In [156]:
```
# Importing the packages used in this project

import pandas as pd
import numpy as np
import seaborn as sns

import matplotlib.pyplot as plt
import matplotlib.mlab as mlab
import matplotlib
plt.style.use('ggplot')
from matplotlib.pyplot import figure
matplotlib.rcParams['figure.figsize'] = (12,8)

pd.options.mode.chained_assignment = None

# Reading in the data
df = pd.read_csv(r'C:\Users\mkmark\Desktop\movies.csv')
```

In [157]:
```
# Looking at the data

df.head()
```

Out[157]:

	name	rating	genre	year	released	score	votes	director	writer	st
0	The Shining	R	Drama	1980	June 13, 1980 (United States)	8.4	927000.0	Stanley Kubrick	Stephen King	Jac Nicholsc
1	The Blue Lagoon	R	Adventure	1980	July 2, 1980 (United States)	5.8	65000.0	Randal Kleiser	Henry De Vere Stacpoole	Brook Shield
2	Star Wars: Episode V - The Empire Strikes Back	PG	Action	1980	June 20, 1980 (United States)	8.7	1200000.0	Irvin Kershner	Leigh Brackett	Ma Ham
3	Airplane!	PG	Comedy	1980	July 2, 1980 (United States)	7.7	221000.0	Jim Abrahams	Jim Abrahams	Robe Hay
4	Caddyshack	R	Comedy	1980	July 25, 1980 (United States)	7.3	108000.0	Harold Ramis	Brian Doyle-Murray	Chev Chas

Data cleaning

In [158]:
```
# Checking if there are any duplicated data

len(df)-len(df.drop_duplicates())
```

Out[158]:
```
0
```

In [159]:
```
# Dropping all duplicates

df.drop_duplicates(inplace=True)
```

In [160]:
```
# Checking if there are any missing data

df.isna().sum()
```

Out[160]:
```
name           0
rating        77
genre          0
year           0
released       2
score          3
votes          3
director       0
writer         3
star           1
country        3
budget      2171
gross        189
company       17
runtime        4
dtype: int64
```

In [161]:
```
# missing data in percent

for col in df.columns:
    pct_missing = np.mean(df[col].isnull())
    print('{} - {}%'.format(col, round(pct_missing*100, 1)))
```

```
name - 0.0%
rating - 1.0%
genre - 0.0%
year - 0.0%
released - 0.0%
score - 0.0%
votes - 0.0%
director - 0.0%
writer - 0.0%
star - 0.0%
country - 0.0%
budget - 28.3%
gross - 2.5%
company - 0.2%
runtime - 0.1%
```

In [162]:
```
# Dropping all nulls

df = df.dropna()
```

In [163]:
```
df.shape
```

Out[163]:
```
(5421, 15)
```

In [164]:
```
# Data Types for our columns

df.dtypes
```

Out[164]:
```
name          object
rating        object
genre         object
year           int64
released      object
score        float64
votes        float64
director      object
writer        object
star          object
country       object
budget       float64
gross        float64
company       object
runtime      float64
dtype: object
```

In [165]:
```
# Changing columns data type

df = df.astype({'budget': 'int64','gross': 'int64','votes': 'int64', })
```

In [166]:
```
# Creating correct Year column

df[['date', 'country1']] = df['released'].astype(str).str.split('(', expand=Tru

df['year'] = df['date'].str[-5:].str.strip()

df.drop(['country1', 'date'], axis=1, inplace=True)
```

In [167]:
```
# Creating correct realeased date column

df[['realeased_date', 'country1']] = df['released'].astype(str).str.split('(',
df.drop(['country1'], axis=1, inplace=True)
```

In [168]:
```
# Dropping unused column

df.drop(['released'], axis=1, inplace=True)
```

In [169]:
```
# Changing data type

df['realeased_date'] = pd.to_datetime(df['realeased_date'])
```

In [170]:
```
# Sorting data

df = df.sort_values(by=['gross'], ascending=False)
```

In [171]:
```
# Data after cleaning process

df.head()
```

Out[171]:

	name	rating	genre	year	score	votes	director	writer	star	country
5445	Avatar	PG-13	Action	2009	7.8	1100000	James Cameron	James Cameron	Sam Worthington	United States
7445	Avengers: Endgame	PG-13	Action	2019	8.4	903000	Anthony Russo	Christopher Markus	Robert Downey Jr.	United States
3045	Titanic	PG-13	Drama	1997	7.8	1100000	James Cameron	James Cameron	Leonardo DiCaprio	United States
6663	Star Wars: Episode VII - The Force Awakens	PG-13	Action	2015	7.8	876000	J.J. Abrams	Lawrence Kasdan	Daisy Ridley	United States
7244	Avengers: Infinity War	PG-13	Action	2018	8.4	897000	Anthony Russo	Christopher Markus	Robert Downey Jr.	United States

Exploring the data

In [172]:
```
# Details about gross and budget tables

df[['gross', 'budget']].describe()
```

Out[172]:

	gross	budget
count	5.421000e+03	5.421000e+03
mean	1.032297e+08	3.600917e+07
std	1.873027e+08	4.157337e+07
min	3.090000e+02	6.000000e+03
25%	1.073640e+07	1.000000e+07
50%	3.686941e+07	2.180000e+07
75%	1.124625e+08	4.500000e+07
max	2.847246e+09	3.560000e+08

In [173]:
```
# Looking at the top 15 companies by gross revenue

df.groupby('company')[['gross']].sum().sort_values('gross', ascending=False)[:1
```

Out[173]:

company	gross
Warner Bros.	54610959970
Universal Pictures	51241105418
Columbia Pictures	42356430218
Paramount Pictures	40021704691
Twentieth Century Fox	39542573303
Walt Disney Pictures	35833650748
New Line Cinema	19612851164
Marvel Studios	15065592411
DreamWorks Animation	11873612858
Dreamworks Pictures	11593807697

In [174]:
```
# Company gross revenue sum sorted

df.groupby(['company', 'year'])[['gross']].sum().sort_values('gross', ascending
```

Out[174]:

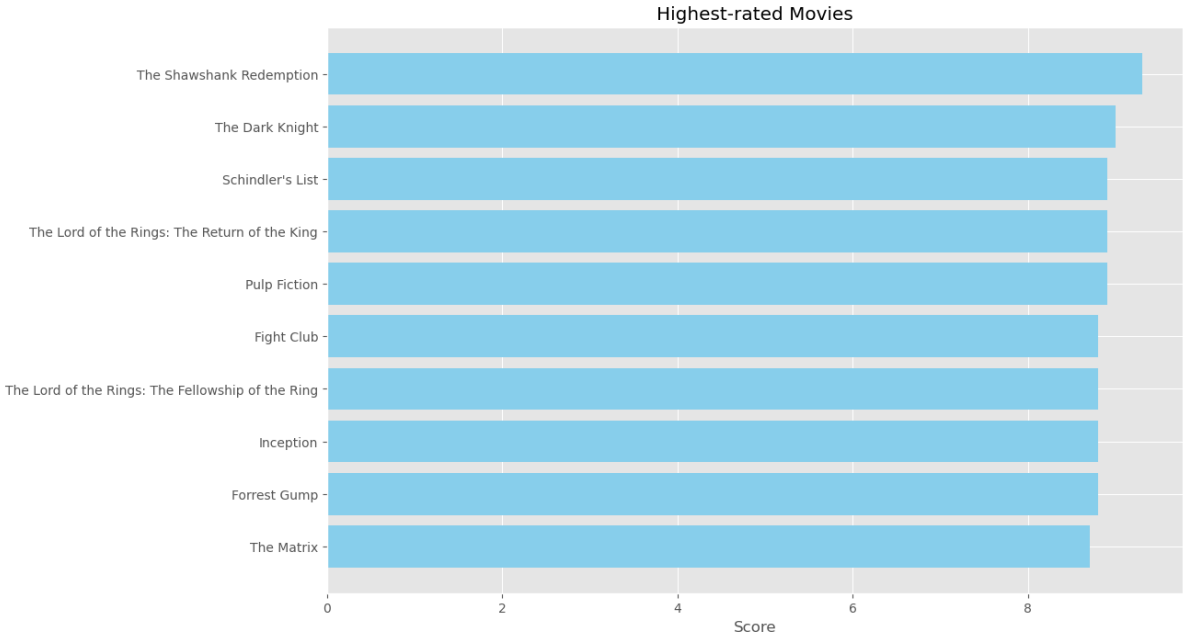
company	year	gross
Walt Disney Pictures	2019	5773131804
Marvel Studios	2018	4018631866
Universal Pictures	2015	3834354888
Twentieth Century Fox	2009	3793491246
Walt Disney Pictures	2017	3789382071
Paramount Pictures	2011	3565705182
Warner Bros.	2011	3168551343
Walt Disney Pictures	2010	3104474158
Paramount Pictures	2014	3071298586
Columbia Pictures	2019	2932757449
	2006	2918469353
Marvel Studios	2019	2797501328
	2018	2774168962
Warner Bros.	2005	2773019821
	2007	2758633559

In [175]:
```
# Company gross revenue mean sorted

df.groupby(['company', 'year'])[['gross']].mean().sort_values(['gross','company
```

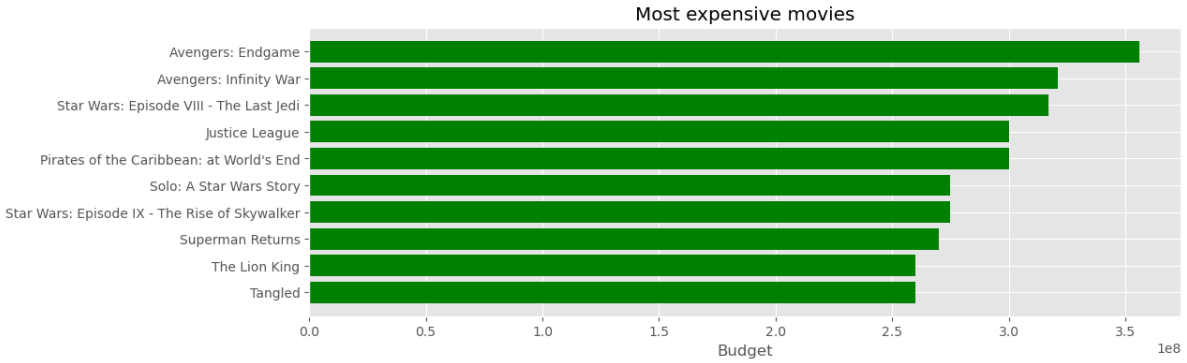
Out[175]:

company	year	gross
Marvel Studios	2019	2.797501e+09
Lucasfilm	2015	2.069522e+09
Marvel Studios	2012	1.518816e+09
Walt Disney Animation Studios	2019	1.450027e+09
Marvel Studios	2015	1.402810e+09
	2018	1.339544e+09
Walt Disney Animation Studios	2013	1.281508e+09
Mandeville Films	2017	1.264435e+09
Illumination Entertainment	2015	1.159445e+09
Pixar Animation Studios	2019	1.073395e+09
Metro-Goldwyn-Mayer (MGM)	2012	1.062787e+09
Lucasfilm	2016	1.056058e+09
Illumination Entertainment	2017	1.034800e+09
Pixar Animation Studios	2016	1.028571e+09
Lucasfilm	1999	1.027083e+09

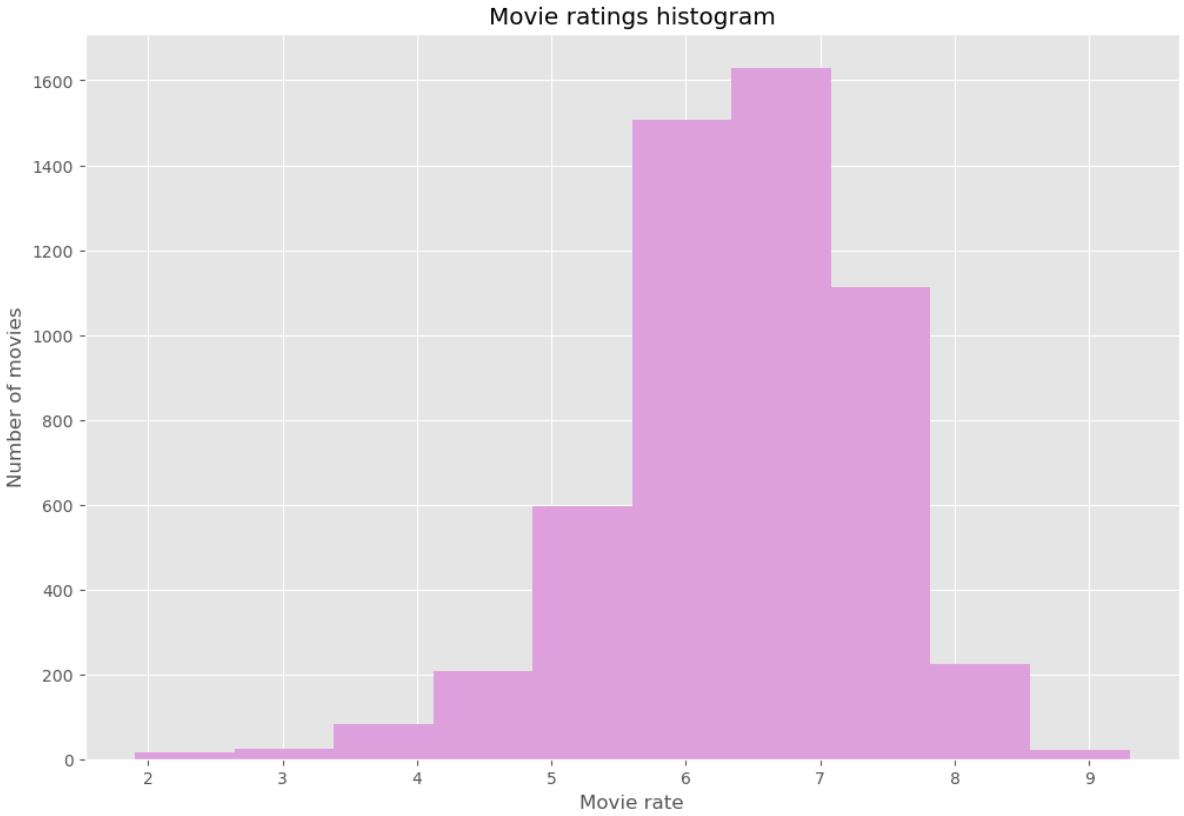
In [176]:
```
film_ranking = df.sort_values('score', ascending=False)

plt.barh(film_ranking['name'].head(10),film_ranking['score'].head(10), align='

plt.gca().invert_yaxis()
plt.xlabel("Score")
plt.title("Highest-rated Movies")
plt.show()
```



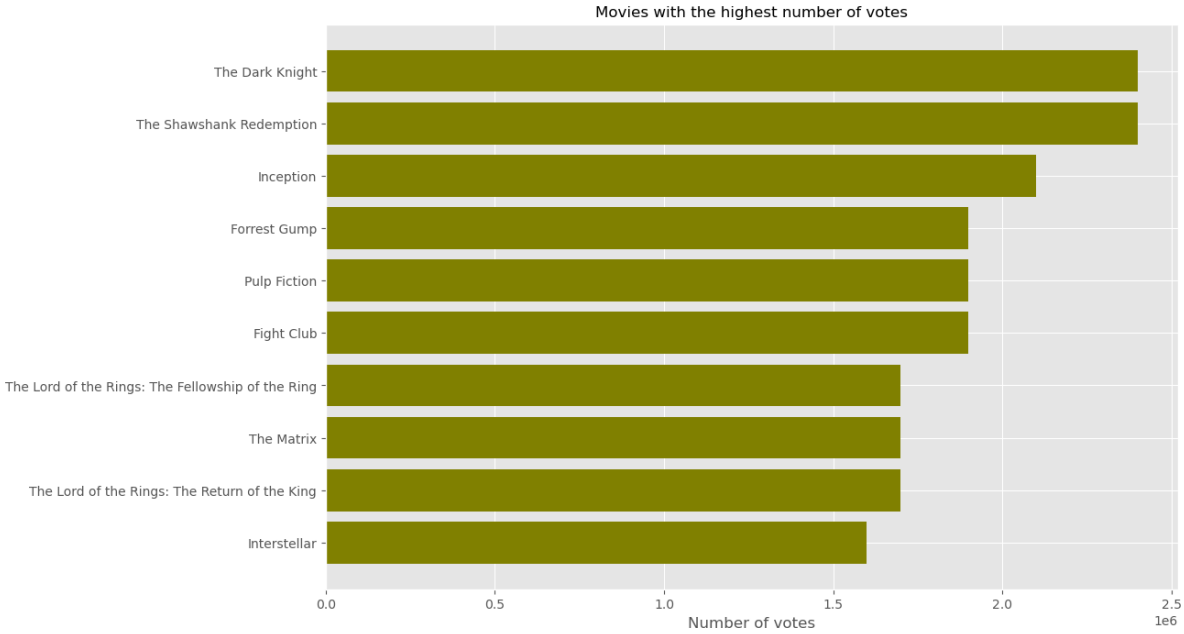
In [177]:
```
budget_ranking = df.sort_values('budget', ascending=False)

plt.figure(figsize=(12,4))

plt.barh(budget_ranking['name'].head(10),budget_ranking['budget'].head(10), al
        color='green')
plt.gca().invert_yaxis()
plt.xlabel("Budget")
plt.title("Most expensive movies")
plt.show()
```



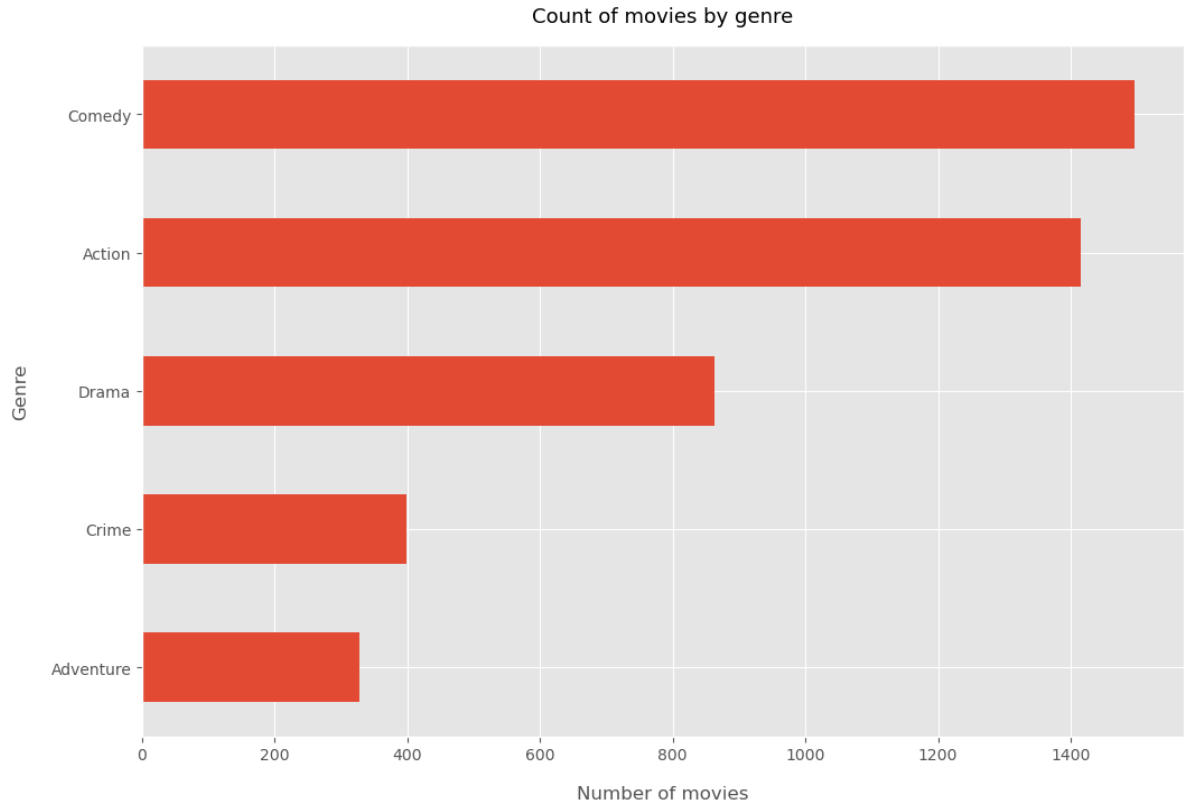
In [178]:
```
plt.hist(x=df['score'], bins=10, color='plum')
plt.xlabel('Movie rate')
plt.ylabel('Number of movies')
plt.title("Movie ratings histogram")
plt.show()
```



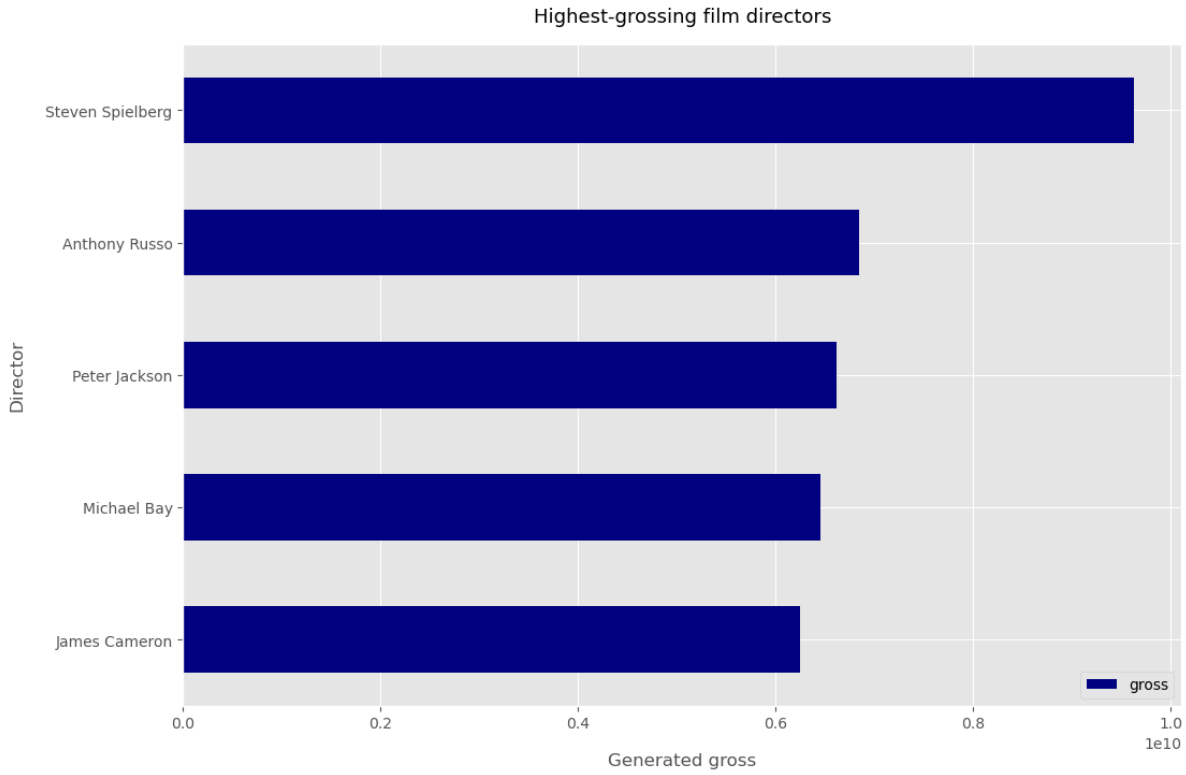
In [179]:
```
film_ranking = df.sort_values('votes', ascending=False)

plt.barh(film_ranking['name'].head(10),film_ranking['votes'].head(10), align='
plt.gca().invert_yaxis()
plt.xlabel("Number of votes")
plt.title("Movies with the highest number of votes", fontsize=12)
plt.show()
```



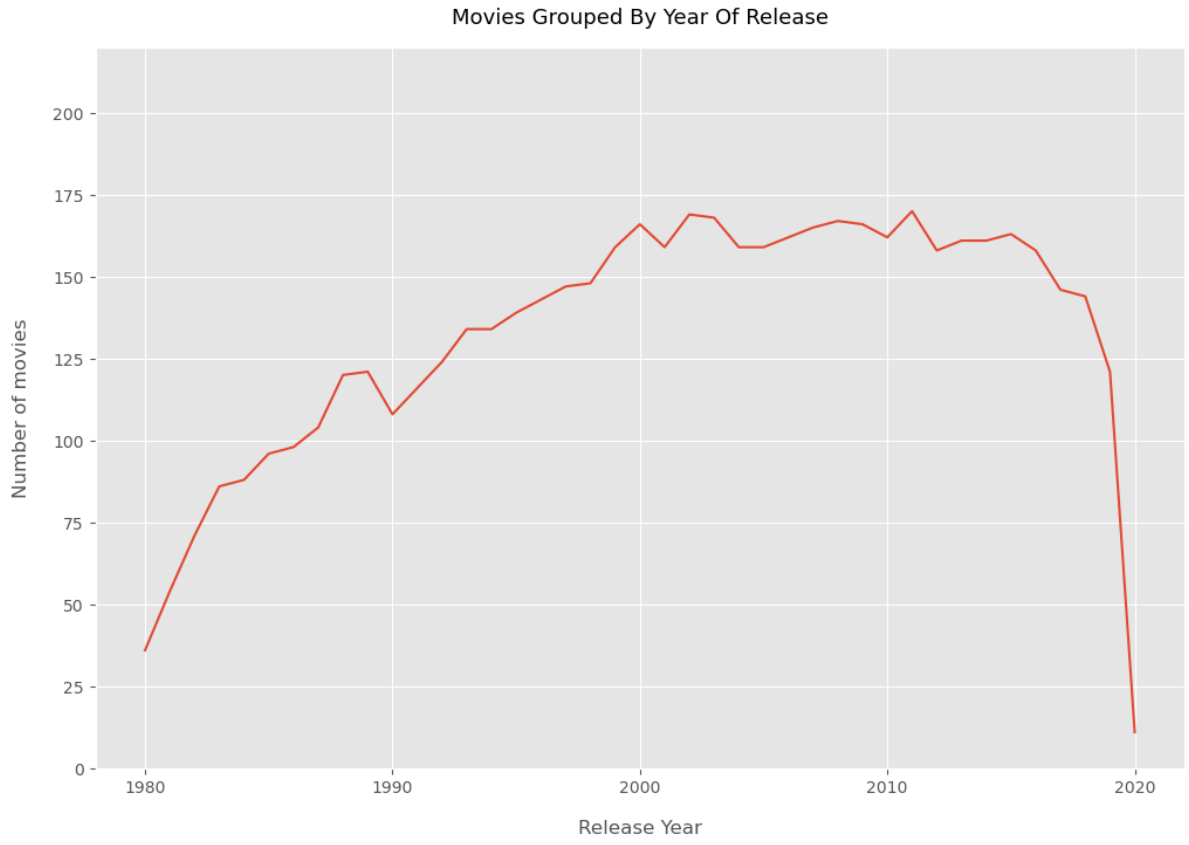
In [180]:
```
df['genre'].value_counts().head(5).sort_values().plot(kind='barh')

plt.xlabel('Number of movies', labelpad=14, fontsize=12)
plt.ylabel('Genre', labelpad=14, fontsize=12)
plt.title('Count of movies by genre', y=1.02, fontsize=13)
plt.show()
```



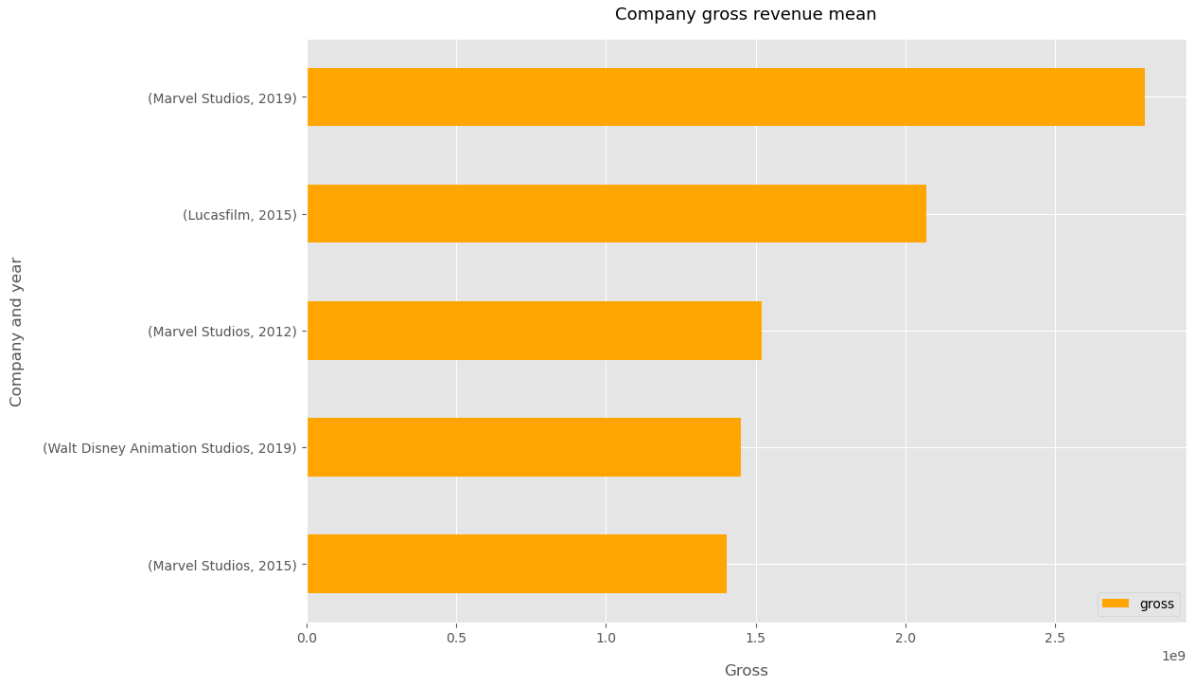
In [195]:
```
df.groupby(['director'])[['gross']].sum().sort_values(['gross'], ascending=Fals

plt.gca().invert_yaxis()
plt.xlabel('Generated gross', labelpad=14, fontsize=12)
plt.ylabel('Director', labelpad=14, fontsize=12)
plt.title('Highest-grossing film directors', y=1.02, fontsize=13)
plt.show()
```



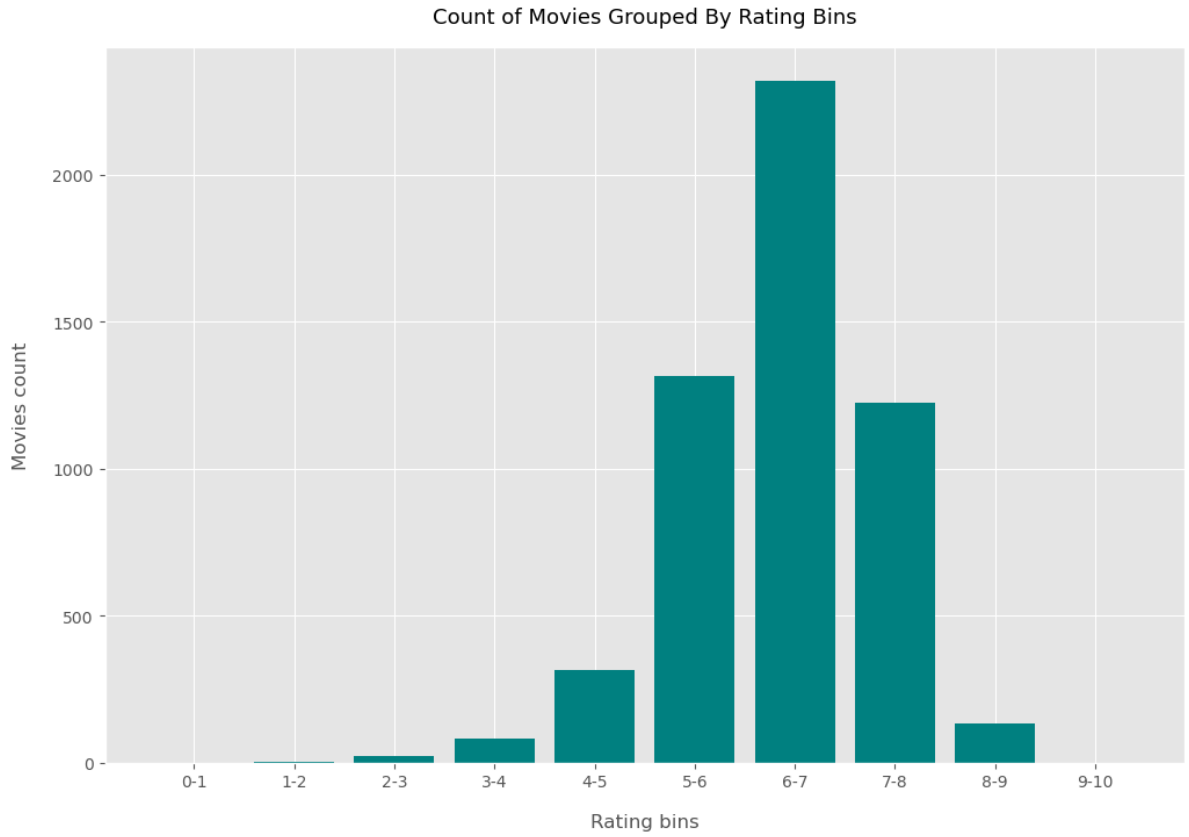
In [183]:
```
data = df['year'].value_counts().sort_index()

plt.plot(data.index, data.values)

plt.title('Movies Grouped By Year Of Release',y=1.02, fontsize=13)
plt.xlabel('Release Year', labelpad=14, fontsize=12)
plt.ylabel('Number of movies', labelpad=14, fontsize=12)

plt.ylim(0, max(data.values)+50)
plt.xticks(['1980', '1990', '2000', '2010', '2020'])
plt.show()
```



In [184]:
```
df.groupby(['company', 'year'])[['gross']].mean().sort_values(['gross','company

plt.gca().invert_yaxis()
plt.xlabel('Gross', labelpad=14, fontsize=12)
plt.ylabel('Company and year', labelpad=14, fontsize=12)
plt.title('Company gross revenue mean', y=1.02, fontsize=13)
plt.show()
```



In [185]:
```
bins = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
labels = ['0-1', '1-2', '2-3', '3-4', '4-5', '5-6', '6-7', '7-8', '8-9', '9-10
df['score_bin'] = pd.cut(x = df['score'], bins = bins, labels = labels, include

x = df['score_bin'].value_counts().sort_index()

plt.bar(x.index, x.values, color='teal')
plt.title('Count of Movies Grouped By Rating Bins',y=1.02, fontsize=13)
plt.xlabel('Rating bins', labelpad=14, fontsize=12)
plt.ylabel('Movies count', labelpad=14, fontsize=12)
plt.show()
```



In [189]:
```
# Correlation Matrix between all numeric columns

df.corr()
```

Out[189]:

	score	votes	budget	gross	runtime
score	1.000000	0.474256	0.072001	0.222556	0.414068
votes	0.474256	1.000000	0.439675	0.614751	0.352303
budget	0.072001	0.439675	1.000000	0.740247	0.318695
gross	0.222556	0.614751	0.740247	1.000000	0.275796
runtime	0.414068	0.352303	0.318695	0.275796	1.000000

In [191]:
```
# Unstacked correlation between numeric features

correlation_mat = df.corr()

corr_pairs = correlation_mat.unstack()

corr_pairs
```

Out[191]:
```
score    score      1.000000
         votes      0.474256
         budget     0.072001
         gross      0.222556
         runtime    0.414068
votes    score      0.474256
         votes      1.000000
         budget     0.439675
         gross      0.614751
         runtime    0.352303
budget   score      0.072001
         votes      0.439675
         budget     1.000000
         gross      0.740247
         runtime    0.318695
gross    score      0.222556
         votes      0.614751
         budget     0.740247
         gross      1.000000
         runtime    0.275796
runtime  score      0.414068
         votes      0.352303
         budget     0.318695
         gross      0.275796
         runtime    1.000000
dtype: float64
```

In [192]:
```
# Sorting unstacked correlation

sorted_pairs = corr_pairs.sort_values()

sorted_pairs
```

Out[192]:
```
budget   score      0.072001
score    budget     0.072001
         gross      0.222556
gross    score      0.222556
runtime  gross      0.275796
gross    runtime    0.275796
budget   runtime    0.318695
runtime  budget     0.318695
         votes      0.352303
votes    runtime    0.352303
runtime  score      0.414068
score    runtime    0.414068
budget   votes      0.439675
votes    budget     0.439675
         score      0.474256
score    votes      0.474256
gross    votes      0.614751
votes    gross      0.614751
budget   gross      0.740247
gross    budget     0.740247
score    score      1.000000
budget   budget     1.000000
votes    votes      1.000000
gross    gross      1.000000
runtime  runtime    1.000000
dtype: float64
```

In [193]:
```
# Highest correlation

high_corr = sorted_pairs[sorted_pairs > 0.5]

high_corr

# Votes and budget have the highest correlation to gross earnings
```

Out[193]:
```
gross    votes      0.614751
votes    gross      0.614751
budget   gross      0.740247
gross    budget     0.740247
score    score      1.000000
budget   budget     1.000000
votes    votes      1.000000
gross    gross      1.000000
runtime  runtime    1.000000
dtype: float64
```

In [ ]:
```
# Changing non numeric columns data type to categorical and numerizing them

df_numerized = df


for col_name in df_numerized.columns:
    if(df_numerized[col_name].dtype == 'object'):
        df_numerized[col_name]= df_numerized[col_name].astype('category')
        df_numerized[col_name] = df_numerized[col_name].cat.codes

df_numerized
```

Out[153]:

	name	rating	genre	year	score	votes	director	writer	star	country	budget	
5445	386	5	0	29	7.8	1100000	785	1263	1534	47	237000000	284
7445	388	5	0	39	8.4	903000	105	513	1470	47	356000000	279
3045	4909	5	6	17	7.8	1100000	785	1263	1073	47	200000000	220
6663	3643	5	0	35	7.8	876000	768	1806	356	47	245000000	206
7244	389	5	0	38	8.4	897000	105	513	1470	47	321000000	204
...	...	...	...	...	...	...	...	...	...	...	...	...
5640	3794	6	6	35	5.8	3500	585	2924	1498	47	3000000	
2434	2969	5	0	14	4.5	1900	1805	3102	186	47	5000000	
3681	1595	3	6	21	6.8	43000	952	1683	527	6	5000000	
272	2909	6	9	2	3.9	2300	261	55	1473	47	800000	
3203	4966	5	4	17	5.7	5800	651	161	1811	47	15000000	

5421 rows × 16 columns

In [ ]:
```
# Correlation between categorical variables

df_numerized.corr()
```

Out[154]:

	name	rating	genre	year	score	votes	director	writer
name	1.000000	-0.029234	0.010996	0.025542	0.014450	0.012615	0.015246	0.012880
rating	-0.029234	1.000000	0.147796	0.022021	0.065983	0.006031	0.014656	-0.003149
genre	0.010996	0.147796	1.000000	-0.069147	0.035106	-0.135990	-0.008553	0.017578
year	0.025542	0.022021	-0.069147	1.000000	0.061923	0.203098	-0.037371	-0.025495
score	0.014450	0.065983	0.035106	0.061923	1.000000	0.474256	0.005413	0.012843
votes	0.012615	0.006031	-0.135990	0.203098	0.474256	1.000000	-0.010376	-0.005316
director	0.015246	0.014656	-0.008553	-0.037371	0.005413	-0.010376	1.000000	0.261735
writer	0.012880	-0.003149	0.017578	-0.025495	0.012843	-0.005316	0.261735	1.000000
star	-0.006882	0.009196	0.003341	-0.032687	0.007296	-0.017638	0.036593	0.018520
country	-0.025490	0.008230	-0.009164	-0.073569	-0.043051	0.041551	0.011133	0.022488
budget	0.023392	-0.203946	-0.368523	0.320312	0.072001	0.439675	-0.009662	-0.039466