In [1]:
```
import os
import pandas as pd
from matplotlib import pyplot as plt

%matplotlib inline
```

In [3]:
```
root_path = os.getcwd()
path = os.path.join(root_path, 'data/ml-latest-small/')
```

Load Movielens dataset

In [21]:
```
ratings_df = pd.read_csv(os.path.join(path, 'ratings.csv'), encoding='utf-8')
tags_df = pd.read_csv(os.path.join(path, 'tags.csv'), encoding='utf-8')
movies_df = pd.read_csv(os.path.join(path, 'movies.csv'), index_col='movieId', encodi
```

Check Dataframe and size

In [22]:
```
print(ratings_df.shape)
ratings_df.head(3)
```

(100836, 4)

Out[22]:

	userId	movieId	rating	timestamp
0	1	1	4.0	964982703
1	1	3	4.0	964981247
2	1	6	4.0	964982224

In [23]:
```
print(tags_df.shape)
tags_df.head(3)
```

(3683, 4)

Out[23]:

	userId	movieId	tag	timestamp
0	2	60756	funny	1445714994
1	2	60756	Highly quotable	1445714996
2	2	60756	will ferrell	1445714992

In [24]:
```
print(movies_df.shape)
movies_df.head(3)
```

(9742, 2)

Out[24]:

	title	genres
movieId		
1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy
2	Jumanji (1995)	Adventure|Children|Fantasy
3	Grumpier Old Men (1995)	Comedy|Romance

Exploratory Data Anaylsis

In [27]:
```
n_unique_users = len(ratings_df['userId'].unique())
print(n_unique_users)
```

610

In [29]:
```
n_unique_moview = len(ratings_df['movieId'].unique())
print(n_unique_moview)
```

9724

In [31]:
```
print(ratings_df['movieId'].mean())
print(ratings_df['rating'].mean())
```

19435.2957177992
3.501556983616962

In [32]:
```
ratings_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100836 entries, 0 to 100835
Data columns (total 4 columns):
 #   Column     Non-Null Count   Dtype  
---  ------     --------------   -----  
 0   userId     100836 non-null  int64  
 1   movieId    100836 non-null  int64  
 2   rating     100836 non-null  float64
 3   timestamp  100836 non-null  int64  
dtypes: float64(1), int64(3)
memory usage: 3.1 MB
```

In [33]:
```
ratings_df.describe()
```

Out[33]:

	userId	movieId	rating	timestamp
count	100836.000000	100836.000000	100836.000000	1.008360e+05
mean	326.127564	19435.295718	3.501557	1.205946e+09
std	182.618491	35530.987199	1.042529	2.162610e+08
min	1.000000	1.000000	0.500000	8.281246e+08
25%	177.000000	1199.000000	3.000000	1.019124e+09
50%	325.000000	2991.000000	3.500000	1.186087e+09
75%	477.000000	8122.000000	4.000000	1.435994e+09
max	610.000000	193609.000000	5.000000	1.537799e+09

In [35]:
```
# nan 값 확인
ratings_df.isnull().sum()
```

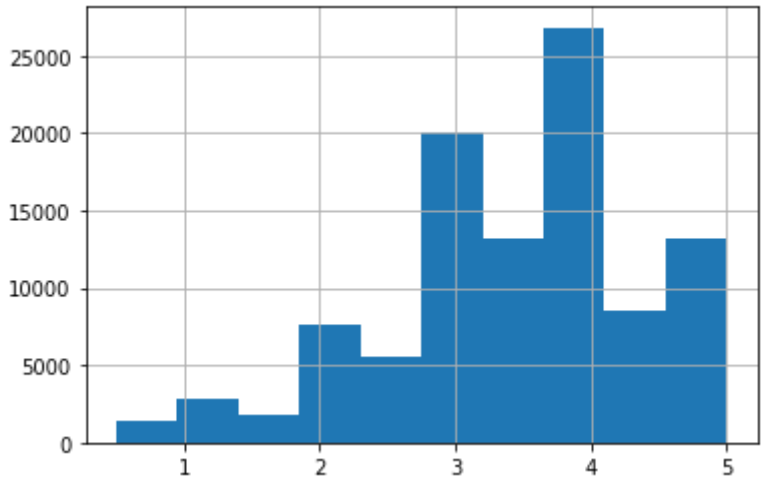
Out[35]:
```
userId       0
movieId      0
rating       0
timestamp    0
dtype: int64
```

In [38]:
```

```

```
ratings_df['rating'].hist()
```

Out[38]: <AxesSubplot:>



In [42]:
```
# userId 와 rating을 기준으로 기초통계량 확인
ratings_df.groupby(['userId']).mean()
```

Out[42]:

userId	movieId	rating	timestamp
1	1854.603448	4.366379	9.649856e+08
2	70350.275862	3.948276	1.445715e+09
3	7058.384615	2.435897	1.306464e+09
4	1982.129630	3.555556	9.658643e+08
5	343.840909	3.636364	8.474351e+08
...	...	...	...
606	9692.197309	3.657399	1.179512e+09
607	1860.636364	3.786096	9.647841e+08
608	4502.605295	3.134176	1.122668e+09
609	483.162162	3.270270	8.472210e+08
610	49590.231183	3.688556	1.489454e+09

610 rows × 3 columns

In [47]:
```
userid_rating_df = pd.DataFrame({'count': ratings_df.groupby(['userId', 'rating']).si
userid_rating_df = userid_rating_df.reset_index()
userid_rating_df.head(10)
```

Out[47]:

	userId	rating	count
0	1	1.0	1
1	1	2.0	5
2	1	3.0	26
3	1	4.0	76

	userId	rating	count
4	1	5.0	124
5	2	2.0	1
6	2	2.5	1
7	2	3.0	4
8	2	3.5	4
9	2	4.0	9

In [52]:
```
user_info = ratings_df.groupby('userId')['movieId'].count()
user_info.describe()
```

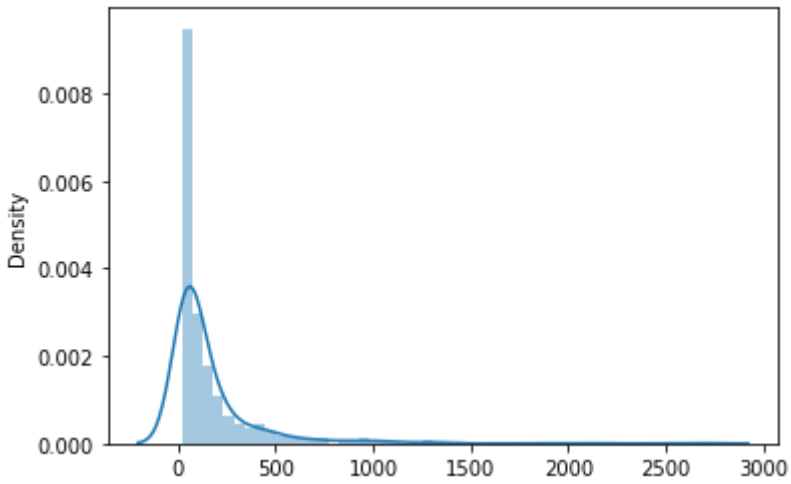
Out[52]:
```
count     610.000000
mean      165.304918
std       269.480584
min        20.000000
25%        35.000000
50%        70.500000
75%       168.000000
max      2698.000000
Name: movieId, dtype: float64
```

In [55]:
```
import seaborn as sns
```

In [56]:
```
# user 가 몇개의 영화에 대해 rating을 했는지 분포 확인
sns.distplot(user_info.values)
```

```
c:₩my_code₩recommendation_system₩venv₩lib₩site-packages₩seaborn₩distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[56]:
```
<AxesSubplot:ylabel='Density'>
```



In [59]:
```
# user 가 평균적으로 준 평점과 평점을 준 영화의 수

stats_df = pd.DataFrame({
    'movie_count': ratings_df.groupby('userId')['movieId'].count(),
    'rating_avg': ratings_df.groupby('userId')['rating'].mean(),
    'rating_std': ratings_df.groupby('userId')['rating'].std()
```

```
})
print(stats_df.shape)
display(stats_df.head())
```

(610, 3)

userId	movie_count	rating_avg	rating_std
1	232	4.366379	0.800048
2	29	3.948276	0.805615
3	39	2.435897	2.090642
4	216	3.555556	1.314204
5	44	3.636364	0.990441

In [61]:

```
# rating이 많은 영화 확인
movieid_user_df = pd.DataFrame({
    'num_users_watch': ratings_df.groupby('movieId')['userId'].count(),
    'avg_ratings': ratings_df.groupby('movieId')['rating'].mean(),
    'std_ratings': ratings_df.groupby('movieId')['rating'].std()
})
movieid_user_df = movieid_user_df.reset_index()
print(movieid_user_df.shape)
display(movieid_user_df.head())
```

(9724, 4)

	movieId	num_users_watch	avg_ratings	std_ratings
0	1	215	3.920930	0.834859
1	2	110	3.431818	0.881713
2	3	52	3.259615	1.054823
3	4	7	2.357143	0.852168
4	5	49	3.071429	0.907148

In [62]:

```
movieid_user_df.sort_values(by='num_users_watch', ascending=False)
```

Out[62]:

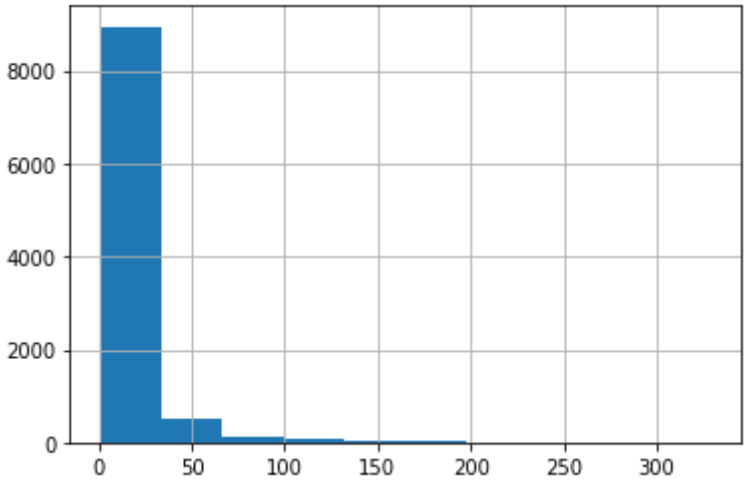
	movieId	num_users_watch	avg_ratings	std_ratings
314	356	329	4.164134	0.831244
277	318	317	4.429022	0.713019
257	296	307	4.197068	0.951997
510	593	279	4.161290	0.853983
1938	2571	278	4.192446	0.975243
...	...	...	...	...
3053	4093	1	1.500000	NaN
3049	4089	1	2.000000	NaN
6687	58351	1	4.000000	NaN
3045	4083	1	4.000000	NaN

	movieId	num_users_watch	avg_ratings	std_ratings
9723	193609	1	4.000000	NaN

9724 rows × 4 columns

In [63]:
```
# 롱테일 법칙 확인
movieid_user_df['num_users_watch'].hist()
```

Out[63]: <AxesSubplot:>



In [64]:
```
# 1번 또는 1명만 평점을 준 영화
movieid_user_df['movieId'][movieid_user_df.num_users_watch == 1].count()
```

Out[64]: 3446

In [65]:
```
# 3번 미만의 영화
movieid_user_df['movieId'][movieid_user_df.num_users_watch < 3].count()
```

Out[65]: 4744

In [67]:
```
# 평점이 높은 영화(장르), 평점을 많이 받은 영화(장르)
movies_df.head()
```

Out[67]:

movieId	title	genres
1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy
2	Jumanji (1995)	Adventure|Children|Fantasy
3	Grumpier Old Men (1995)	Comedy|Romance
4	Waiting to Exhale (1995)	Comedy|Drama|Romance
5	Father of the Bride Part II (1995)	Comedy

In [68]:
```
# 평점을 많이 받은 영화
ratings_count_df = ratings_df.groupby('movieId')['userId'].count()
ratings_count_df.head()
```

Out[68]:
```
movieId
1    215
2    110
3     52
4      7
5     49
Name: userId, dtype: int64
```

In [69]:
```
df = pd.DataFrame({
    'ratings_count': ratings_df.groupby('movieId')['userId'].count(),
})
```

In [70]:
```
df['movie_name'] = df.apply(lambda x: movies_df['title'].loc[x.index])
```

In [72]:
```
df.head()
```

Out[72]:

movieId	ratings_count	movie_name
1	215	Toy Story (1995)
2	110	Jumanji (1995)
3	52	Grumpier Old Men (1995)
4	7	Waiting to Exhale (1995)
5	49	Father of the Bride Part II (1995)

In [73]:
```
df.sort_values(by='ratings_count', ascending=False)
```

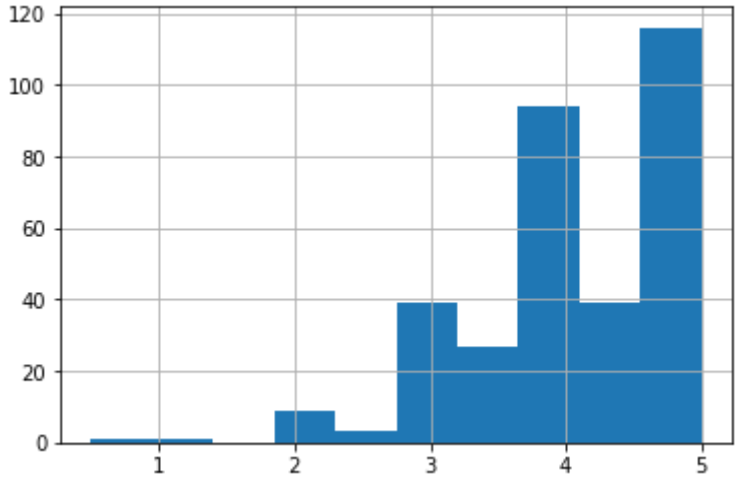
Out[73]:

movieId	ratings_count	movie_name
356	329	Forrest Gump (1994)
318	317	Shawshank Redemption, The (1994)
296	307	Pulp Fiction (1994)
593	279	Silence of the Lambs, The (1991)
2571	278	Matrix, The (1999)
...	...	...
4093	1	Cop (1988)
4089	1	Born in East L.A. (1987)
58351	1	City of Men (Cidade dos Homens) (2007)
4083	1	Best Seller (1987)
193609	1	Andrew Dice Clay: Dice Rules (1991)

9724 rows × 2 columns

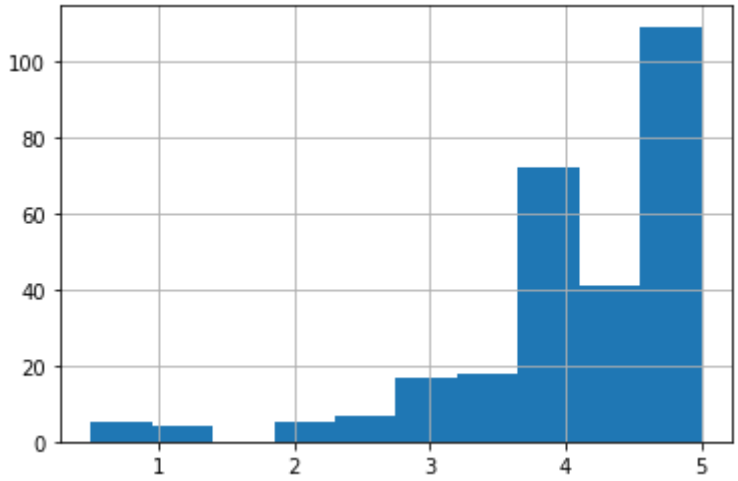
In [74]:
```
# 356번 영화 평점분포 확인
ratings_df[ratings_df.movieId == 356]['rating'].hist()
```

Out[74]: <AxesSubplot:>



In [76]:
```
# 2571번 영화 평점분포 확인
ratings_df[ratings_df.movieId == 2571]['rating'].hist()
```

Out[76]: <AxesSubplot:>



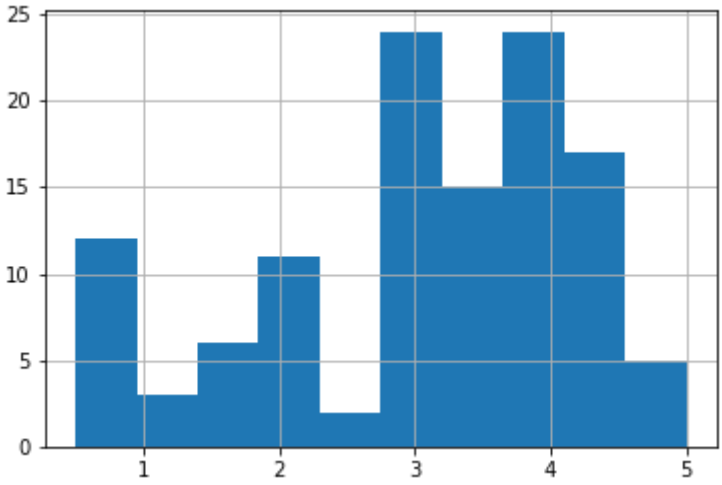
In [77]:
```
# 2점 이하로 준 user 확인
ratings_df[(ratings_df.movieId == 356) & (ratings_df.rating < 2)]
```

Out[77]:

	userId	movieId	rating	timestamp
12274	76	356	1.0	1439165536
13553	89	356	0.5	1520408275

In [81]:
```
# 76 번 유저의 전체평점분포
ratings_df[ratings_df.userId == 76]['rating'].hist()
```

Out[81]: <AxesSubplot:>



In [160]:
```
# 장르에 대한 분석
all_genres = [x.split('|') for x in movies_df['genres'].values]
```

In [90]:
```
import itertools

genres = list(set(list(itertools.chain(*all_genres))))
print(len(all_genres))
print(len(genres))
print(genres)
```

```
9742
20
['Drama', 'Mystery', 'Action', '(no genres listed)', 'Crime', 'Fantasy', 'Adventure',
'Western', 'Children', 'IMAX', 'War', 'Film-Noir', 'Sci-Fi', 'Documentary', 'Romance',
'Animation', 'Thriller', 'Horror', 'Comedy', 'Musical']
```

In [95]:
```
genres_df = pd.DataFrame(columns=genres, index=movies_df.index)
genres_df.head()
```

Out[95]:

movieId	Drama	Mystery	Action	(no genres listed)	Crime	Fantasy	Adventure	Western	Children	IMAX	'
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	I
2	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	I
3	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	I
4	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	I
5	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	I

In [97]:
```
for i, row in genres_df.iterrows():
    movie_id = row.name
    list_of_genres = movies_df.loc[movie_id]['genres'].split('|')

    genres_df.loc[movie_id][list_of_genres]
```

In [100]:
```
genres_df = genres_df.fillna(0)
genres_df['num_genres'] = genres_df.sum(axis=1)
```

```
genres_df.head()
```

Out[100]:

movieId	Drama	Mystery	Action	(no genres listed)	Crime	Fantasy	Adventure	Western	Children	IMAX	.
1	0	0	0	0	0	1	1	0	1	0	.
2	0	0	0	0	0	1	1	0	1	0	.
3	0	0	0	0	0	0	0	0	0	0	.
4	1	0	0	0	0	0	0	0	0	0	.
5	0	0	0	0	0	0	0	0	0	0	.

5 rows × 21 columns

In [104]:

```
# get_dummies 활용
genres_df = movies_df['genres'].str.get_dummies(sep='|')
genres_df.head()
```

Out[104]:

movieId	(no genres listed)	Action	Adventure	Animation	Children	Comedy	Crime	Documentary	Drama
1	0	0	1	1	1	1	0	0	0
2	0	0	1	0	1	0	0	0	0
3	0	0	0	0	0	1	0	0	0
4	0	0	0	0	0	1	0	0	1
5	0	0	0	0	0	1	0	0	0

In [105]:

```
movies_df = pd.concat([movies_df, genres_df], axis=1)
movies_df.head()
```

Out[105]:

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio
1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy	0	0	1	
2	Jumanji (1995)	Adventure|Children|Fantasy	0	0	1	
3	Grumpier Old Men (1995)	Comedy|Romance	0	0	0	

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio
4	Waiting to Exhale (1995)	Comedy|Drama|Romance	0	0	0	
5	Father of the Bride Part II (1995)	Comedy	0	0	0	

5 rows × 22 columns

In [106]:
```
# 특정장르의 평점과 user 분석
movies_df.columns
```

Out[106]:
```
Index(['title', 'genres', '(no genres listed)', 'Action', 'Adventure',
       'Animation', 'Children', 'Comedy', 'Crime', 'Documentary', 'Drama',
       'Fantasy', 'Film-Noir', 'Horror', 'IMAX', 'Musical', 'Mystery',
       'Romance', 'Sci-Fi', 'Thriller', 'War', 'Western'],
      dtype='object')
```

In [109]:
```
# 애니메이션 장르에 해당하는 영화
movieId_list = movies_df['title'][movies_df.Animation == 1]
movieId_list.index
```

Out[109]:
```
Int64Index([     1,     13,     48,    239,    313,    364,    551,    558,
               588,    594,
            ...
            182639, 183897, 187541, 190219, 193565, 193567, 193573, 193581,
            193583, 193587],
           dtype='int64', name='movieId', length=611)
```

In [111]:
```
animation_df = ratings_df[ratings_df['movieId'].isin(movieId_list.index)]
animation_df.head()
```

Out[111]:

	userId	movieId	rating	timestamp
0	1	1	4.0	964982703
35	1	596	5.0	964982838
38	1	661	5.0	964982838
39	1	673	3.0	964981775
50	1	1023	5.0	964982681

In [113]:
```
# user 는 애니메이션 장르 영화에 대한 평점 평균
animation_df.groupby('userId')['rating'].mean()
```

Out[113]:
```
userId
1      4.689655
3      0.500000
4      4.000000
5      4.333333
```

```
6       4.071429
          ...
606     3.714286
607     3.333333
608     3.118182
609     3.000000
610     3.901515
Name: rating, Length: 527, dtype: float64
```

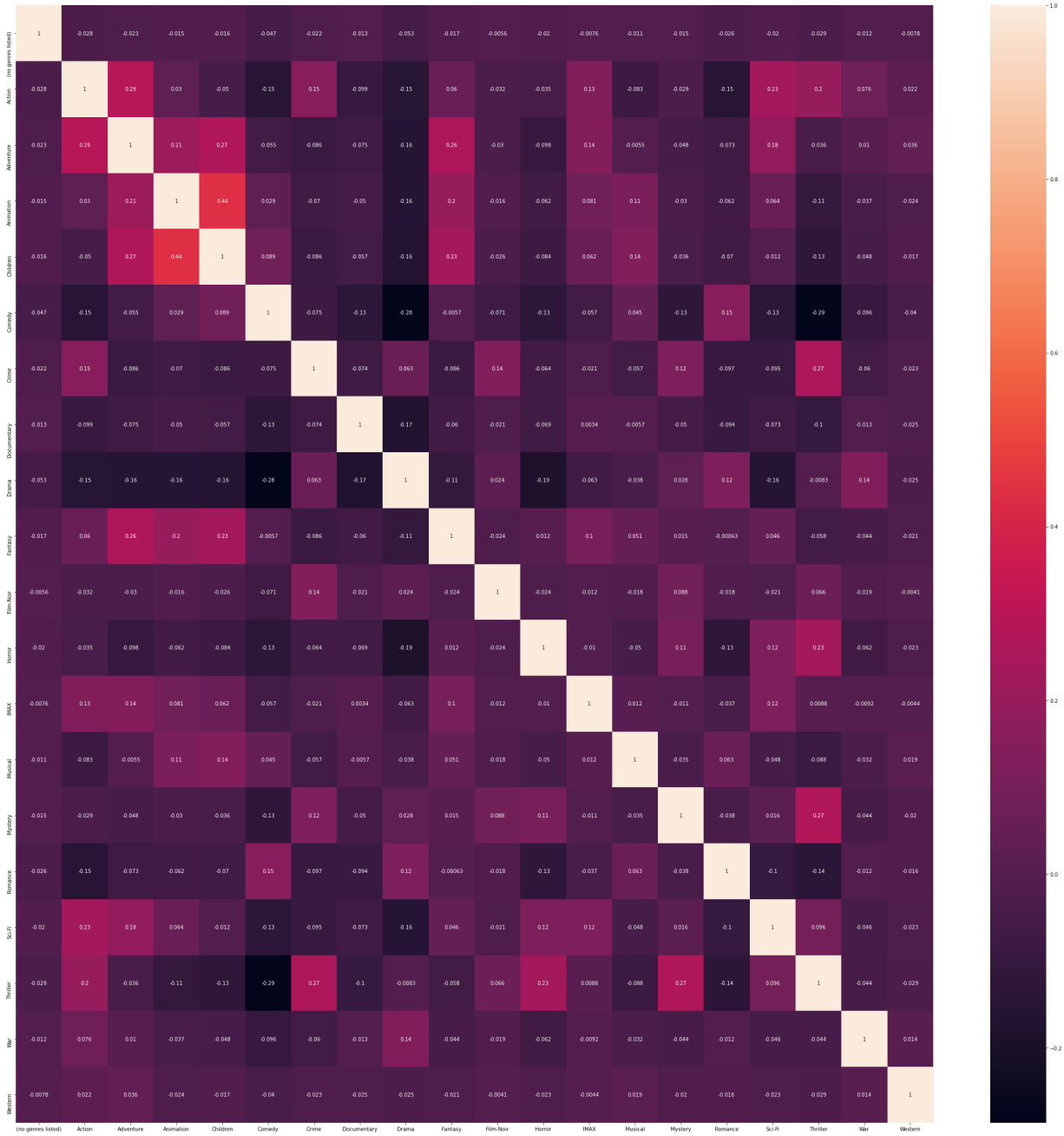
In [114]:
```
# 장르간 상관성 확인
genres_df.corr()
```

Out[114]:

	(no genres listed)	Action	Adventure	Animation	Children	Comedy	Crime	Docume
(no genres listed)	1.000000	-0.028442	-0.022840	-0.015309	-0.016005	-0.046878	-0.022171	-0.0
Action	-0.028442	1.000000	0.291949	0.029659	-0.049652	-0.148968	0.154471	-0.0
Adventure	-0.022840	0.291949	1.000000	0.211472	0.273931	-0.055215	-0.085988	-0.0
Animation	-0.015309	0.029659	0.211472	1.000000	0.437376	0.029079	-0.069847	-0.0
Children	-0.016005	-0.049652	0.273931	0.437376	1.000000	0.088701	-0.086442	-0.0
Comedy	-0.046878	-0.148968	-0.055215	0.029079	0.088701	1.000000	-0.075282	-0.1
Crime	-0.022171	0.154471	-0.085988	-0.069847	-0.086442	-0.075282	1.000000	-0.0
Documentary	-0.012871	-0.099463	-0.075111	-0.050144	-0.056859	-0.131657	-0.073955	1.0
Drama	-0.053277	-0.152964	-0.156327	-0.160504	-0.160742	-0.283472	0.063005	-0.1
Fantasy	-0.017447	0.059931	0.262511	0.196895	0.234117	-0.005708	-0.086254	-0.0
Film-Noir	-0.005618	-0.031649	-0.030140	-0.015555	-0.025673	-0.070710	0.137141	-0.0
Horror	-0.019769	-0.035443	-0.098423	-0.062464	-0.083569	-0.133382	-0.063805	-0.0
IMAX	-0.007599	0.131864	0.143982	0.080744	0.062011	-0.056627	-0.020892	0.0
Musical	-0.011151	-0.083331	-0.005544	0.111804	0.137072	0.045466	-0.056850	-0.0
Mystery	-0.014794	-0.028515	-0.048427	-0.030477	-0.036449	-0.127209	0.124138	-0.0
Romance	-0.026195	-0.146670	-0.072584	-0.061882	-0.070189	0.153088	-0.097444	-0.0
Sci-Fi	-0.019792	0.233475	0.181797	0.064093	-0.011910	-0.132400	-0.095166	-0.0
Thriller	-0.029073	0.199042	-0.035942	-0.107822	-0.127716	-0.286289	0.265196	-0.1
War	-0.011956	0.076289	0.010195	-0.036990	-0.048341	-0.095919	-0.059585	-0.0
Western	-0.007816	0.021600	0.036136	-0.024378	-0.016890	-0.039622	-0.022997	-0.0

In [115]:
```
plt.figure(figsize=(40, 40))
sns.heatmap(genres_df.corr(), annot=True)
```

Out[115]: <AxesSubplot:>



In [116]:
```
# 영화 이름, 연도 분석
movies_df.head()
```

Out[116]:

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio
1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy	0	0	1	
2	Jumanji (1995)	Adventure|Children|Fantasy	0	0	1	
3	Grumpier Old Men (1995)	Comedy|Romance	0	0	0	
4	Waiting to Exhale (1995)	Comedy|Drama|Romance	0	0	0	

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio
5	Father of the Bride Part II (1995)	Comedy	0	0	0	

5 rows × 22 columns

In [143]:
```
title_df = movies_df.copy()
title_df['year'] = title_df['title'].str.extract('(₩(₩d₩d₩d₩d₩))')
title_df.head()
```

Out[143]:

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio
1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy	0	0	1	
2	Jumanji (1995)	Adventure|Children|Fantasy	0	0	1	
3	Grumpier Old Men (1995)	Comedy|Romance	0	0	0	
4	Waiting to Exhale (1995)	Comedy|Drama|Romance	0	0	0	
5	Father of the Bride Part II (1995)	Comedy	0	0	0	

5 rows × 23 columns

In [137]:
```
# nan값 확인
title_df['year'].isna().sum()
```

Out[137]: 12

In [149]:
```
# 연도 또는 장르가 없는 영화 드랍
title_df[title_df['(no genres listed)'] == 1].shape
title_df.dropna(axis=0, inplace=True)
title_df['year'] = title_df['year'].apply(lambda x: x.replace('(', '').replace(')',
title_df.head()
```

Out[149]:

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio

movieId	title	genres	(no genres listed)	Action	Adventure	Animatio
movieId						
1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy	0	0	1	
2	Jumanji (1995)	Adventure|Children|Fantasy	0	0	1	
3	Grumpier Old Men (1995)	Comedy|Romance	0	0	0	
4	Waiting to Exhale (1995)	Comedy|Drama|Romance	0	0	0	
5	Father of the Bride Part II (1995)	Comedy	0	0	0	

5 rows × 23 columns

In [145]:
```
# 연도별 출시 영화 분석
year_freq_df = title_df.groupby('year')['title'].count()
year_freq_df
```

Out[145]:
```
year
1902       1
1903       1
1908       1
1915       1
1916       4
         ...
2014     278
2015     274
2016     218
2017     147
2018      41
Name: title, Length: 106, dtype: int64
```

In [146]:
```
year_freq_df.sort_values(ascending=False)
```

Out[146]:
```
year
2002     311
2006     295
2001     294
2007     284
2000     283
         ...
1919       1
1917       1
1915       1
1908       1
1902       1
Name: title, Length: 106, dtype: int64
```

In [147]:
```
year_freq_df.describe()
```

Out[147]:
```
count    106.000000
mean      91.783019
std      102.227757
min        1.000000
25%       16.000000
50%       39.500000
75%      151.500000
max      311.000000
Name: title, dtype: float64
```

In [150]:
```
# 2017 개봉연도 영화 평점 분석
title_df[title_df['year'] == '2017']
```

Out[150]:

movieId	title	genres	(no genres listed)	Action	Adventure	Animation	Childre
122896	Pirates of the Caribbean: Dead Men Tell No Tal...	(no genres listed)	1	0	0	0	
122898	Justice League (2017)	Action|Adventure|Sci-Fi	0	1	1	0	
122906	Black Panther (2017)	Action|Adventure|Sci-Fi	0	1	1	0	
122916	Thor: Ragnarok (2017)	Action|Adventure|Sci-Fi	0	1	1	0	
122918	Guardians of the Galaxy 2 (2017)	Action|Adventure|Sci-Fi	0	1	1	0	
...	...	...	...	...	...	...	...
190215	Liquid Truth (2017)	Drama	0	0	0	0	
191005	Gintama (2017)	Action|Adventure|Comedy|Sci-Fi	0	1	1	0	
193581	Black Butler: Book of the Atlantic (2017)	Action|Animation|Comedy|Fantasy	0	1	0	1	
193583	No Game No Life: Zero (2017)	Animation|Comedy|Fantasy	0	0	0	1	
193585	Flint (2017)	Drama	0	0	0	0	

147 rows × 23 columns

In [153]:
```
ratings_df['rating'][ratings_df['movieId'].isin(title_df[title_df['year'] == '2017'].
```

Out[153]: 3.5780911062906724

In [155]:
```
results = []
for year in title_df['year'].unique():
    avg_ratings = ratings_df['rating'][ratings_df['movieId'].isin(title_df[title_df['y
    results.append((year, avg_ratings))
```

In [156]:
```
result_df = pd.DataFrame(results, columns=['year', 'avg_ratings'])
result_df.sort_values(by='year')
```

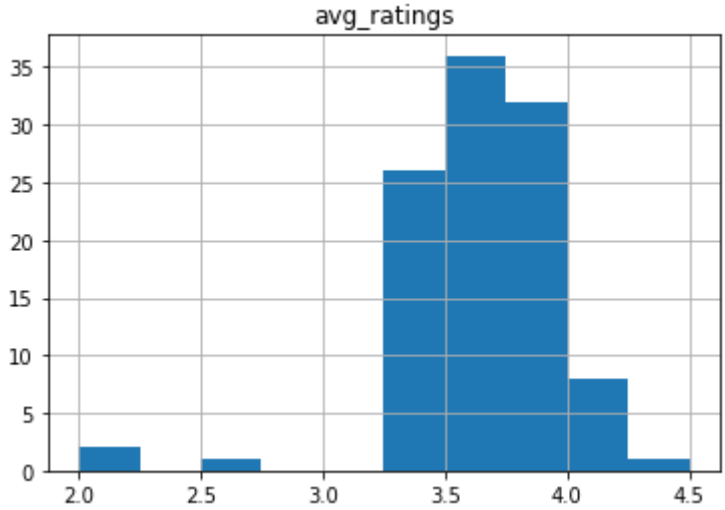
Out[156]:

	year	avg_ratings
91	1902	3.500000
92	1903	2.500000
105	1908	4.000000
84	1915	2.000000
87	1916	3.600000
...	...	...
100	2014	3.512879
101	2015	3.410386
102	2016	3.387261
103	2017	3.578091
104	2018	3.483516

106 rows × 2 columns

In [159]:
```
result_df.hist()
```

Out[159]: array([[<AxesSubplot:title={'center':'avg_ratings'}>]], dtype=object)


avg_ratings
35
30
25
20
15
10
5
0
2.0
2.5
3.0
3.5
4.0
4.5