In [5]:
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import time
from sklearn.model_selection import train_test_split
from scipy.sparse import coo_matrix, csr_matrix
from scipy.spatial.distance import jaccard, cosine
```

In [6]:
```
MV_users = pd.read_csv('data/users.csv')
MV_movies = pd.read_csv('data/movies.csv')
train = pd.read_csv('data/train.csv')
test = pd.read_csv('data/test.csv')
```

In [7]:
```
from collections import namedtuple
Data = namedtuple('Data', ['users','movies','train','test'])
data = Data(MV_users, MV_movies, train, test)
print(data)
```

```
Data(users=       uID gender  age  accupation    zip
0         1      F    1          10  48067
1         2      M   56          16  70072
2         3      M   25          15  55117
3         4      M   45           7  02460
4         5      M   25          20  55455
...     ...    ...  ...         ...    ...
6035   6036      F   25          15  32603
6036   6037      F   45           1  76006
6037   6038      F   56           1  14706
6038   6039      F   45           0  01060
6039   6040      M   25           6  11106

[6040 rows x 5 columns], movies=       mID                         title  yea
r  Doc  Com  Hor  Adv  Wes  Dra  \
0         1                     Toy Story  1995    0    1    0    0    0    0
1         2                       Jumanji  1995    0    0    0    1    0    0
2         3             Grumpier Old Men  1995    0    1    0    0    0    0
3         4            Waiting to Exhale  1995    0    1    0    0    0    1
4         5  Father of the Bride Part II  1995    0    1    0    0    0    0
...     ...                           ...   ...  ...  ...  ...  ...  ...  ...
3878   3948             Meet the Parents  2000    0    1    0    0    0    0
3879   3949          Requiem for a Dream  2000    0    0    0    0    0    1
3880   3950                    Tigerland  2000    0    0    0    0    0    1
3881   3951             Two Family House  2000    0    0    0    0    0    1
3882   3952               Contender, The  2000    0    0    0    0    0    1

      Ani  ...  Chi  Cri  Thr  Sci  Mys  Rom  Fil  Fan  Act  Mus
0       1  ...    1    0    0    0    0    0    0    0    0    0
1       0  ...    1    0    0    0    0    0    0    1    0    0
2       0  ...    0    0    0    0    0    1    0    0    0    0
3       0  ...    0    0    0    0    0    0    0    0    0    0
4       0  ...    0    0    0    0    0    0    0    0    0    0
...   ...  ...  ...  ...  ...  ...  ...  ...  ...  ...  ...  ...
3878    0  ...    0    0    0    0    0    0    0    0    0    0
3879    0  ...    0    0    0    0    0    0    0    0    0    0
3880    0  ...    0    0    0    0    0    0    0    0    0    0
3881    0  ...    0    0    0    0    0    0    0    0    0    0
3882    0  ...    0    0    1    0    0    0    0    0    0    0

[3883 rows x 21 columns], train=         uID   mID  rating
0         744  1210       5
1        3040  1584       4
2        1451  1293       5
3        5455  3176       2
4        2507  3074       5
...       ...   ...     ...
700141   1184  2916       3
700142    137  1372       5
700143    195  2514       3
700144   1676  2566       3
700145   4611  1888       1

[700146 rows x 3 columns], test=         uID   mID  rating
0        2233   440       4
1        4274   587       5
```

```
2       2498   454       3
3       2868  2336       5
4       1636  2686       5
...      ...   ...     ...
300058   810   247       4
300059  1193  3210       4
300060  6039  2289       4
300061  5397   429       3
300062  1912   117       4

[300063 rows x 3 columns])
```

Train an NMF for user ratings

We will train an NMF on the genre of a movie and the user id to see if we can predict the rating on the test set. From the data above, it is possible that gender, age, occupation, zip, genre, and year of movie may be helpful in predicting rating. Only doing 40k rows to not explode my computer...

In [48]:
```
from sklearn.decomposition import NMF
from sklearn.preprocessing import LabelEncoder

train_dataset = pd.DataFrame(columns={'uID':[],'mID':[], 'gender':[],'age':[

i = 0
n = 0
for idx in data.train.index[:30000]:
    uID = data.train['uID'][idx]
    mID = data.train['mID'][idx]

    user = data.users[data.users['uID'] == uID]
    gender = user['gender'].values[0]
    if gender == 'M':
        gender = 0
    else:
        gender = 1
    age = user['age'].values[0]
    accupation = user['accupation'].values[0]
    zip = user['zip'].values[0]

    movie = data.movies[data.movies['mID'] == mID]
    year = movie['year'].values[0]
    genre = movie.values[0][3:]
    genre_str = ''
    for item in genre:
        genre_str = genre_str + str(item)

    train_dataset.loc[len(train_dataset)] = [
        uID, mID, gender, age, accupation, zip, genre_str, year
    ]

    if i < 10000:
        i+=1
```

```
    else:
        print(f'{n/(len(data.train.index[:30000])+len(data.test.index[:10000
        i=0
    n+=1

for idx in data.test.index[:10000]:
    uID = data.test['uID'][idx]
    mID = data.test['mID'][idx]

    user = data.users[data.users['uID'] == uID]
    gender = user['gender'].values[0]
    if gender == 'M':
        gender = 0
    else:
        gender = 1
    age = user['age'].values[0]
    accupation = user['accupation'].values[0]
    zip = user['zip'].values[0]

    movie = data.movies[data.movies['mID'] == mID]
    year = movie['year'].values[0]
    genre = movie.values[0][3:]
    genre_str = ''
    for item in genre:
        genre_str = genre_str + str(item)

    train_dataset.loc[len(train_dataset)] = [
        uID, mID, gender, age, accupation, zip, genre_str, year
    ]

    if i < 10000:
        i+=1
    else:
        print(f'{n/(len(data.train[:30000].index)+len(data.test.index[:10000
        i=0
    n+=1

encoder = LabelEncoder()
train_dataset['genre'] = encoder.fit_transform(train_dataset['genre'])

print(train_dataset)
```

```
25.00 percent complete
50.00 percent complete
75.00 percent complete
```

	uID	mID	gender	age	accupation	zip	genre	year
0	744	1210	0	25	17	77007	161	1983
1	3040	1584	0	25	8	22046	83	1997
2	1451	1293	0	35	20	90012	72	1982
3	5455	3176	1	18	17	55449	91	1999
4	2507	3074	0	25	4	94107	117	1972
...	...	...	...	...	...	...	...	...
39995	855	3392	1	18	2	72701	207	1989
39996	3224	1508	1	25	14	93428	72	1997
39997	5267	3409	0	35	7	20191	85	2000
39998	883	2160	1	35	14	92673	193	1968
39999	4471	531	0	25	6	94108	107	1993

```
[40000 rows x 8 columns]
```

Now that all user and movie data has been organized, an nmf can be used to categorize them from 1-5 and see if the categories match the ratings.

In [49]:
```
from sklearn.decomposition import NMF
import re

train_dataset['zip'] = [re.sub(r'-', '', x) for x in train_dataset.zip.tolis

nmf = NMF(n_components = 5)
rating_df = nmf.fit_transform(train_dataset)
rating_df = pd.DataFrame(rating_df)

print(rating_df)
```

	0	1	2	3	4
0	0.007568	0.0	0.000006	0.0	0.016804
1	0.000000	0.0	0.000000	0.0	0.004875
2	0.012315	0.0	0.000012	0.0	0.019533
3	0.000000	0.0	0.000000	0.0	0.012261
4	0.000629	0.0	0.000021	0.0	0.020733
...	...	...	...	...	...
39995	0.000000	0.0	0.000000	0.0	0.016076
39996	0.012109	0.0	0.000028	0.0	0.020253
39997	0.000000	0.0	0.000000	0.0	0.004465
39998	0.006926	0.0	0.000008	0.0	0.020282
39999	0.019995	0.0	0.000038	0.0	0.020158

```
[40000 rows x 5 columns]
```

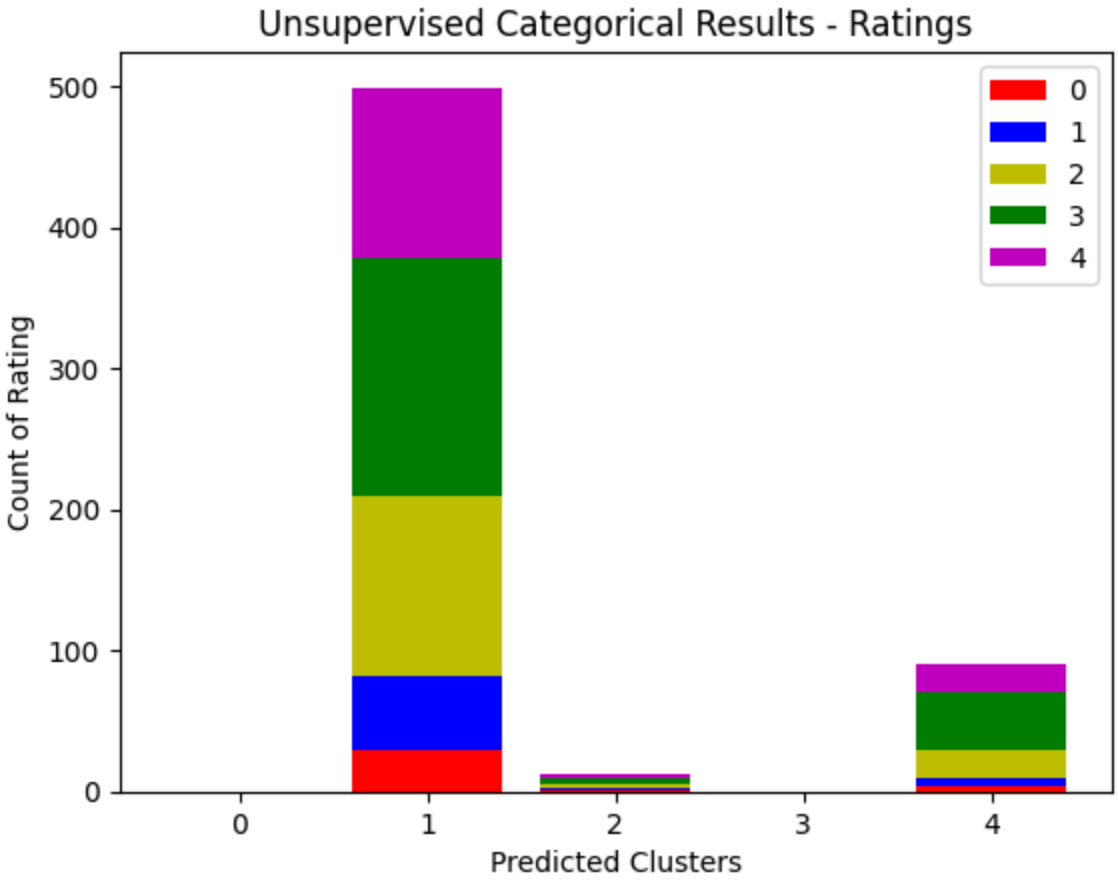
In [50]:
```
test_pred = pd.DataFrame(columns={'uID':[],'mID':[],'Pred':[], 'rating':[]})

for idx in test.index[:10000]:
    uID = test['uID'][idx]
    mID = test['mID'][idx]
    rating = test['rating'][idx]
    pred_list = rating_df.loc[29999+idx].tolist()

    test_pred.loc[len(test_pred)] = [
```

```
        uID,
        mID,
        pred_list.index(max(pred_list))+1,
        rating
    ]

print(test_pred)
```

```
      uID   mID  Pred  rating
0     2233   440     5       4
1     4274   587     5       5
2     2498   454     5       3
3     2868  2336     5       5
4     1636  2686     5       5
...    ...   ...   ...     ...
9995   855  3392     5       2
9996  3224  1508     5       4
9997  5267  3409     5       4
9998   883  2160     5       4
9999  4471   531     5       3

[10000 rows x 4 columns]
```

In [52]:
```
x = [0, 1, 2, 3, 4]

y_cats = {}

for category in test_pred.rating.unique():
    cat_df = test_pred[test_pred['rating'] == category].copy()
    y_cats[category] = []
    for pred in x:
        y_cats[category].append(len(cat_df[cat_df['Pred'] == pred].index))

    y_cats[category] = np.array(y_cats[category])

y_true = []
for idx in test_pred.index:
    category = test_pred['rating'][idx]
    y_true.append(
        list(y_cats[category]).index(max(y_cats[category]))
    )

plt.bar(x, y_cats[1], color = 'r')
plt.bar(x, y_cats[2], bottom = y_cats[1], color='b')
plt.bar(x, y_cats[3], bottom = y_cats[1] + y_cats[2], color='y')
plt.bar(x, y_cats[4], bottom = y_cats[1] + y_cats[2]
        + y_cats[3], color='g')
plt.bar(x, y_cats[5], bottom = y_cats[1] + y_cats[2]
        + y_cats[3] + y_cats[4], color='m')
plt.xlabel("Predicted Clusters")
plt.ylabel("Count of Rating")
plt.legend(["0", "1", "2", "3", "4"])
plt.title("Unsupervised Categorical Results - Ratings")
plt.show()

from sklearn.metrics import accuracy_score
```

```
print(f'Accuracy = {accuracy_score(y_true, test_pred["Pred"]):0.2f}')
print(f'RMSE = {np.sqrt(((y_true-test_pred["Pred"])**2).mean())}')
```




```
Accuracy = 0.05
RMSE = 3.8884315604109583
```

Discussion

The results are.. terrible. It could be that the NMF is getting confused by the different numerical inputs like zip and gender. Zip has many different values, whereas gender is 0 and 1. Perhaps better data cleaning would yield better results.

In [ ]: