue = df['type'],
              palette = colors_movietv,order=df[colname].value_counts().index,ax=
for p in ax.patches:
    if p.get_height()>2000:
        y = p.get_height()+60
    else:
        y = p.get_height()+100
    if np.isnan(p.get_height()):
        val = 0
    else:
        val = int(p.get_height())
    ax.annotate("{}".format(val), (p.get_x()+0.2, y), ha='center', va='top', colo
plt.xlabel(colname,fontsize=14)
plt.legend(fontsize=12,loc="upper right")
plt.ylabel('Number of count',fontsize=14)
plt.title('Netflix Ratings for Movies and TV Shows',fontsize=16)
plt.show()
fig.savefig('figures/' + colname +'count.png')
```

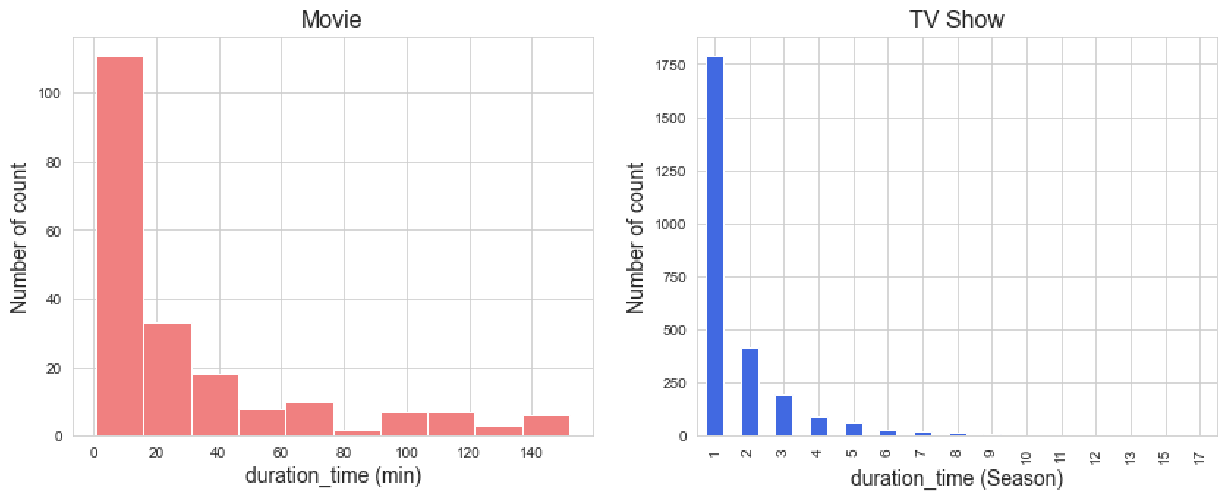


TV-MA, TV-14, TV-PG are the three ratings with top three counts

In [29]:
```
# The column: duration
colname = 'duration'
df[colname].value_counts()
# It have two units, i.e., Season(s) or min, corresponding to TV shows and Movie
# Create a new column to save the duration_time after removing units
df['duration_time']= df['duration'].apply(lambda x: x.replace(' min','').replace(
df['duration_time']= df['duration_time'].astype(int)
df['duration_time'].value_counts()
```

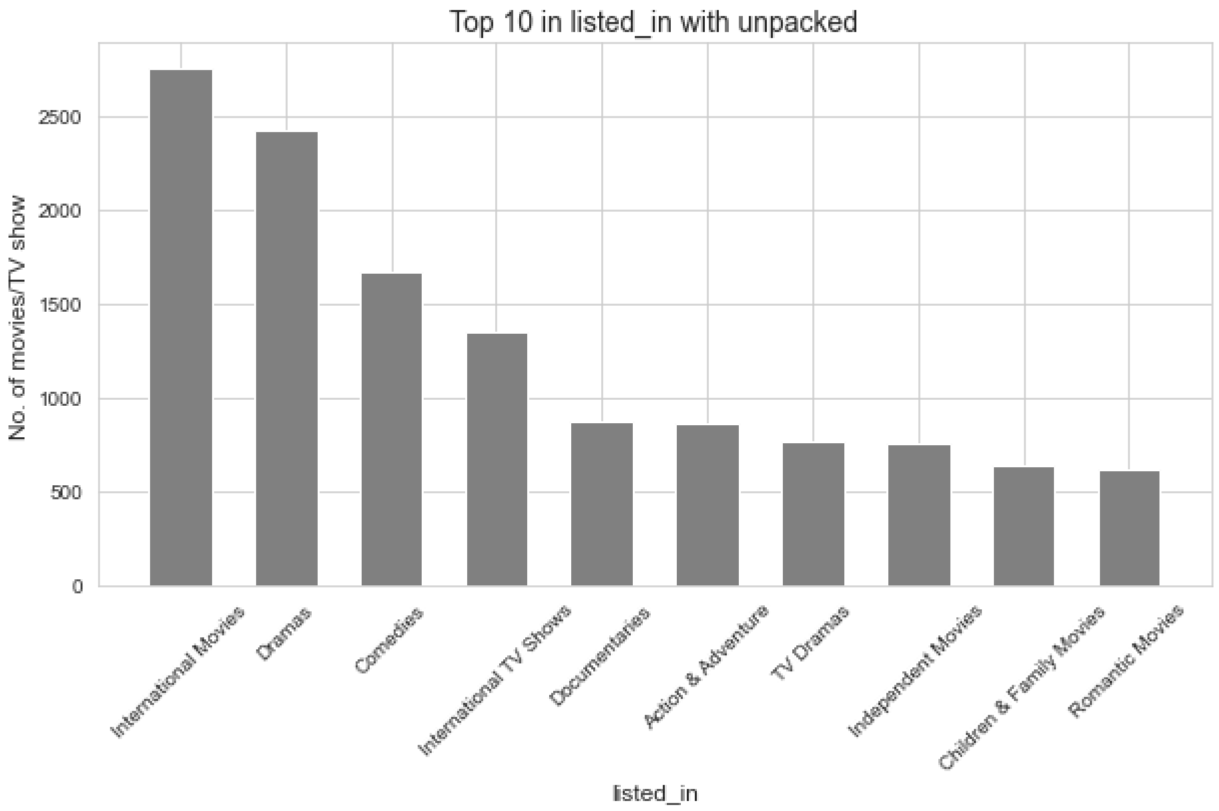
Out[29]:
```
1      1791
2       421
3       199
90      152
97      146
       ...
200       1
208       1
224       1
312       1
191       1
Name: duration_time, Length: 210, dtype: int64
```

In [30]:
```
colname = 'duration_time'
units = {'Movie': 'min',
         'TV Show': 'Season'}
fig,ax = plt.subplots(1,2,figsize = (14, 5))
for ii,key in enumerate(list(colors_movietv.keys())):
    if key == 'TV Show':# display in the format of bar
        df[df['type'] == key].groupby(colname).size().plot(kind = 'bar',color=col
    else: # display in the format of histogram since there are too many unique va
        df[df['type'] == key].groupby(colname).size().plot(kind='hist',color = co
    ax[ii].set_xlabel(colname+' (' + units[key] + ')',fontsize=14)
    ax[ii].set_ylabel('Number of count',fontsize=14)
    ax[ii].set_title(key,fontsize=16)
fig.savefig('figures/' + colname +'count.png')
```



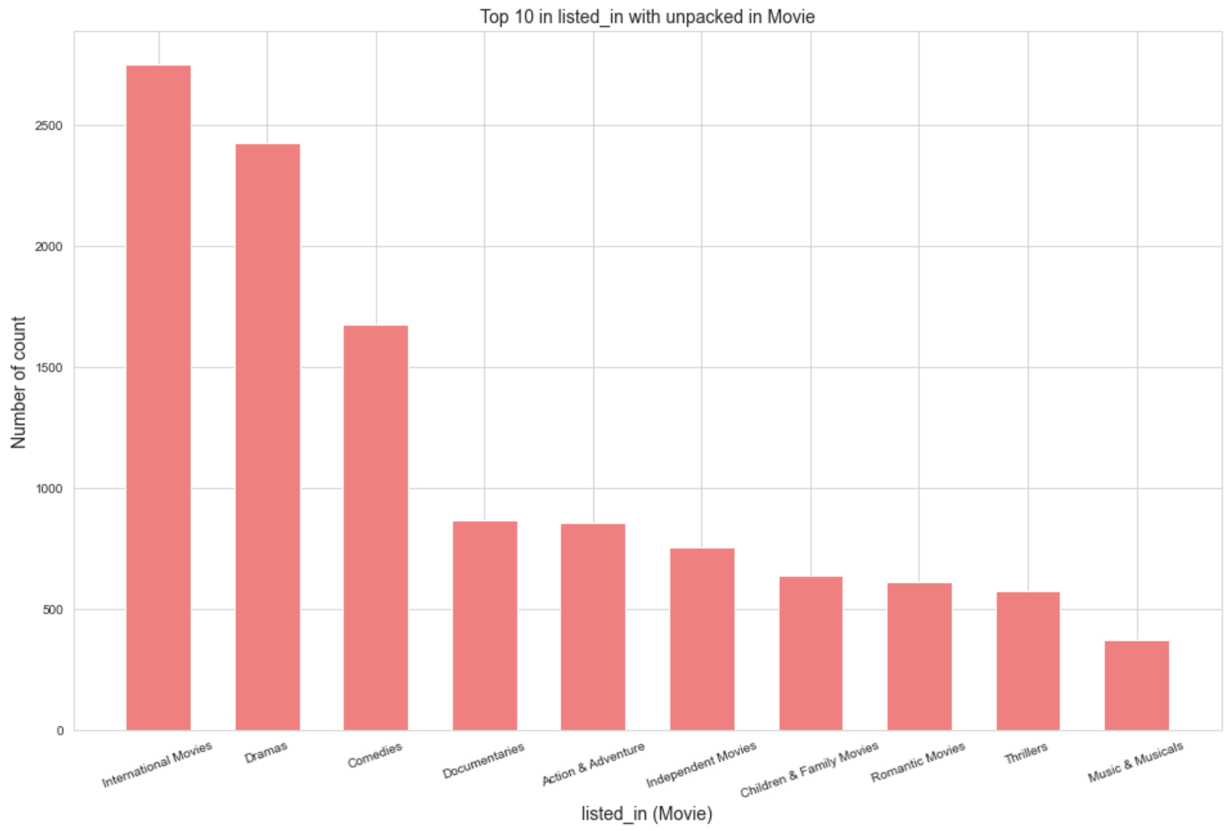
```
In [31]: # The column: listed_in
colname = 'listed_in'
df_tmp = getunpackedvals(df,colname)
print("Unique values in '{}': {}\n".format(colname,len(df_tmp[colname].unique()))
print('The ' + colname +' with top 10 movie/tv show:\n')
# bar plot for the top 10 directors
fig = plt.figure(figsize = (10, 5))
rowidx = range(0,10)
plt.bar(df_tmp[colname].value_counts()[rowidx].index, df_tmp[colname].value_count
        width = 0.6)
#plt.yticks(np.arange(0, 20, 2))
plt.xlabel(colname,fontsize=12)
plt.xticks(rotation=45)
plt.ylabel("No. of movies/TV show",fontsize=12)
plt.title("Top 10 in " + colname + ' with unpacked',fontsize=14)
plt.show()
fig.savefig('figures/top10' + colname +'unpacked_TV.png')
```

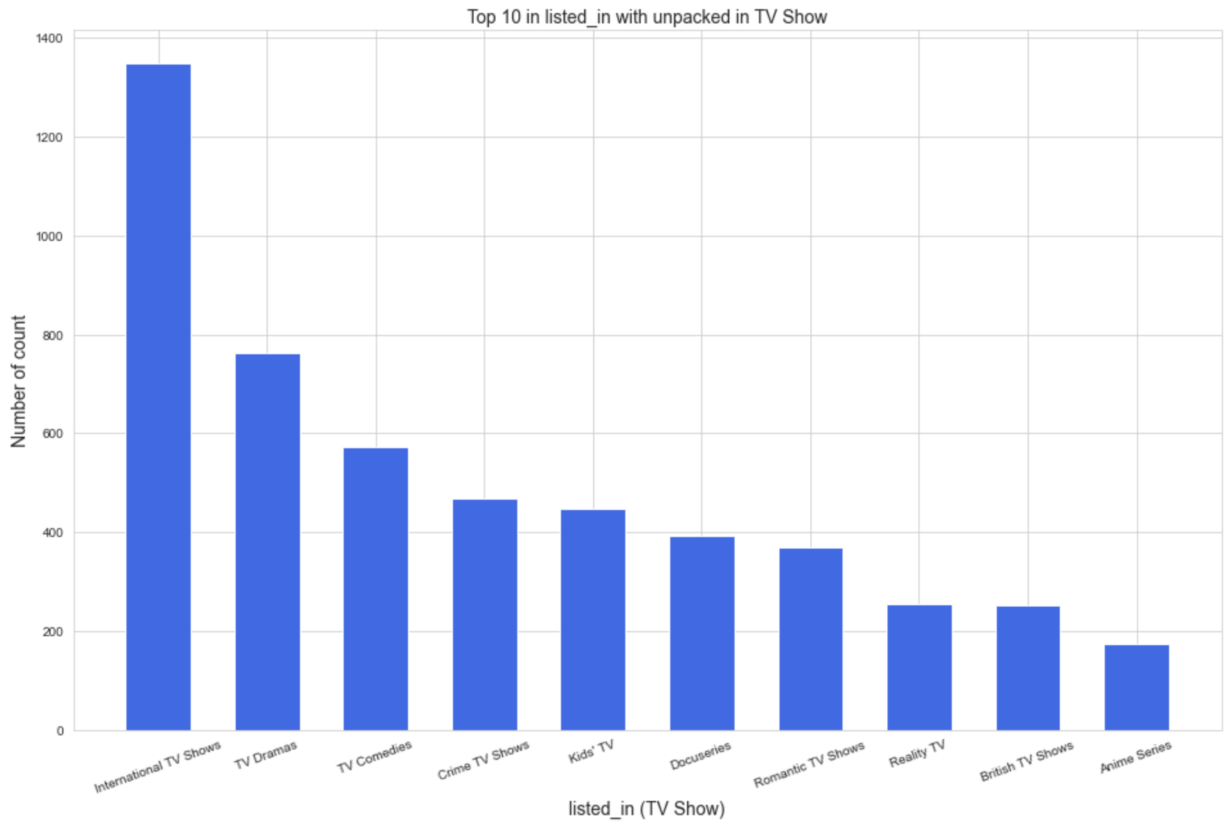
```
number of missing values listed_in    0
dtype: int64

Unique values in 'listed_in': 42

The listed_in with top 10 movie/tv show:
```



In [32]:
```
# seprate them between TV shows and Movies
colname = 'listed_in'
fig,axs = plt.subplots(2,1,figsize = (16, 22))
for ii,key in enumerate(list(colors_movietv.keys())):
    df_key = df[df['type'] == key]
    df_tmp = getunpackedvals(df_key,colname)
    print("Unique values in '{}': {}\n".format(colname,len(df_tmp[colname].unique
    print('The ' + colname +' with top 10 movie/tv shows:\n')
    # bar plot for the top 10 directors
    rowidx = range(0,10)
    axs[ii].bar(df_tmp[colname].value_counts()[rowidx].index, df_tmp[colname].val
            color =colors_movietv[key], width = 0.6)
    axs[ii].set_xlabel(colname +' (' + key + ')',fontsize=14)
    axs[ii].set_xticklabels(df_tmp[colname].value_counts()[rowidx].index,rotation
    axs[ii].set_ylabel('Number of count',fontsize=14)
    axs[ii].set_title("Top 10 in " + colname + ' with unpacked in ' + key,fontsiz
fig.savefig('figures/top10' + colname +'unpacked' + key.replace(' ','') +'.png')
```

```
number of missing values listed_in    0
dtype: int64

Unique values in 'listed_in': 20

The listed_in with top 10 movie/tv shows:

number of missing values listed_in    0
dtype: int64

Unique values in 'listed_in': 22

The listed_in with top 10 movie/tv shows:
```



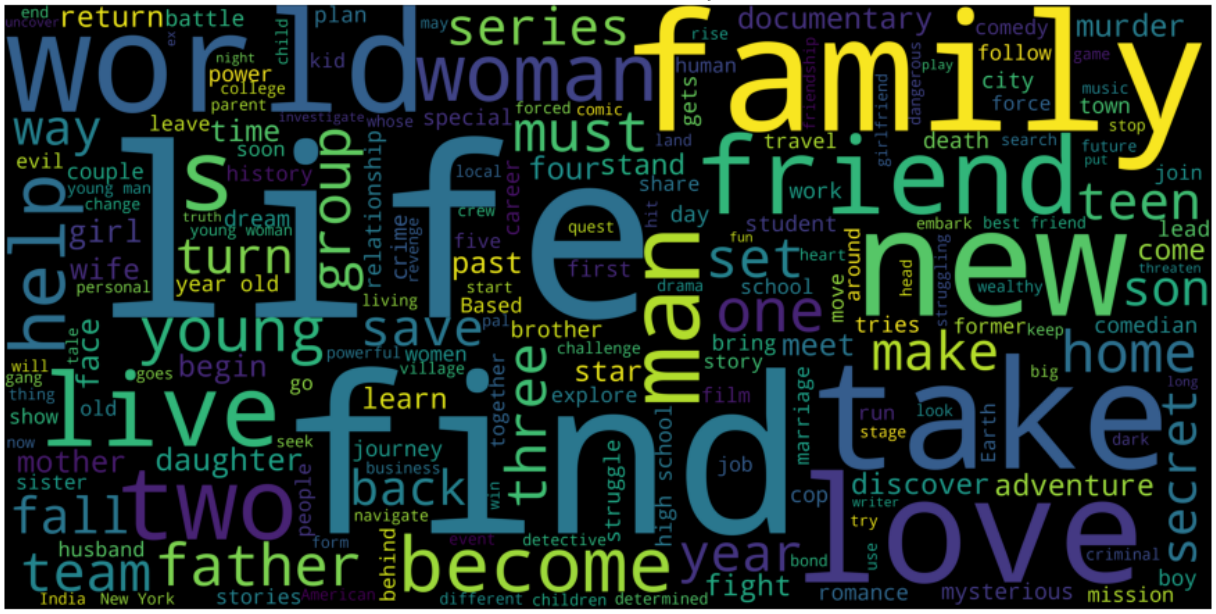


International, drama,comedies, are the to 3 categories

In [33]:
```
# The column: description
import wordcloud
from wordcloud import WordCloud, STOPWORDS
colname = 'description'
# Create a wordcloud of the description
#df['title'] = movies['title'].fillna("").astype('str')
description_corpus = ' '.join(df[colname])
description_wordcloud = WordCloud(stopwords=STOPWORDS,
                                  background_color='black', height=2000, width=4
```

In [34]:
```
# Plot the wordcloud
fig = plt.figure(figsize=(16,8))
plt.imshow(description_wordcloud)
plt.axis('off')
plt.title('Word Cloud of the ' + colname, fontsize=16)
plt.show()
fig.savefig('figures/' + colname +'wordcloud' +'.png')
```

Word Cloud of the description



In [71]:
```
list(description_wordcloud.words_.items())[0:10]
```

Out[71]:
```
[('life', 1.0),
 ('find', 0.8387533875338753),
 ('family', 0.8143631436314364),
 ('new', 0.6978319783197832),
 ('take', 0.6951219512195121),
 ('love', 0.6666666666666666),
 ('world', 0.6626016260162602),
 ('friend', 0.5867208672086721),
 ('two', 0.5257452574525745),
 ('live', 0.5257452574525745)]
```

The life, find, family, new,take,love have the most occurrence

The End of the EDA

The Start of Recommendation

Since I only have movie and TV show data and no rates from audience, I will build a content-based recommendation system

- Recommendation only on the same type of data: TV show or Movie
- Recommendation on combined Movie and TV show data

In [36]:
```
df.head()
```

Out[36]:

	type	title	director	cast	country	date_added	release_year	rating	duration	
0	Movie	Dick Johnson Is Dead	Kirsten Johnson	nodata	United States	September 25, 2021	2020	PG-13	90 min	Docu
1	TV Show	Blood & Water	nodata	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	In TV D
2	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	United States	September 24, 2021	2021	TV-MA	1 Season	In TV
3	TV Show	Jailbirds New Orleans	nodata	nodata	United States	September 24, 2021	2021	TV-MA	1 Season	D
4	TV Show	Kota Factory	nodata	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	In Rc Sh

The features used for recommendation

- director
- cast
- rating
- listed_in

- description

In [37]:
```
# Create feature combinations
from itertools import combinations
possible_features = ['director','cast','rating','listed_in','description']
list_combinations = list()
for n in range(len(possible_features) + 1):
    list_combinations += list(combinations(possible_features, n))
     #print(list_combinations)
feat_combs = list_combinations[list(len(list_combination) > 3 for list_combinatic
print('Selected feature combinations:')
print(feat_combs)
```

```
Selected feature combinations:
[('director', 'cast', 'rating', 'listed_in'), ('director', 'cast', 'rating', 'd
escription'), ('director', 'cast', 'listed_in', 'description'), ('director', 'r
ating', 'listed_in', 'description'), ('cast', 'rating', 'listed_in', 'descripti
on'), ('director', 'cast', 'rating', 'listed_in', 'description')]
```

In [56]:
```
# make the comb_feats as a dictionary
feat_combsdict = dict()
for ii in range(len(feat_combs)):
    feat_combsdict['comb_features' + str(ii)] = feat_combs[ii]
feat_combsdict
```

Out[56]:
```
{'comb_features0': ('director', 'cast', 'rating', 'listed_in'),
 'comb_features1': ('director', 'cast', 'rating', 'description'),
 'comb_features2': ('director', 'cast', 'listed_in', 'description'),
 'comb_features3': ('director', 'rating', 'listed_in', 'description'),
 'comb_features4': ('cast', 'rating', 'listed_in', 'description'),
 'comb_features5': ('director', 'cast', 'rating', 'listed_in', 'description')}
```

In [39]:
```
# The comma needs to be removed
def remove_comma(x):
    if isinstance(x, list):
        return [str.lower(i.replace(",", "")) for i in x]
    else:
        if isinstance(x, str):
            return str.lower(x.replace(",", ""))
        else:
            return ''
```

In [41]:
```
# add the combined features into the df
for ii, feat_comb in enumerate(feat_combs):
    df['comb_features'+ str(ii)] = ""
    for feat in feat_comb:
        #print(feat)
        df['comb_features'+ str(ii)] = df['comb_features'+ str(ii)] + " " + df[fe
    df['comb_features'+ str(ii)] = df['comb_features'+ str(ii)].apply(remove_comm
```

```
director
cast
rating
listed_in
director
cast
rating
description
director
cast
listed_in
description
director
rating
listed_in
description
cast
rating
listed_in
description
director
cast
rating
listed_in
description
```

Out[41]:

	type	title	director	cast	country	date_added	release_year	rating	duration	
0	Movie	Dick Johnson Is Dead	Kirsten Johnson	nodata	United States	September 25, 2021	2020	PG-13	90 min	D
1	TV Show	Blood & Water	nodata	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	T
2	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	United States	September 24, 2021	2021	TV-MA	1 Season	T

	type	title	director	cast	country	date_added	release_year	rating	duration
3	TV Show	Jailbirds New Orleans	nodata	nodata	United States	September 24, 2021	2021	TV-MA	1 Season
4	TV Show	Kota Factory	nodata	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons

In [42]:
```
df.head()
```

Out[42]:

ate_added	release_year	rating	duration	listed_in	description	date_addeddt	year_added	dura
September 25, 2021	2020	PG-13	90 min	Documentaries	As her father nears the end of his life, filmm...	2021-09-25	2021	
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...	2021-09-24	2021	
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...	2021-09-24	2021	
September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	Feuds, flirtations and toilet talk go down amo...	2021-09-24	2021	
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...	2021-09-24	2021	

In [43]:
```
df['title']= df['title'].str.lower()
```

In [44]:
```
# Build the recommendation functions
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics.pairwise import cosine_similarity
cv = CountVectorizer(stop_words='english')
```

In [45]:
```
# The function to suggest possible titles if the input one is not existed in the
def get_possible_titles(title,dfall):
    temp = ''
    possible_titles = dfall['title'].copy()
    for i in title.lower():
        out = []
        temp += i
        for j in possible_titles:
            if temp in j:
                out.append(j)
        if len(out) == 0:
            return possible_titles
        out.sort()
        possible_titles = out.copy()
    return possible_titles
```

In [58]:
```
# The recommendation function based on an input title and combination feature typ
def recommenddata(title,numrecmd,dfall,cv,combfeattype):
    # title: the title of movie or TV show
    if title.lower() in [tit for tit in dfall['title']]:
        # From all
        count_matall = cv.fit_transform(dfall[combfeattype])
        # From same type df
        type_title = dfall[dfall['title'] == title.lower()]
        # print('{} is a {}\n'.format(title,type_title.iloc[0]['type']))
        dfsametype = dfall[dfall['type'] == type_title.iloc[0]['type']].reset_inc
        # print(dfsametype.info())
        count_matsametype = cv.fit_transform(dfsametype[combfeattype])
        cosine_simall = cosine_similarity(count_matall)
        cosine_simsametype = cosine_similarity(count_matsametype)
        # print(cosine_simsametype.shape)
        indices_all = pd.Series(dfall.index, index=dfall['title'])
        indices_sametype = pd.Series(dfsametype.index, index=dfsametype['title']
        recmdres = dict()
        for ii in range(2):
            if ii == 0:
                idx = indices_all[title.lower()]
                sim_scores = list(enumerate(cosine_simall[idx]))
                dfsel = dfall
                typesel = 'all'
            else:
                idx = indices_sametype[title.lower()]
                sim_scores = list(enumerate(cosine_simsametype[idx]))
                dfsel = dfsametype
                typesel = dfsel.iloc[0]['type']
            sim_scores = sorted(sim_scores, key=lambda x: x[1], reverse=True)
            sim_scores = sim_scores[1:numrecmd+1]
            #print(sim_scores)
            recmd_indices = [i[0] for i in sim_scores]
            #recmd_list = dfsel['title'].iloc[recmd_indices]
            print('Recommended items in {} for \'{}\' in decending order \nbased
                  format(typesel,title,combfeattype,feat_combsdict[combfeattype]
            print('-'*(56+len(title)))
            dftmp = dfsel.iloc[recmd_indices][['title','type']]
            dftmp['sim_scores'] = [i[1] for i in sim_scores]
            if ii == 0:
                recmdres['all'] = dftmp
            else:
                recmdres['sametype'] = dftmp
                #print(dfsel.iloc[recmd_indices][['title','type']])
            print(dftmp)
           # print(*recmd_list, sep = "\n")
            print('-'*(56+len(title)) +'\n')
        return recmdres
    else:
        possible_titles = get_possible_titles(title,dfall)
        print('We have nothing to recommend for \'{}\' at that time, since it is
        Try with other similar movies:\n {}.'.format(title,possible_titles))
```

In [59]:
```
# test the input title is not existed in the database
title_input = 'Gangland'#df.iloc[10].title
comb_feattype = 'comb_features5'
recmdres = recommenddata(title_input,10,df,cv,comb_feattype)
```

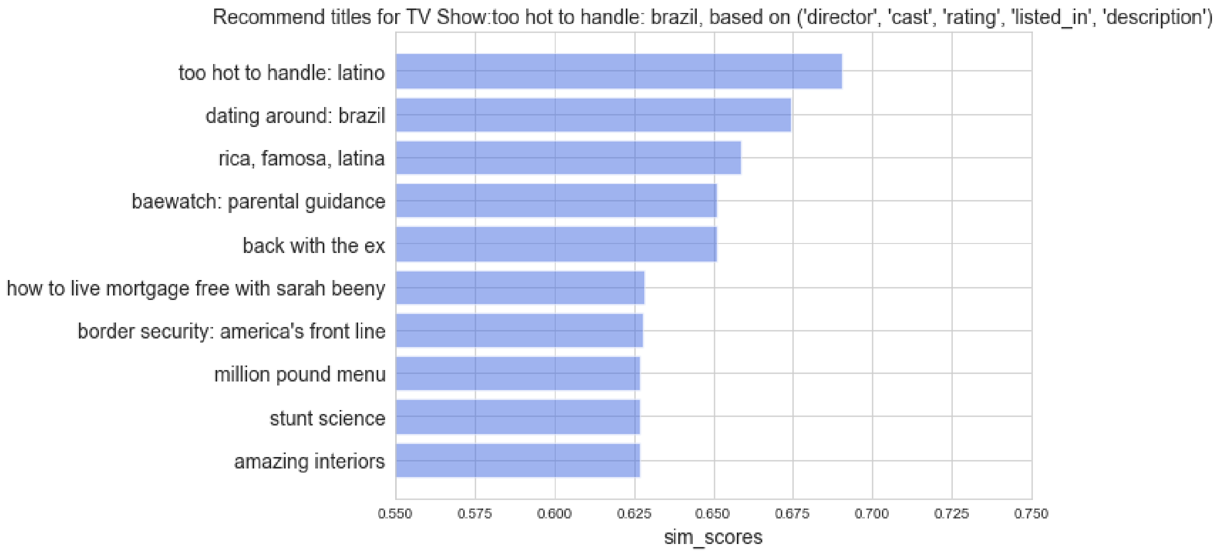
```
We have nothing to recommend for 'Gangland' at that time, since it is not exist
ed in the database.
Try with other similar movies:
 ['ganglands'].
```

In [60]:
```
title_input = 'Ganglands'#df.iloc[10].title
comb_feattype = 'comb_features5'
recmdres = recommenddata(title_input,10,df,cv,comb_feattype)
```

```
Recommended items in all for 'Ganglands' in decending order
based on comb_features5=('director', 'cast', 'rating', 'listed_in', 'descriptio
n')
-----------------------------------------------------------------
                                           title     type  sim_scores
3976                        the eagle of el-se'eed  TV Show    0.486854
3789                                killer ratings  TV Show    0.481932
6741                                 fatal destiny  TV Show    0.471010
7017  how to live mortgage free with sarah beeny  TV Show    0.471010
749                                  l.a.’s finest  TV Show    0.467735
5157                                         argon  TV Show    0.458220
5278                                       apaches  TV Show    0.454183
697               elite short stories: carla samuel  TV Show    0.453572
4752                                       smoking  TV Show    0.453572
7538                                 my hotter half  TV Show    0.450806
-----------------------------------------------------------------

Recommended items in TV Show for 'Ganglands' in decending order
based on comb_features5=('director', 'cast', 'rating', 'listed_in', 'descriptio
n')
-----------------------------------------------------------------
                                           title     type  sim_scores
1464                        the eagle of el-se'eed  TV Show    0.486854
1381                                killer ratings  TV Show    0.481932
2249                                 fatal destiny  TV Show    0.471010
2307  how to live mortgage free with sarah beeny  TV Show    0.471010
279                                  l.a.’s finest  TV Show    0.467735
1841                                         argon  TV Show    0.458220
1889                                       apaches  TV Show    0.454183
257               elite short stories: carla samuel  TV Show    0.453572
1711                                       smoking  TV Show    0.453572
2414                                 my hotter half  TV Show    0.450806
-----------------------------------------------------------------
```

it seems the recommendation based on the same type or both types are generally similar, after several tries on different titles

In [68]:
```
# Visualization for the same type one:
recmdtype = 'sametype'
y_pos = np.arange(recmdres[recmdtype].shape[0])
fig = plt.figure(figsize=(8,6))
plt.barh(y_pos, recmdres[recmdtype].sim_scores, align='center', alpha=0.5,
         color= colors_movietv[recmdres['sametype'].iloc[0].type])
plt.yticks(y_pos, recmdres[recmdtype].title,fontsize=14)
plt.xlim(round(recmdres[recmdtype].sim_scores.min(),1)-0.05,round(recmdres[recmdt
plt.xlabel('sim_scores',fontsize=14)
plt.gca().invert_yaxis()
plt.title('Recommend titles for {}:{}, based on {}'.format(recmdres['sametype'].i
                                                             title_input,feat_combs

plt.show()
titname = title_input.replace(' ','')
titname = titname.replace(':','')
fig.savefig('figures/top' + str(recmdres[recmdtype].shape[0]) +'recomdtitles_' +
```



In [65]:
```
# test by using different combination features
title_input = 'too hot to handle: brazil'#df.iloc[10].title
recmdresdifcomb = dict()
recmdresdifcombdf = pd.DataFrame()
for ii,comb_feattype in enumerate(feat_combsdict.keys()):
    recmdresdifcomb[comb_feattype] = recommenddata(title_input,10,df,cv,comb_feat
    recmdresdifcombdf[comb_feattype] = [i for i in recmdresdifcomb[comb_feattype]
```

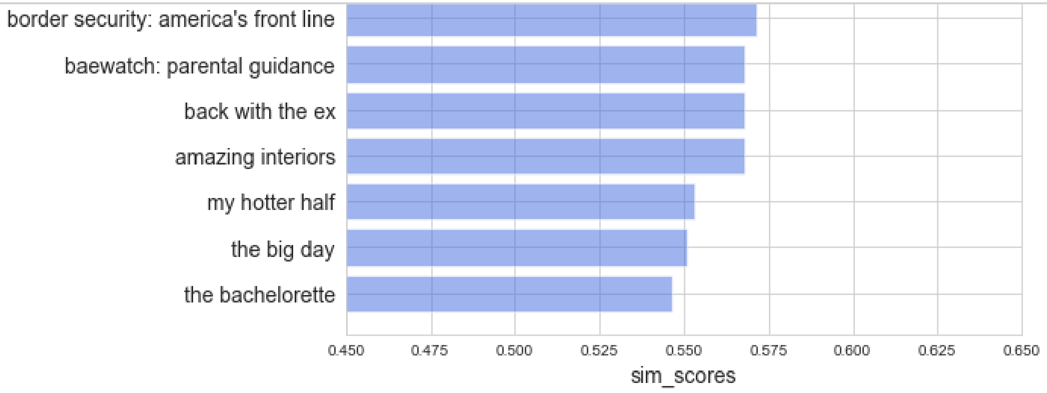
```
30                        too hot to handle: latino  TV Show    0.683130
790                           dating around: brazil  TV Show    0.674748
2499                           rica, famosa, latina  TV Show    0.642416
730                      baewatch: parental guidance  TV Show    0.634183
1536                                back with the ex  TV Show    0.634183
2115                                    age gap love  TV Show    0.617213
227                                too hot to handle  TV Show    0.612372
2307  how to live mortgage free with sarah beeny  TV Show    0.611010
1067        border security: america's front line  TV Show    0.609938
1268                               million pound menu  TV Show    0.608816
-----------------------------------------------------------------------------
----
```

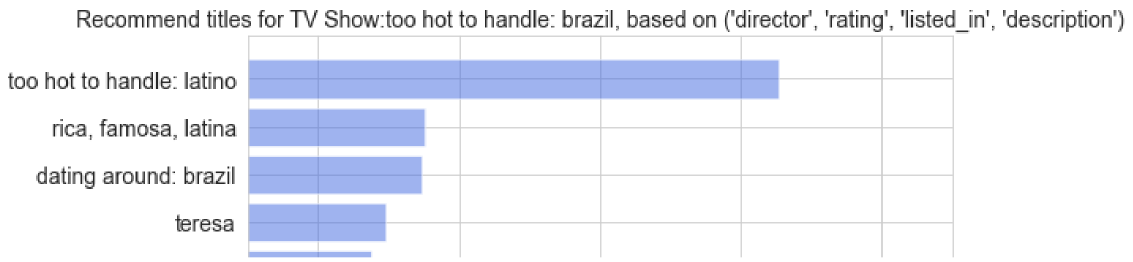
In [66]:
```
recmdresdifcombdf
```

Out[66]:

	comb_features0	comb_features1	comb_features2	comb_features3	comb_features4	comb_featu
0	back with the ex	too hot to handle	dating around: brazil	too hot to handle: latino	too hot to handle: latino	too hot to har la
1	too hot to handle: latino	bling empire	too hot to handle: latino	rica, famosa, latina	dating around: brazil	dating aro b
2	the big day	we are the champions	rica, famosa, latina	dating around: brazil	rica, famosa, latina	rica, fam la
3	baewatch: parental guidance	too hot to handle: latino	border security: america's front line	teresa	baewatch: parental guidance	baewa pare guida
4	million pound menu	the movies that made us	baewatch: parental guidance	baewatch: parental guidance	back with the ex	back with th
5	stunt science	rica, famosa, latina	back with the ex	back with the ex	age gap love	how tc mortgage with sarah be
6	churchill's secret agents: the new recruits	the circle brazil	amazing interiors	too hot to handle	too hot to handle	border secu america's
7	how to live mortgage free with sarah beeny	dating around: brazil	my hotter half	i hear you	how to live mortgage free with sarah beeny	million pc m
8	the calling	westside	the big day	age gap love	border security: america's front line	stunt scie
9	rea(l)ove	diva brides	the bachelorette	my hotter half	million pound menu	amazing inte

```
In [69]: # Visualization for the same type one:
         recmdtype = 'sametype'
         for ii,comb_feat in enumerate(recmdresdifcomb.keys()):
             recmdres = recmdresdifcomb[comb_feat]
             y_pos = np.arange(recmdres[recmdtype].shape[0])
             fig = plt.figure(figsize=(8,6))
             plt.barh(y_pos, recmdres[recmdtype].sim_scores, align='center', alpha=0.5,
             color= colors_movietv[recmdres['sametype'].iloc[0].type])
             plt.yticks(y_pos, recmdres[recmdtype].title,fontsize=14)
             plt.xlim(round(recmdres[recmdtype].sim_scores.min(),1)-0.05,round(recmdres[re
             plt.xlabel('sim_scores',fontsize=14)
             plt.gca().invert_yaxis()
             plt.title('Recommend titles for {}:{}, based on {}'.format(recmdres['sametype
                                                                        title_inpu

             plt.show()
             titname = title_input.replace(' ','')
             titname = titname.replace(':','')
             fig.savefig('figures/top' + str(recmdres[recmdtype].shape[0]) +'recomdtitles_
```



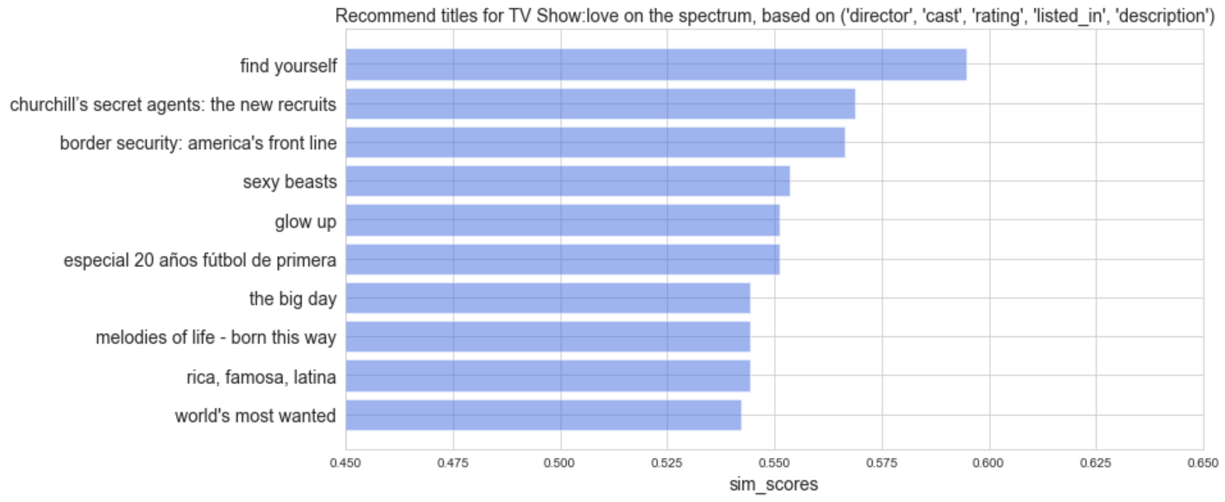


Different combinations of features generally recommend the similar titles

Final results of two examples

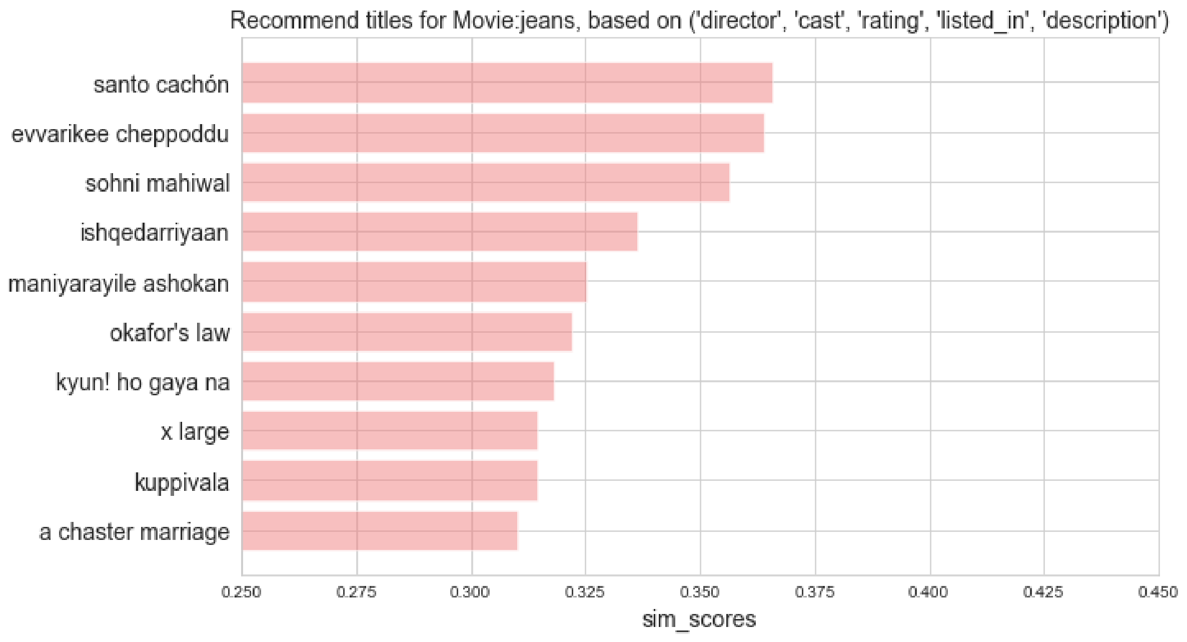
In [77]:
```
# A TV show
title_input = df.iloc[25].title
comb_feattype = 'comb_features5'
recmdres = recommenddata(title_input,10,df,cv,comb_feattype)
recmdtype = 'all'#'sametype'
y_pos = np.arange(recmdres[recmdtype].shape[0])
fig = plt.figure(figsize=(12,6))
plt.barh(y_pos, recmdres[recmdtype].sim_scores, align='center', alpha=0.5,
         color= colors_movietv[recmdres['sametype'].iloc[0].type])
plt.yticks(y_pos, recmdres[recmdtype].title,fontsize=14)
plt.xlim(round(recmdres[recmdtype].sim_scores.min(),1)-0.05,round(recmdres[recmdt
plt.xlabel('sim_scores',fontsize=14)
plt.gca().invert_yaxis()
plt.title('Recommend titles for {}:{}, based on {}'.format(recmdres['sametype'].i
                                                           title_input,feat_combs
plt.show()
titname = title_input.replace(' ','')
titname = titname.replace(':','')
fig.savefig('figures/top' + str(recmdres[recmdtype].shape[0]) +'recomdtitles_' +
```

```
Recommended items in all for 'love on the spectrum' in decending order
based on comb_features5=('director', 'cast', 'rating', 'listed_in', 'descriptio
n')
----------------------------------------------------------------------------
                                          title     type  sim_scores
2982                              find yourself  TV Show    0.594684
4807  churchill’s secret agents: the new recruits  TV Show    0.568815
3053        border security: america's front line  TV Show    0.566365
430                                 sexy beasts  TV Show    0.553637
366                                     glow up  TV Show    0.551014
2495          especial 20 años fútbol de primera  TV Show    0.551014
1093                                the big day  TV Show    0.544415
7438             melodies of life - born this way  TV Show    0.544415
7867                       rica, famosa, latina  TV Show    0.544415
2165                         world's most wanted  TV Show    0.542228
----------------------------------------------------------------------------

Recommended items in TV Show for 'love on the spectrum' in decending order
based on comb_features5=('director', 'cast', 'rating', 'listed_in', 'descriptio
n')
----------------------------------------------------------------------------
                                          title     type  sim_scores
1032                              find yourself  TV Show    0.594684
1728  churchill’s secret agents: the new recruits  TV Show    0.568815
1067        border security: america's front line  TV Show    0.566365
148                                 sexy beasts  TV Show    0.553637
128                                     glow up  TV Show    0.551014
861           especial 20 años fútbol de primera  TV Show    0.551014
379                                 the big day  TV Show    0.544415
2395             melodies of life - born this way  TV Show    0.544415
2499                       rica, famosa, latina  TV Show    0.544415
759                          world's most wanted  TV Show    0.542228
----------------------------------------------------------------------------
```


Recommend titles for TV Show:love on the spectrum, based on ('director', 'cast', 'rating', 'listed_in', 'description')
find yourself
churchill's secret agents: the new recruits
border security: america's front line
sexy beasts
glow up
especial 20 años fútbol de primera
the big day
melodies of life - born this way
rica, famosa, latina
world's most wanted
0.450
0.475
0.500
0.525
0.550
0.575
0.600
0.625
0.650
sim_scores

In [76]:
```
# An example for a movie
title_input = df[df['type']== 'Movie'].iloc[10].title
comb_feattype = 'comb_features5'
recmdres = recommenddata(title_input,10,df,cv,comb_feattype)
recmdtype = 'all'#'sametype'
y_pos = np.arange(recmdres[recmdtype].shape[0])
fig = plt.figure(figsize=(10,6))
plt.barh(y_pos, recmdres[recmdtype].sim_scores, align='center', alpha=0.5,
             color= colors_movietv[recmdres['sametype'].iloc[0].type])
plt.yticks(y_pos, recmdres[recmdtype].title,fontsize=14)
plt.xlim(round(recmdres[recmdtype].sim_scores.min(),1)-0.05,round(recmdres[recmdt
plt.xlabel('sim_scores',fontsize=14)
plt.gca().invert_yaxis()
plt.title('Recommend titles for {}:{}, based on {}'.format(recmdres['sametype'].i
                                                        title_input,feat_combsdict
plt.show()
titname = title_input.replace(' ','')
titname = titname.replace(':','')
fig.savefig('figures/top' + str(recmdres[recmdtype].shape[0]) +'recomdtitles_' +
```

```
Recommended items in all for 'jeans' in decending order
based on comb_features5=('director', 'cast', 'rating', 'listed_in', 'descriptio
n')
-------------------------------------------------------------
                     title   type  sim_scores
4474           santo cachón  Movie    0.365636
3224    evvarikee cheppoddu  Movie    0.363803
5309          sohni mahiwal  Movie    0.356512
7099         ishqedarriyaan  Movie    0.336336
2082   maniyarayile ashokan  Movie    0.325396
3153          okafor's law  Movie    0.321839
7249       kyun! ho gaya na  Movie    0.318018
2442                x large  Movie    0.314414
7243              kuppivala  Movie    0.314414
1891     a chaster marriage  Movie    0.310253
-------------------------------------------------------------

Recommended items in Movie for 'jeans' in decending order
based on comb_features5=('director', 'cast', 'rating', 'listed_in', 'descriptio
n')
-------------------------------------------------------------
                     title   type  sim_scores
2854           santo cachón  Movie    0.365636
2097    evvarikee cheppoddu  Movie    0.363803
3407          sohni mahiwal  Movie    0.356512
4766         ishqedarriyaan  Movie    0.336336
1359   maniyarayile ashokan  Movie    0.325396
2048          okafor's law  Movie    0.321839
4887       kyun! ho gaya na  Movie    0.318018
1597                x large  Movie    0.314414
4882              kuppivala  Movie    0.314414
1234     a chaster marriage  Movie    0.310253
-------------------------------------------------------------
```


Recommend titles for Movie:jeans, based on ('director', 'cast', 'rating', 'listed_in', 'description')
santo cachón
evvarikee cheppoddu
sohni mahiwal
ishqedarriyaan
maniyarayile ashokan
okafor's law
kyun! ho gaya na
x large
kuppivala
a chaster marriage
0.250
0.275
0.300
0.325
0.350
0.375
0.400
0.425
0.450
sim_scores

```
In [ ]:
```