

Experiment-05

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Aim: Write a Program to perform Collaborative filtering and develop a small recommender system by considering some self-created data.

Details:

- Create a transaction data for users for different items they have purchased along with ratings.
- Let there be missing ratings and predict the ratings for these missing items and state if we can recommend the item to the user.

Batch-1: Item-based CF

Theory:

Example- Item Based filtering

(i)

ID	User	Item	Rating
1	U ₁	m ₁	2
2	U ₁	m ₃	3
3	U ₂	m ₁	5
4	U ₂	m ₂	3
5	U ₃	m ₁	3
6	U ₃	m ₂	3
7	U ₃	m ₃	1
8	U ₄	m ₂	2
9	U ₄	m ₃	2

Step 1:- User-Item matrix

User \ Item	m ₁	m ₂	m ₃
U ₁	2	?	3
U ₂	5	3	?
U ₃	3	3	1
U ₄	?	2	2

(1) Sim m₁ & m₂
 User Space $\Rightarrow U_2, U_3$ [Users who have gives rating to both m₁ & m₂]
 $m_1: V_1 = 5U_2 + 3U_3$
 $m_2: V_2 = 3U_2 + 3U_3$
 $\cos \text{Sim}(V_1, V_2) = \frac{a_1 b_1 + a_2 b_2}{\sqrt{a_1^2 + a_2^2} \sqrt{b_1^2 + b_2^2}}$
 $= \frac{5 \times 3 + 3 \times 3}{\sqrt{25 + 9} \sqrt{9 + 9}} = 0.97$

(2) Sim m₁ & m₃
 User Space $\Rightarrow U_1, U_3$
 $(m_1) V_1 = 2U_1 + 3U_3$
 $(m_3) V_3 = 3U_1 + 1U_3$
 $\cos \text{Sim}(V_1, V_3) = \frac{2 \times 3 + 3 \times 1}{\sqrt{2^2 + 3^2} \sqrt{3^2 + 1^2}} = 0.789$

(3) Sim m₂ & m₃ User Space $\Rightarrow U_3, U_4$
 $m_2: V_2 = 3U_3 + 2U_4$
 $m_3: V_3 = 1U_3 + 2U_4$
 $\cos \text{Sim}(V_2, V_3) = 0.868$

Step 2:- Item-Item matrix

Item \ Item	m ₁	m ₂	m ₃
m ₁	1	0.97	0.789
m ₂		1	0.868
m ₃			1

Item-item sim

	m_1	m_2	m_3
m_1	1	0.97	0.789
m_2		1	0.868
m_3			1

step 1 - Find missing Rating
 $u_1 - m_2$?
 target $\rightarrow m_1 R_1 = 2$
 $m_2 \rightarrow m_3 R_3 = 3$

① Rating (u_1 for m_2) = $\frac{R_1 \times \text{sim}(m_1, m_2) + R_3 \times \text{sim}(m_2, m_3)}{\text{sim}(m_1, m_2) + \text{sim}(m_2, m_3)}$

$$= \frac{2 \times 0.97 + 3 \times 0.868}{0.97 + 0.868}$$

$$= 2.47$$

② Rating (u_2 for m_3) * Recommend m_3 to User 2

Users

$m_1 R_1 = 5$
 $m_2 R_2 = 3$

$$= \frac{R_1 \times \text{sim}(m_1, m_2) + R_2 \times \text{sim}(m_2, m_3)}{\text{sim}(m_1, m_2) + \text{sim}(m_2, m_3)}$$

$$= 3.95$$

③ Rating (u_4 for m_1)

$m_1 R_1 = 2$
 $m_2 R_2 = 2$
 $m_3 R_3 = 2$

$$= \frac{R_2 \times \text{sim}(m_1, m_2) + R_3 \times \text{sim}(m_1, m_3)}{\text{sim}(m_1, m_2) + \text{sim}(m_1, m_3)}$$

$$= 2$$

Code:

```
from math import sqrt

#USER ITEM RATING AND DICTIONARY OF USER ITEM
user_dict={}
user_set=set()
item_user_dict={}
item_set=set()

inputs=int(input("Enter no. of inputs : - "))

for i in range(1,inputs+1):
    user,item,rating=map(int,input("Enter space seperated input for
USER ITEM RATING : ").split())

    user_set.add(user)
    item_set.add(item)

    if item in item_user_dict:
        item_user_dict[item].append(user)
    else:
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        item_user_dict[item] = [user]
    user_dict[(user,item)]=rating
# print(user_dict)
# print(item_set)

#COSINE FORMULA
len_item_set=len(item_set)
list_item_set=list(item_set)
item_matrix=[[1 for _ in range(len_item_set)] for _ in
range(len_item_set)]
# print(item_matrix)
for i in range(1,len_item_set):
    for j in range(i+1,len_item_set+1):

set_common_users=set(item_user_dict[i]).intersection(set(item_user_d
ict[j]))

    list_set_common_users=list(set_common_users)
    # print(list_set_common_users)
    numerator=0
    denominator1=0
    denominator2=0
    for k in range(len(set_common_users)):

numerator+=user_dict[(list_set_common_users[k],i)]*user_dict[(list_s
et_common_users[k],j)]

        denominator1+=user_dict[(list_set_common_users[k],i)]**2
        denominator2+=user_dict[(list_set_common_users[k],j)]**2
    # print(i,j,item_matrix)

    item_matrix[i-1][j-
1]=numerator/(sqrt(denominator1)*sqrt(denominator2))

    item_matrix[j-1][i-
1]=numerator/(sqrt(denominator1)*sqrt(denominator2))

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# print(item_matrix)

#RECOMMENDER SYSTEM
predicted_rating_dict={}
for item in range(1,len_item_set+1):
    user_notRated = list(user_set - set(item_user_dict[item]))
    # print(item,user_notRated)
    for user in user_notRated:
        numerator=0
        denominator=0
        for i in range(1,len_item_set+1):
            if i!=item and (user,i) in user_dict:
                numerator+=user_dict[(user,i)]*item_matrix[i-
1][item-1]
                denominator+=item_matrix[i-1][item-1]
        predicted_rating_dict[(user,item)]=numerator/denominator

#DISPLAY
for user,rating in predicted_rating_dict.items():
    print("Predicted Rating of Item ",user[1]," by USER ",user[0],"
is : ",rating)

```

Output:

```

PS C:\Users\ACER\Desktop\Courses\College Courses\WIBD\Lab\EXPT1> & C:/Users/ACER/AppData/Local/Programs/Python/Python39/python.exe "c:/Users/ACER/Desktop/Courses/College Courses/WIBD/Lab/EXPT1/prac5.py"
Enter no. of inputs : - 9
Enter space seperated input for USER ITEM RATING : 1 1 2
Enter space seperated input for USER ITEM RATING : 1 3 3
Enter space seperated input for USER ITEM RATING : 2 1 5
Enter space seperated input for USER ITEM RATING : 2 2 3
Enter space seperated input for USER ITEM RATING : 3 1 3
Enter space seperated input for USER ITEM RATING : 3 2 3
Enter space seperated input for USER ITEM RATING : 3 3 1
Enter space seperated input for USER ITEM RATING : 4 2 2
Enter space seperated input for USER ITEM RATING : 4 3 2
Predicted Rating of Item 1 by USER 4 is : 2.0
Predicted Rating of Item 2 by USER 1 is : 2.4722856413589422
Predicted Rating of Item 3 by USER 2 is : 3.9524064034711746
PS C:\Users\ACER\Desktop\Courses\College Courses\WIBD\Lab\EXPT1>

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*** END ***