Recommender System Project – Movielens100k

Data discription

- 根據 ml-100k 中 readme.md 的描述：

  u.data 有 100000 筆資料，u1.base～u5.base 各有 80000 筆資料，u1.test～u5.test 各有 20000 筆資料。

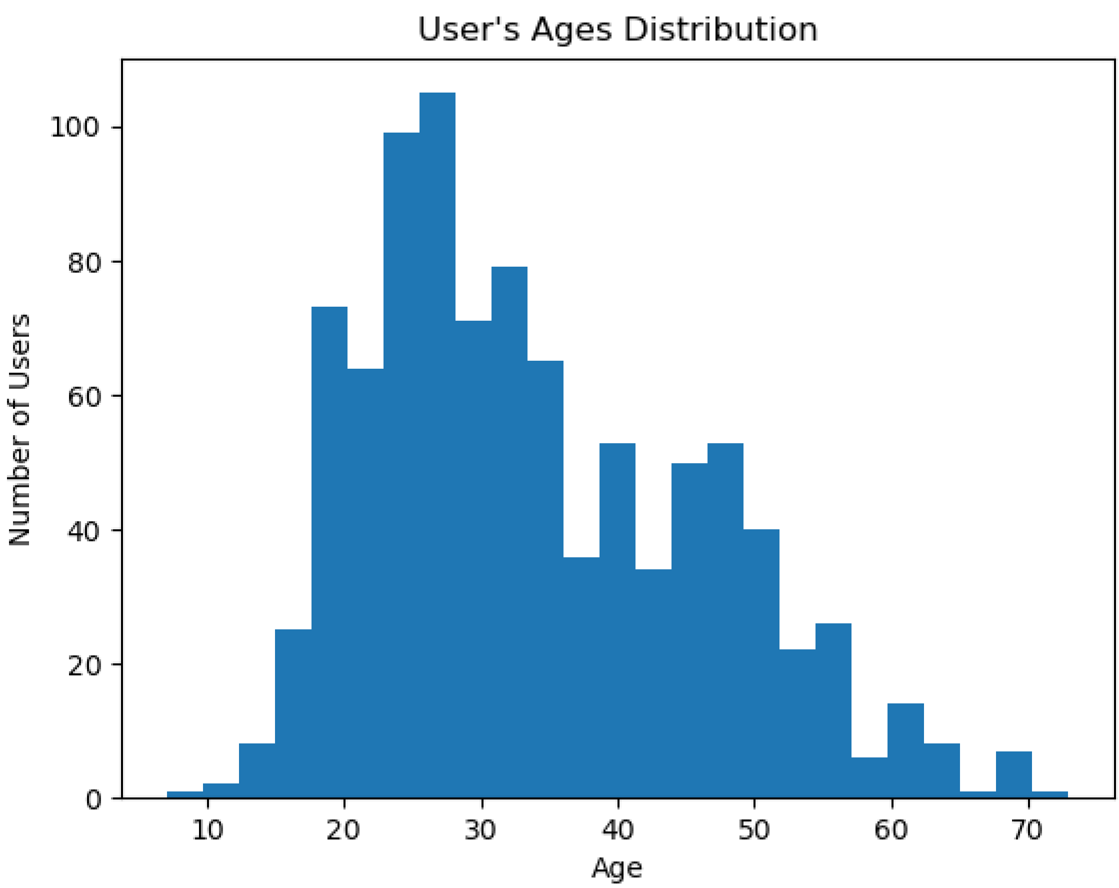
- u.data u1～u5 中都有 4 個 columns：

  user id | item id | rating | timestamp

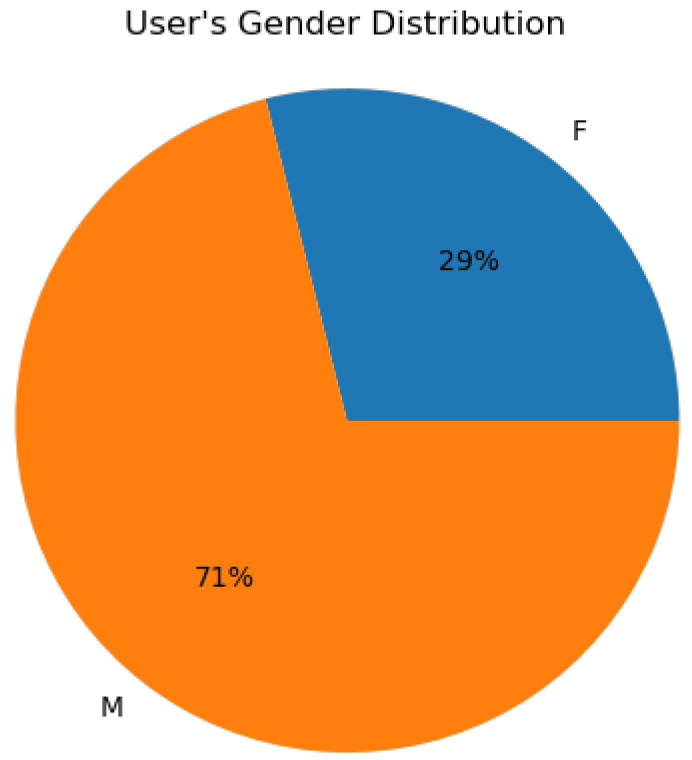
- u.user 中有 5 個 columns：

  user id | age | gender | occupation | zip code

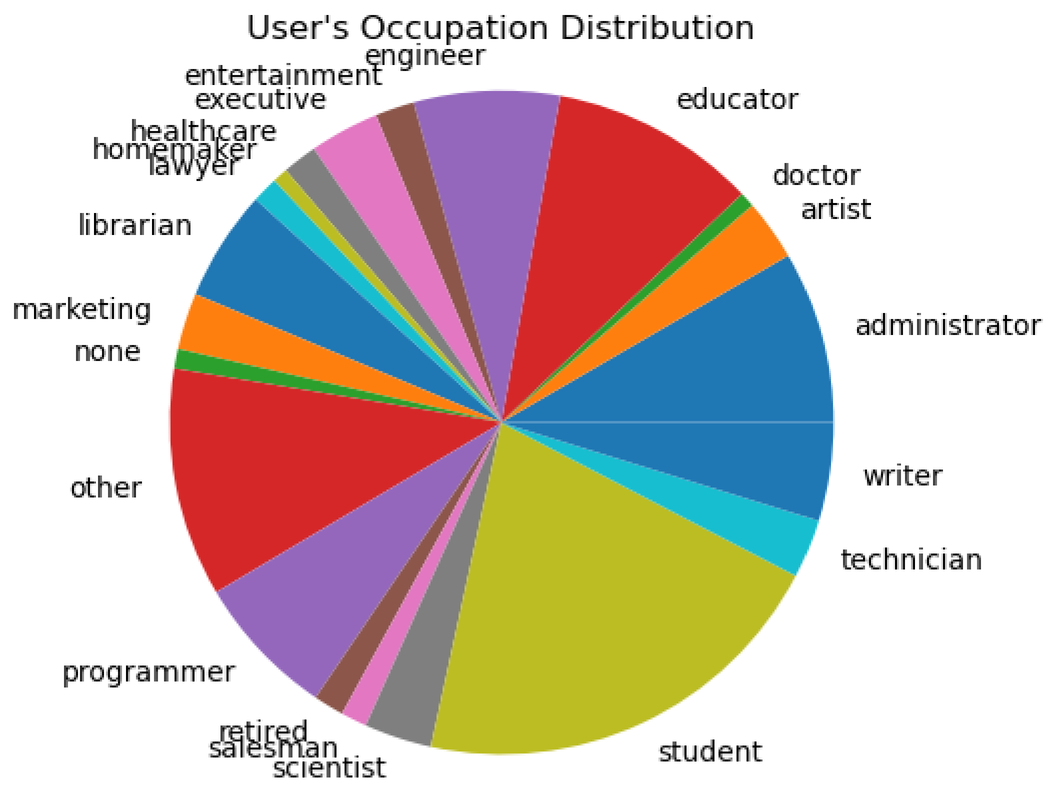
  其中 age 的分佈爲：



  gender 的分佈爲：



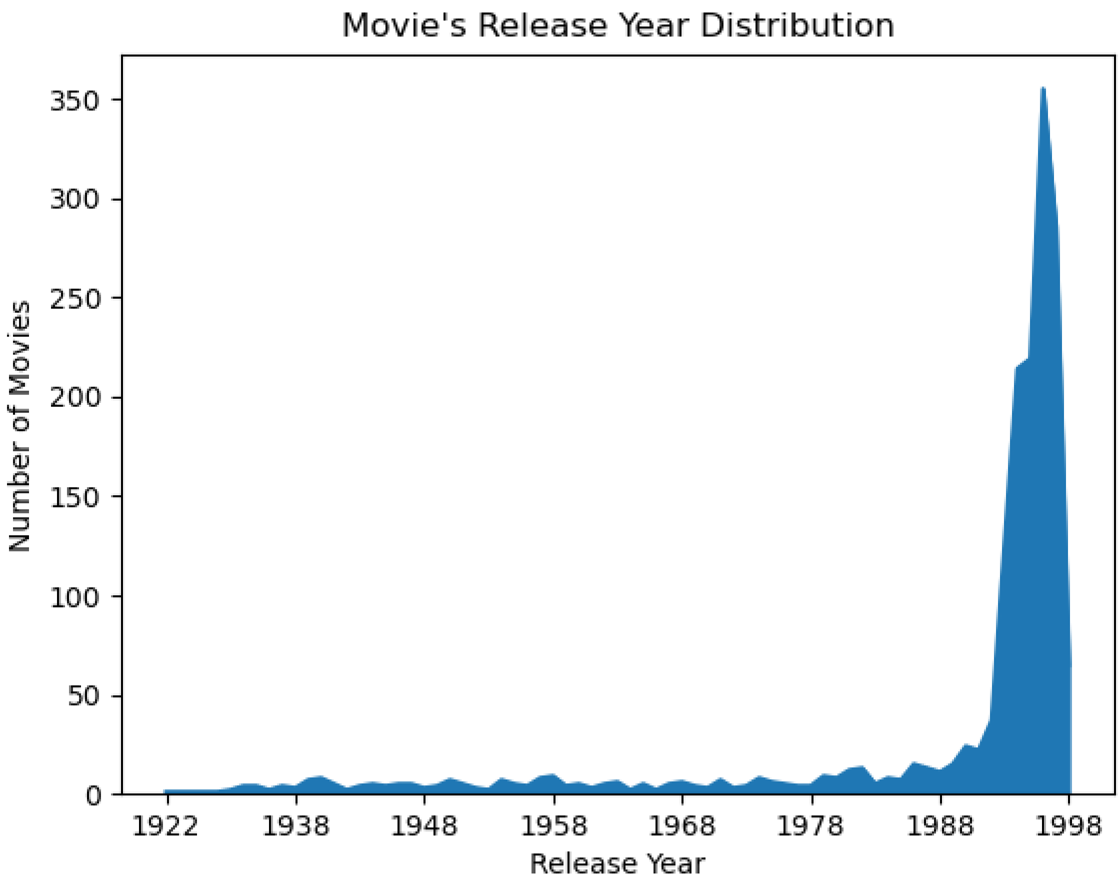
occupation 的分佈爲:



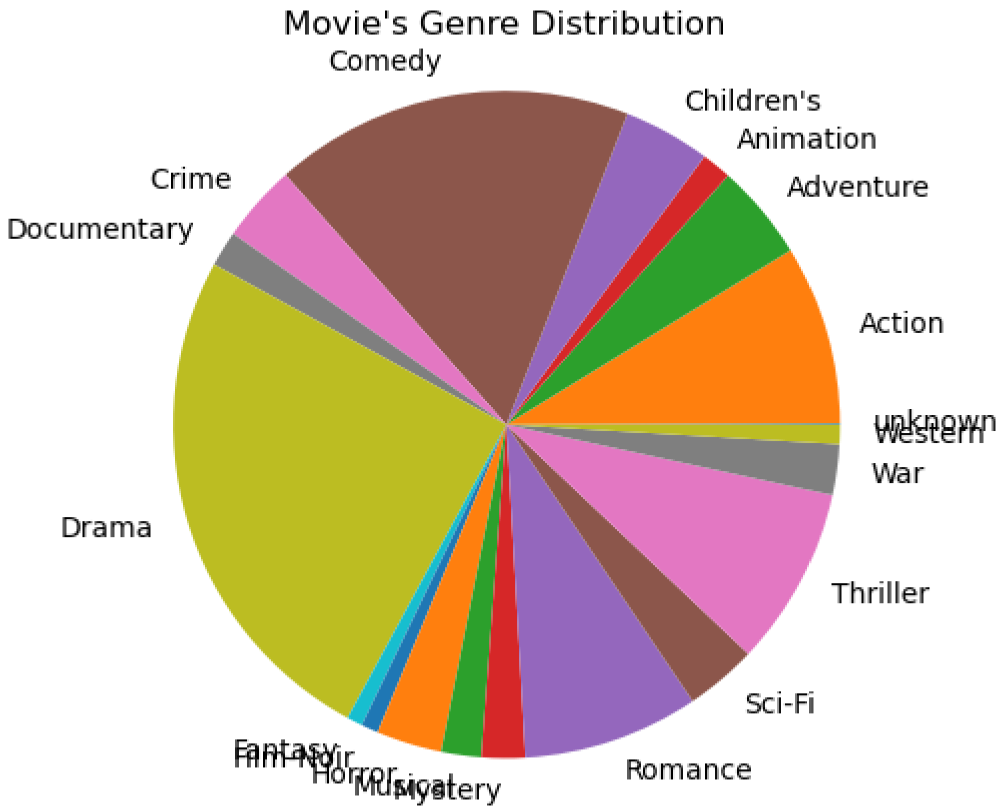
- u.item 中有 24 個 columns：

  movie id | movie title | release date | video release date | IMDb URL | unknown | Action | Adventure | Animation | Children's | Comedy | Crime | Documentary | Drama | Fantasy | Film-Noir | Horror | Musical | Mystery | Romance | Sci-Fi | Thriller | War | Western

  其中 release date (modified to release year) 的分佈爲：



  各個 genre 的分佈爲：



Program discription

Item Base Collaborative Filtering Model

實作方法:

1. 使用 pandas 的 pivot 將 rating data 轉換成 item-to-user 的稀疏矩陣。
2. 使用 sklearn 的 NearestNeighbors 由 item-to-user 矩陣取得 k-neighbor's cosine similarity 還有 k-neighbor's indices。
3. 照公式 $\widehat{rate}=\cfrac{\sum (similarity \times rate)}{\sum similarity}$ 得出預測的 rating 的值。
4. 計算 RMSE 衡量預測值的誤差。

Code 如下:

```
class Item_Base_CF:
    def __init__(self, n_neighbors=3) -> None:
        self.item_user = np.empty((1682, 943))
        self.n = n_neighbors
        self.knn = NearestNeighbors(n_neighbors=self.n, metric="cosine")
        self.distances, self.indices = np.empty((1682, self.n)),
np.empty((1682, self.n))
        self.similarities = np.empty((1682, self.n))

    def fit(self, data):
        self.item_user = data.pivot(index="item_id", columns="user_id",
```

```
values="rating")
        # Fail to adjust item-to-user matrix with mean of user-ratings
        # self.item_user =
self.item_user.subtract(self.item_user.mean(axis=1), axis = 0).fillna(0)
        self.item_user = self.item_user.reindex(index=np.arange(1,1683),
fill_value=0).fillna(0)
        # Use sklearn NearestNeighbors to find n similar item's indices &
cosine similarities
        self.knn.fit(self.item_user)
        self.distances, self.indices =
self.knn.kneighbors(n_neighbors=self.n)
        self.similarities = 1 - self.distances

    def predict(self, item_id, user_id, epsilon=1e-8):
        # Function to predict rating via item_id & user_id
        # Using formula in 01_Neighborhood-
based_collaborative_filtering.pptx page 32
        pred_r = self.item_user.iloc[item_id-1,user_id-1]
        sim, ind = self.similarities[item_id-1], self.indices[item_id-1]
        product = 1
        product_sum = 0
        if self.item_user.iloc[item_id-1,user_id-1]!=0:
            return pred_r
        else:
            for i in range(len(ind)):
                product = self.item_user.iloc[ind[i],user_id-1] * sim[i]
                product_sum += product
            pred_r = product_sum / (np.sum(sim)+epsilon)
        return pred_r

    def rmse(self, data):
        # Function to calculate RMSE of predicted rating & actual rating
        x = data[["item_id", "user_id"]].to_numpy()
        y = data[["rating"]].to_numpy()
        losses = []
        for i in range(len(x)):
            losses.append((self.predict(x[i][0], x[i][1]) - y[i]).item())
        return sqrt(np.nanmean(np.square(losses)))
```

輸出結果:

```
# Number of neighbors set
k = [2, 4, 8]
```

使用 u1～u5 的資料集進行 5 次 RMSE 輸出, 計算其平均值。

已知若使用所有預測值皆爲 0 的 model, 其 5 次的 RMSE 輸出將會落在 3.6, 3.7 左右, 相較之下 Item Base CF 的誤差值有顯著的減少。

```
```

```
----------2-neighbors----------
u1.test RMSE : 2.8520523211052926
u2.test RMSE : 2.687808126654529
u3.test RMSE : 2.603465358260204
u4.test RMSE : 2.647911007490916
u5.test RMSE : 2.7360450020224687
mean : 2.705456363106682
----------4-neighbors----------
u1.test RMSE : 2.7258851793259886
u2.test RMSE : 2.5596291495946533
u3.test RMSE : 2.4705296126894747
u4.test RMSE : 2.526707312903369
u5.test RMSE : 2.62215865725013
mean : 2.580981982352723
----------8-neighbors----------
u1.test RMSE : 2.6828780812337185
u2.test RMSE : 2.500036414134187
u3.test RMSE : 2.425303738135374
u4.test RMSE : 2.4748264591987574
u5.test RMSE : 2.575107201472646
mean : 2.5316303788349366
```