

TOTVSLABS - TEST

July 25, 2018

Question 1-- We can learn more about the items, such as the items that sell more. We could make a Recommendation system too, because we have a lot of information about customers. The timing of sales can also be important, and we have the order date, so we can look for correlations between the products and the date of sales. About the seller, we can see who are the best, grouping those who sell more. It can be important for a new job, a new position or even dismiss someone if they do not have a good sales record.

Question 2- If the company is a E-Commerce or no, a good recommender system is a very important thing today. The company could offer the right products to customers, sell and profit more. To do that, i will use Pandas, JSON, and the Scikit Surprise, a Python Library to make Recommender Systems.

Question 3-

```
In [1]: import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import json
%matplotlib inline
```

```
In [2]: sns.set_style('whitegrid')
```

```
In [3]: a= pd.read_json('challenge.json')
```

```
In [4]: a.head(5)
```

```
Out[4]:
```

	branch_id	customer_code	group_code	is_churn	item_code	\
0	0	143	0	0.0	854	
1	0	433	0	0.0	246	
2	0	486	0	0.0	1420	
3	0	107	0	0.0	1963	
4	0	768	0	0.0	1786	

	item_total_price	order_id	quantity	register_date	sales_channel	\
0	292.91	21804	10	2017-11-10T00:00:00Z	0	
1	287.19	5486	20	2011-05-16T00:00:00Z	1	
2	184.84	22662	12	2018-01-24T00:00:00Z	0	
3	189.18	3956	18	2010-07-28T00:00:00Z	1	
4	66.87	4730	5	2010-12-17T00:00:00Z	1	

	segment_code	seller_code	total_price	unit_price
0	0	190	1613.53	25.04
1	5	153	11163.69	12.33
2	0	166	6432.12	12.80
3	0	156	831.82	10.51
4	0	218	1736.48	11.82

In [5]: a.describe()

Out [5]:

	branch_id	customer_code	group_code	is_churn	item_code \
count	204428.0	204428.000000	204428.000000	202513.000000	204428.000000
mean	0.0	447.489062	0.307184	0.191168	1437.298981
std	0.0	246.678026	0.714639	0.393222	903.166319
min	0.0	0.000000	0.000000	0.000000	0.000000
25%	0.0	221.000000	0.000000	0.000000	631.000000
50%	0.0	486.000000	0.000000	0.000000	1455.000000
75%	0.0	651.000000	0.000000	0.000000	2048.000000
max	0.0	837.000000	3.000000	1.000000	2980.000000

	item_total_price	order_id	quantity	sales_channel \
count	204428.000000	204428.000000	204428.000000	204428.000000
mean	304.048244	12434.088863	12.332694	1.761182
std	1009.268287	6935.623011	53.299314	2.929541
min	0.000000	0.000000	1.000000	0.000000
25%	79.600000	6497.750000	3.000000	0.000000
50%	156.150000	12698.000000	6.000000	0.000000
75%	293.862500	18280.000000	12.000000	2.000000
max	102951.110000	24617.000000	7000.000000	105.000000

	segment_code	seller_code	total_price	unit_price
count	204428.000000	204428.000000	204428.000000	204428.000000
mean	0.846381	145.543022	5337.072931	47.456664
std	1.615763	75.197609	21268.855032	145.295694
min	0.000000	0.000000	0.010000	0.010000
25%	0.000000	83.000000	1180.470000	14.670000
50%	0.000000	156.000000	2035.820000	21.780000
75%	2.000000	195.000000	3611.070000	46.720000
max	7.000000	289.000000	428976.460000	26280.000000

In [6]: a.info()

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 204428 entries, 0 to 204427
Data columns (total 14 columns):
branch_id      204428 non-null int64
customer_code  204428 non-null int64
group_code     204428 non-null int64
is_churn       202513 non-null float64
```

```

item_code          204428 non-null int64
item_total_price   204428 non-null float64
order_id           204428 non-null int64
quantity           204428 non-null int64
register_date      204428 non-null object
sales_channel      204428 non-null int64
segment_code       204428 non-null int64
seller_code        204428 non-null int64
total_price        204428 non-null float64
unit_price         204428 non-null float64
dtypes: float64(4), int64(9), object(1)
memory usage: 21.8+ MB

```

```
In [7]: a.nunique()
```

```

Out[7]: branch_id          1
        customer_code     838
        group_code         4
        is_churn           2
        item_code         2981
        item_total_price   55336
        order_id          24618
        quantity          290
        register_date     3121
        sales_channel      106
        segment_code        8
        seller_code        290
        total_price        22713
        unit_price         19828
        dtype: int64

```

Now, i will start to use the SciKit Surprise, the library to make recommender systems in Python. Recommender systems use a lot of Algebra, so, it's more easy and fast use a good library to do that.

```

In [8]: from surprise import Dataset
        from surprise import Reader

```

But, before we start to make the recommender system, we have to clean the dataset, and use only the features that we need.

```
In [9]: af=a.drop(columns=['branch_id','group_code','is_churn','item_total_price','unit_price'])
```

```
In [10]: af.head()
```

```

Out[10]:   customer_code  item_code  quantity
0         143         854         10
1         433         246         20

```

2	486	1420	12
3	107	1963	18
4	768	1786	5

```
In [34]: reader=Reader()
```

```
In [35]: data= Dataset.load_from_df(df[['customer_code','item_code','quantity']],reader)
```

In a lot of E-Commerce's the recommender systems have as a base, the ratings given by the customers. We don't have the ratings here, but, when the companys don't have a ratings systems, they can exchange that for a quantity of items purchased or even by a number of views in a E-Commerce website.

We will run a cross validation with the widely known SVD, or Singular Value decomposition, to verify the RMSE and MAE

```
In [36]: from surprise import SVD
         from surprise.model_selection import cross_validate
         from surprise import accuracy

         # Run 5-fold cross-validation and print results
         cross_validate(SVD(), data, measures=['RMSE', 'MAE'], cv=5, verbose=True)
```

Evaluating RMSE, MAE of algorithm SVD on 5 split(s).

	Fold 1	Fold 2	Fold 3	Fold 4	Fold 5	Mean	Std
MAE (testset)	9.8774	9.5644	9.6489	9.0412	9.5457	9.5355	0.2739
RMSE (testset)	60.8896	53.1756	59.8363	46.0989	47.2457	53.4492	6.1439
Fit time	15.33	14.97	15.07	14.02	14.13	14.70	0.53
Test time	0.77	0.55	0.31	0.52	0.53	0.54	0.14

```
Out[36]: {'fit_time': (15.333637475967407,
                      14.965435266494751,
                      15.067651987075806,
                      14.020308256149292,
                      14.129225492477417),
          'test_mae': array([ 9.87736634,  9.56444749,  9.64892628,  9.0411887 ,  9.54572582]),
          'test_rmse': array([ 60.88958052,  53.17555346,  59.83627076,  46.09888744,  47.24568144]),
          'test_time': (0.7675597667694092,
                      0.5536813735961914,
                      0.31467223167419434,
                      0.5155928134918213,
                      0.5312130451202393)}
```

We will run a GridSearch to achieve the best parameters in the SVD algorithm

```
In [38]: from surprise.model_selection import GridSearchCV

         param_grid = {'n_epochs': [3, 30], 'lr_all': [0.001, 0.006],
```

```

        'reg_all': [0.2, 0.6]}
gs = GridSearchCV(SVD, param_grid, measures=['rmse', 'mae'], cv=5)

gs.fit(data)

# best RMSE score
print(gs.best_score['mae'])

# combination of parameters that gave the best RMSE score
print(gs.best_params['mae'])

9.53553368406
{'reg_all': 0.2, 'lr_all': 0.001, 'n_epochs': 3}

```

Now, we will run a function to get the top 7 recommendation items for the users.

```

In [40]: from collections import defaultdict

def get_top_n(predictions, n=7):

    # First map the predictions to each user.
    top_n = defaultdict(list)
    for uid, iid, true_r, est, _ in predictions:
        top_n[uid].append((iid, est))

    # Then sort the predictions for each user and retrieve the k highest ones.
    for uid, user_ratings in top_n.items():
        user_ratings.sort(key=lambda x: x[1], reverse=True)
        top_n[uid] = user_ratings[:n]

    return top_n


# First train an SVD algorithm on the movielens dataset.
data= Dataset.load_from_df(df[['customer_code', 'item_code', 'quantity']], reader)
trainset = data.build_full_trainset()
algo = SVD()
algo.fit(trainset)

# Then predict ratings for all pairs (u, i) that are NOT in the training set.
testset = trainset.build_anti_testset()
predictions = algo.test(testset)

top_n = get_top_n(predictions, n=7)

# Print the recommended items for each user

```

```

for uid, user_ratings in top_n.items():
    print(uid, [iid for (iid, _) in user_ratings])

```

0 [854, 1420, 1786, 2854, 1842, 410, 713]
1 [854, 1420, 1963, 1786, 2854, 1962, 2843]
2 [854, 1420, 1963, 1786, 2854, 1842, 410]
3 [854, 2854, 410, 713, 1389, 667, 1591]
4 [2854, 1962, 2843, 713, 2845, 1389, 538]
5 [854, 2854, 1842, 410, 1962, 713, 1389]
6 [2854, 2843, 713, 2845, 1389, 538, 2127]
7 [1420, 2854, 410, 1962, 2843, 713, 2845]
8 [1963, 410, 1962, 713, 1389, 2127, 1548]
9 [854, 2854, 410, 713, 2845, 1389, 667]
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Now, we have the list of the 7 recommended items for each user.

Question 4- 2 I would love to have more time to test and develop more the system. I could use some framework like the Apache Spark, who have a recommender system module, to became able to perform with a big dataset that could not fit in memory. I could serialize the system, i could make a API. The Dataset have a lot of possible things to do, and that is the beauty of the Machine Learning, we can make a lot of things, and help in a lot of ways.