# Machine Learning
# (Assignment for IITP –BSE Course)

**A1: Consider the iris data set and perform clustering on it. The iris dataset is of 150 instances**
**represented by 4 features. The last column in the iris data set represents the label information.**
**Group the dataset in an unsupervised way i.e., without considering the label information.**
**Perform the clustering algorithm using the following algorithm i) K-means, ii) Bottom-up Hierarchical Clustering (BUHC) using single linkage, and iii) Fuzzy C means (FCM) (nonoverlapping).**
**Provide the number of cluster K as K=3, 4 and 5. Use the Silhouette score and Adjusted Rank Index (ARI) for evaluating the generated clusters. Report the score obtained**
**below in a tabular form.**

| | SILHOUETTE SCORE | | | ARI | | |
|---|---|---|---|---|---|---|
| | K-means | BUHC | FCM | K-means | BUHC | FCM |
| **K=3** | 0.4599 | 0.50464 | 0.4584 | 0.6201 | 0.5583 | 0.6303 |
| **K=4** | 0.3882 | 0.4067 | 0.4016 | 0.4440 | 0.5522 | 0.5877 |
| **K=5** | 0.3423 | 0.3424 | 0.3448 | 0.4324 | 0.5517 | 0.5617 |

**A2:**
**1.Load data on colab from the following GitHub links:**

```
ratings="https://github.com/couturierc/tutorials/raw/master/recommender_system/data/ratings.csv"
movies="https://github.com/couturierc/tutorials/raw/master/recommender_system/data/movies.csv"

df_ratings = pd.read_csv(ratings, sep=',')
df_ratings.columns = ['userId', 'itemId', 'rating', 'timestamp']
df_movies = pd.read_csv(movies, sep=',')
df_movies.columns = ['itemId', 'title', 'genres']
```

**2.Print first 20 rows for each dataset.**

**Movies:**

| S.NO | itemId | title | genres |
|---|---|---|---|
| **0** | 1 | Toy Story (1995) | Adventure\|Animation\|Children\|Comedy\|Fantasy |
| **1** | 2 | Jumanji (1995) | Adventure\|Children\|Fantasy |

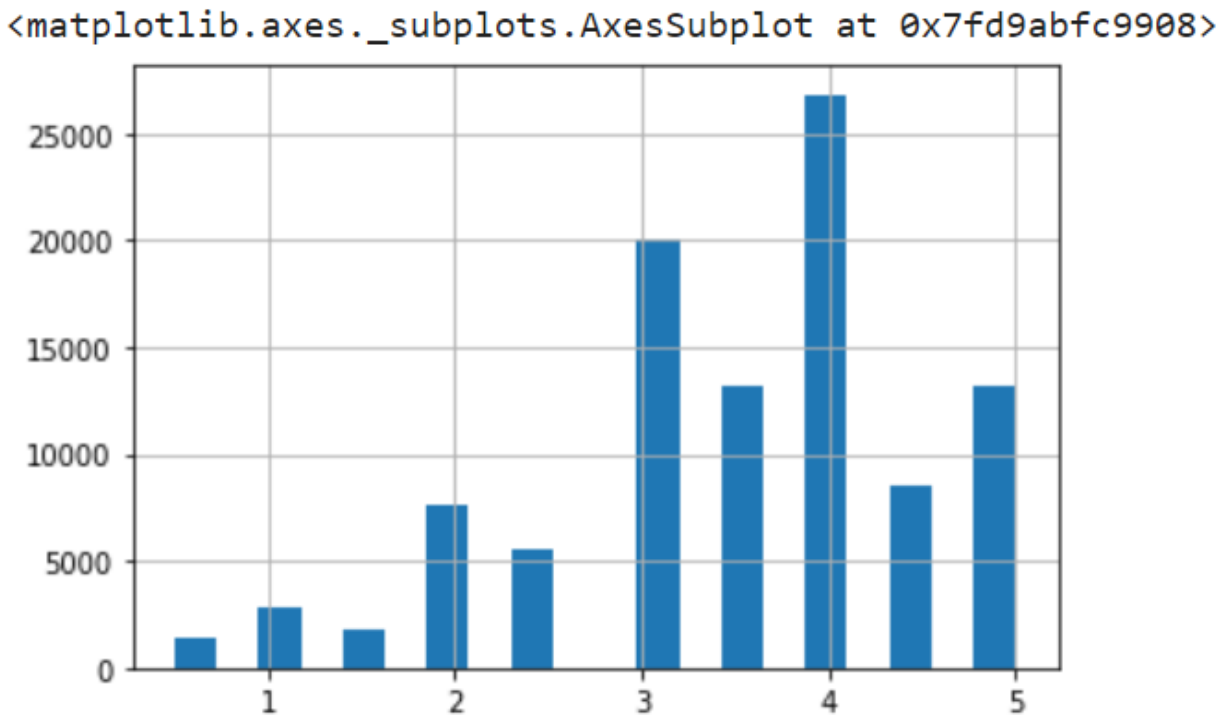
| | | | |
|---|---|---|---|
| **2** | 3 | Grumpier Old Men (1995) | Comedy\|Romance |
| **3** | 4 | Waiting to Exhale (1995) | Comedy\|Drama\|Romance |
| **4** | 5 | Father of the Bride Part II (1995) | Comedy |
| **5** | 6 | Heat (1995) | Action\|Crime\|Thriller |
| **6** | 7 | Sabrina (1995) | Comedy\|Romance |
| **7** | 8 | Tom and Huck (1995) | Adventure\|Children |
| **8** | 9 | Sudden Death (1995) | Action |
| **9** | 10 | GoldenEye (1995) | Action\|Adventure\|Thriller |
| **10** | 11 | American President, The (1995) | Comedy\|Drama\|Romance |
| **11** | 12 | Dracula: Dead and Loving It (1995) | Comedy\|Horror |
| **12** | 13 | Balto (1995) | Adventure\|Animation\|Children |
| **13** | 14 | Nixon (1995) | Drama |
| **14** | 15 | Cutthroat Island (1995) | Action\|Adventure\|Romance |
| **15** | 16 | Casino (1995) | Crime\|Drama |
| **16** | 17 | Sense and Sensibility (1995) | Drama\|Romance |
| **17** | 18 | Four Rooms (1995) | Comedy |
| **18** | 19 | Ace Ventura: When Nature Calls (1995) | Comedy |
| **19** | 20 | Money Train (1995) | Action\|Comedy\|Crime\|Drama\|Thriller |

**Ratings:**

| S.NO | userId | itemId | Rating | timestamp |
|---|---|---|---|---|
| **0** | 1 | 1 | 4.0 | 964982703 |
| **1** | 1 | 3 | 4.0 | 964981247 |
| **2** | 1 | 6 | 4.0 | 964982224 |
| **3** | 1 | 47 | 5.0 | 964983815 |
| **4** | 1 | 50 | 5.0 | 964982931 |
| **5** | 1 | 70 | 3.0 | 964982400 |

| | | | | |
|---|---|---|---|---|
| **6** | 1 | 101 | 5.0 | 964980868 |
| **7** | 1 | 110 | 4.0 | 964982176 |
| **8** | 1 | 151 | 5.0 | 964984041 |
| **9** | 1 | 157 | 5.0 | 964984100 |
| **10** | 1 | 163 | 5.0 | 964983650 |
| **11** | 1 | 216 | 5.0 | 964981208 |
| **12** | 1 | 223 | 3.0 | 964980985 |
| **13** | 1 | 231 | 5.0 | 964981179 |
| **14** | 1 | 235 | 4.0 | 964980908 |
| **15** | 1 | 260 | 5.0 | 964981680 |
| **16** | 1 | 296 | 3.0 | 964982967 |
| **17** | 1 | 316 | 3.0 | 964982310 |
| **18** | 1 | 333 | 5.0 | 964981179 |
| **19** | 1 | 349 | 4.0 | 964982563 |

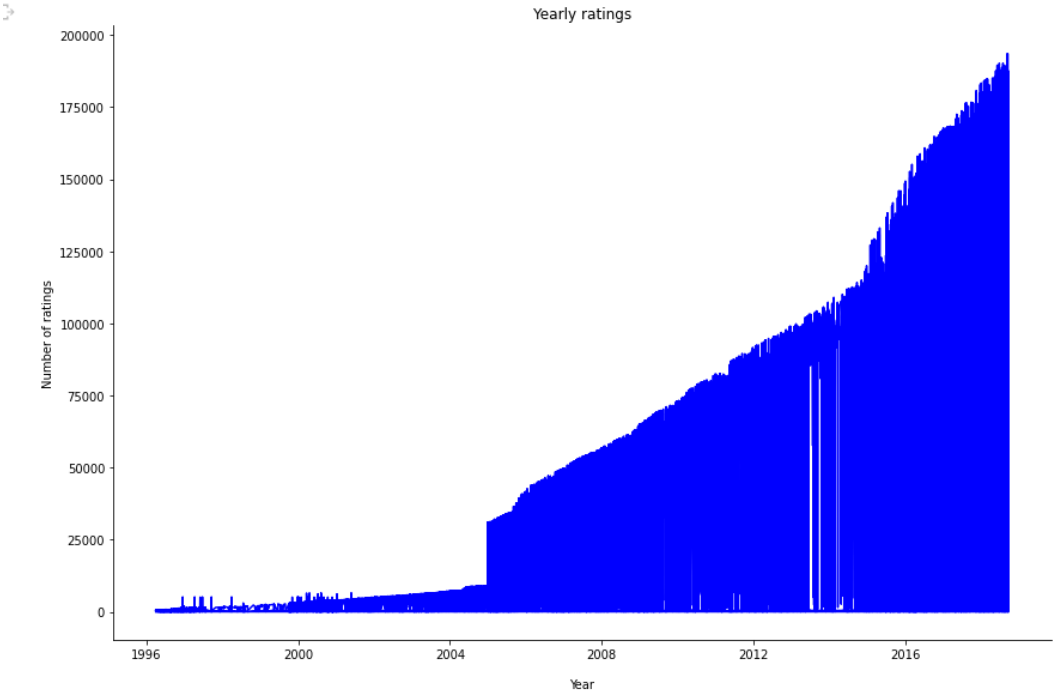
**3.Give a graphical representation of how the total number of users varies from rating 1 to 5.**



**4.Print max, min, and average ratings for userId 10.**

```
count    140.000000
mean       3.278571
std        1.175700
min        0.500000
25%        3.000000
50%        3.500000
75%        4.000000
max        5.000000
Name: rating, dtype: float64
```

**5.Give a graphical representation of how the total number of users (based on the number of posted ratings) varies from time to time.**




**6.Convert the Rating data to matrix form where columns indicate ‘userId' and row indicates**
**‘itemId’ and each entry indicates rating values.**

| itemId | 1 | 2 | 3 | 4 | ... | 193583 | 193585 | 193587 | 193609 |
|---|---|---|---|---|---|---|---|---|---|
| userId | | | | | ... | | | | |
| 1 | 4.0 | NaN | 4.0 | NaN | ... | NaN | NaN | NaN | NaN |
| 2 | NaN | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| 3 | NaN | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| 4 | NaN | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| 5 | 4.0 | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 606 | 2.5 | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| 607 | 4.0 | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| 608 | 2.5 | 2.0 | 2.0 | NaN | ... | NaN | NaN | NaN | NaN |
| 609 | 3.0 | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |
| 610 | 5.0 | NaN | NaN | NaN | ... | NaN | NaN | NaN | NaN |

```
[610 rows x 9724 columns]
```

**7.For instance, print rating for userId=10 for movies with itemId 1 to 30.**

```
itemId
1     0.0
2     0.0
3     0.0
4     0.0
5     0.0
6     0.0
7     0.0
8     0.0
9     0.0
10    0.0
11    0.0
12    0.0
13    0.0
14    0.0
15    0.0
16    0.0
17    0.0
18    0.0
19    0.0
20    0.0
21    0.0
22    0.0
23    0.0
24    0.0
25    0.0
26    0.0
27    0.0
28    0.0
29    0.0
30    0.0
Name: 10, dtype: float64
```

**8.Save the movie ids for userId: 21.**

```
Int64Index([     1,      2,      3,      4,      5,      6,      7,
8,
                 9,     10,
             ...
             193565, 193567, 193571, 193573, 193579, 193581, 193583,
193585,
             193587, 193609],
            dtype='int64', name='itemId', length=9724)
```

**9.Model 1:** Apply Approximate SVD with stochastic gradient descend (SGD) on the dataset with
n_factors = 10, # number of factors
alpha = .01, # learning rate
n_epochs = 3, # number of iteration of the SGD procedure

MAE: 2.4

**Model 2:** Apply Approximate SVD with stochastic gradient descend (SGD) on the dataset with
n_factors = 20, # number of factors
alpha = .01, # learning rate
n_epochs = 6, # number of iteration of the SGD procedure

MAE: 3.4

**Model 3:** Apply Approximate SVD with stochastic gradient descend (SGD) on the dataset with
n_factors = 40, # number of factors
alpha = .01, # learning rate
n_epochs = 18, # number of iteration of the SGD procedure

MAE: 3.8