

machine-learning-assignment-6

December 6, 2023

Q1.Illustrate apriori algorithm with an example transactions.

Ans= The Apriori algorithm is a method for finding frequent itemsets in transactional datasets. The steps taken in the example of Apriori algorithm with movie purchase transactions:

Given Transactions: - Transaction 1: Comedy, Action, Drama - Transaction 2: Comedy, Drama - Transaction 3: Action, Drama - Transaction 4: Comedy, Romance - Transaction 5: Action, Romance

Steps of Apriori Algorithm:

Step 1: Identify Unique Items and Counts: - Unique items in transactions: Comedy, Action, Drama, Romance - Counts: - Comedy: 3 - Action: 3 - Drama: 4 - Romance: 2

Step 2: Set Minimum Support Threshold: Assume the minimum support is 2.

Step 3: Generate Frequent Itemsets of Length 1: - {Comedy}, {Action}, {Drama}

Step 4: Generate Frequent Itemsets of Length 2: - Possible combinations: {Comedy, Action}, {Comedy, Drama}, {Action, Drama} - Counts: - {Comedy, Action}: 1 - {Comedy, Drama}: 2 - {Action, Drama}: 2

Step 5: Generate Frequent Itemsets of Length 3: - No length 3 itemsets meet the minimum support threshold.

Frequent Itemsets Obtained (Minimum Support = 2): - {Comedy} - {Action} - {Drama} - {Comedy, Drama} - {Action, Drama}

These frequent itemsets represent combinations of movie genres that appear frequently in the transactions with a count above the specified minimum support threshold.

Q2.What is the difference between KNN and KMeans

Ans=

K-Nearest Neighbors (KNN) and K-Means are both machine learning algorithms, but they serve different purposes and belong to different categories of algorithms:

a)Purpose:

KNN: Used for classification and regression tasks with labeled data.

K-Means: Used for clustering unlabeled data into distinct groups based on similarity.

b)Learning Type:

KNN: Supervised learning.

K-Means: Unsupervised learning.

c)Data Requirement:

KNN: Requires labeled data for training.

K-Means: Works on unlabeled data; no need for explicit target labels.

d)Operation:

KNN: Predicts based on similarity to neighboring data points.

K-Means: Clusters data by minimizing distances to centroids iteratively.

Q3.Apply apriori algorithm and find associations rules for the datasets:bread_basket and retail_basket.

Ans= i)Using bread_basket

```
[2]: import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
```

```
[3]: df=pd.read_csv('bread_basket.csv')
df.head()
```

```
[3]:
```

	Transaction	Item	date_time	period_day	weekday_weekend
0	1	Bread	30-10-2016 09:58	morning	weekend
1	2	Scandinavian	30-10-2016 10:05	morning	weekend
2	2	Scandinavian	30-10-2016 10:05	morning	weekend
3	3	Hot chocolate	30-10-2016 10:07	morning	weekend
4	3	Jam	30-10-2016 10:07	morning	weekend

```
[4]: #converting date time columns into format of pandas
df['date_time']=pd.to_datetime(df['date_time'])
df.head()
```

```
[4]:
```

	Transaction	Item	date_time	period_day	weekday_weekend
0	1	Bread	2016-10-30 09:58:00	morning	weekend
1	2	Scandinavian	2016-10-30 10:05:00	morning	weekend
2	2	Scandinavian	2016-10-30 10:05:00	morning	weekend
3	3	Hot chocolate	2016-10-30 10:07:00	morning	weekend
4	3	Jam	2016-10-30 10:07:00	morning	weekend

```
[5]: #Extracting time
df['time']=df['date_time'].dt.time
df.head()
```

```
[5]:
```

	Transaction	Item	date_time	period_day	weekday_weekend	\
0	1	Bread	2016-10-30 09:58:00	morning	weekend	
1	2	Scandinavian	2016-10-30 10:05:00	morning	weekend	
2	2	Scandinavian	2016-10-30 10:05:00	morning	weekend	

3	3	Hot chocolate	2016-10-30 10:07:00	morning	weekend
4	3	Jam	2016-10-30 10:07:00	morning	weekend

	time
0	09:58:00
1	10:05:00
2	10:05:00
3	10:07:00
4	10:07:00

```
[6]: #Extracting month
df['month']=df['date_time'].dt.month
df.head()
```

```
[6]: Transaction      Item      date_time period_day weekday_weekend \
0          1      Bread 2016-10-30 09:58:00    morning    weekend
1          2  Scandinavian 2016-10-30 10:05:00    morning    weekend
2          2  Scandinavian 2016-10-30 10:05:00    morning    weekend
3          3  Hot chocolate 2016-10-30 10:07:00    morning    weekend
4          3          Jam 2016-10-30 10:07:00    morning    weekend
```

	time	month
0	09:58:00	10
1	10:05:00	10
2	10:05:00	10
3	10:07:00	10
4	10:07:00	10

```
[7]: #Extracting the hours
df['hour']=df['date_time'].dt.hour
df.head()
```

```
[7]: Transaction      Item      date_time period_day weekday_weekend \
0          1      Bread 2016-10-30 09:58:00    morning    weekend
1          2  Scandinavian 2016-10-30 10:05:00    morning    weekend
2          2  Scandinavian 2016-10-30 10:05:00    morning    weekend
3          3  Hot chocolate 2016-10-30 10:07:00    morning    weekend
4          3          Jam 2016-10-30 10:07:00    morning    weekend
```

	time	month	hour
0	09:58:00	10	9
1	10:05:00	10	10
2	10:05:00	10	10
3	10:07:00	10	10
4	10:07:00	10	10

```
[8]: hour_obj=('1-2','2-3','3-4','4-5','5-6','6-7','7-8','8-9','9-10','10-11','11-12','12-13','13-14')
hour_num=(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23)
```

```
[9]: df['hour']=df['hour'].replace(hour_num,hour_obj)
```

```
[10]: df.drop('date_time',axis=1,inplace=True)
```

```
[11]: #Cleaning the item column
df['Item']=df['Item'].str.strip()
df['Item']=df['Item'].str.lower()
df.head()
```

```
[11]: Transaction      Item period_day weekday_weekend      time  month \
0           1      bread    morning          weekend  09:58:00     10
1           2  scandinavian    morning          weekend  10:05:00     10
2           2  scandinavian    morning          weekend  10:05:00     10
3           3 hot chocolate    morning          weekend  10:07:00     10
4           3      jam        morning          weekend  10:07:00     10

      hour
0    9-10
1   10-11
2   10-11
3   10-11
4   10-11
```

```
[12]: #Take necessary libraries
from mlxtend.frequent_patterns import association_rules,apriori

transaction_str=df.groupby(['Transaction','Item'])['Item'].count().
↳reset_index(name='count')
transaction_str
```

```
[12]: Transaction      Item  count
0           1      bread      1
1           2  scandinavian      2
2           3      cookies      1
3           3 hot chocolate      1
4           3      jam        1
...         ...         ...
18882      9682  tacos/fajita      1
18883      9682      tea        1
18884      9683      coffee      1
18885      9683      pastry      1
18886      9684  smoothies      1
```

```
[18887 rows x 3 columns]
```

```
[13]: my_basket=transaction_str.  
      ↪pivot_table(index='Transaction',columns='Item',values='count').fillna(0)  
      my_basket
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:  
DeprecationWarning: `should_run_async` will not call `transform_cell`  
automatically in the future. Please pass the result to `transformed_cell`  
argument and any exception that happen during thetransform in  
`preprocessing_exc_tuple` in IPython 7.17 and above.  
and should_run_async(code)
```

```
[13]: Item          adjustment  afternoon with the baker  alfajores  argentina night  \  
Transaction  
1              0.0              0.0          0.0          0.0  
2              0.0              0.0          0.0          0.0  
3              0.0              0.0          0.0          0.0  
4              0.0              0.0          0.0          0.0  
5              0.0              0.0          0.0          0.0  
...          ...          ...          ...          ...  
9680          0.0              0.0          0.0          0.0  
9681          0.0              0.0          0.0          0.0  
9682          0.0              0.0          0.0          0.0  
9683          0.0              0.0          0.0          0.0  
9684          0.0              0.0          0.0          0.0
```

```
Item          art tray  bacon  baguette  bakewell  bare popcorn  basket  ...  \  
Transaction  
1              0.0    0.0    0.0    0.0          0.0    0.0  ...  
2              0.0    0.0    0.0    0.0          0.0    0.0  ...  
3              0.0    0.0    0.0    0.0          0.0    0.0  ...  
4              0.0    0.0    0.0    0.0          0.0    0.0  ...  
5              0.0    0.0    0.0    0.0          0.0    0.0  ...  
...          ...    ...    ...    ...    ...    ...  
9680          0.0    0.0    0.0    0.0          0.0    0.0  ...  
9681          0.0    0.0    0.0    0.0          0.0    0.0  ...  
9682          0.0    0.0    0.0    0.0          0.0    0.0  ...  
9683          0.0    0.0    0.0    0.0          0.0    0.0  ...  
9684          0.0    0.0    0.0    0.0          0.0    0.0  ...
```

```
Item          the bart  the nomad  tiffin  toast  truffles  tshirt  \  
Transaction  
1              0.0          0.0    0.0    0.0          0.0    0.0  
2              0.0          0.0    0.0    0.0          0.0    0.0  
3              0.0          0.0    0.0    0.0          0.0    0.0  
4              0.0          0.0    0.0    0.0          0.0    0.0  
5              0.0          0.0    0.0    0.0          0.0    0.0  
...          ...          ...    ...    ...    ...    ...
```

9680	0.0	0.0	0.0	0.0	0.0	0.0
9681	0.0	0.0	0.0	0.0	1.0	0.0
9682	0.0	0.0	0.0	0.0	0.0	0.0
9683	0.0	0.0	0.0	0.0	0.0	0.0
9684	0.0	0.0	0.0	0.0	0.0	0.0

Item	valentine's card	vegan feast	vegan mincepie	victorian sponge
Transaction				
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
...
9680	0.0	0.0	0.0	0.0
9681	0.0	0.0	0.0	0.0
9682	0.0	0.0	0.0	0.0
9683	0.0	0.0	0.0	0.0
9684	0.0	0.0	0.0	0.0

[9465 rows x 94 columns]

```
[14]: def encode1(x):
      if x<=0:
          return 0
      if x>=1:
          return 1
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)
```

```
[15]: my_new_basket=my_basket.applymap(encode1)
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)
```

```
[16]: my_new_basket
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
```

automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during the transform in `preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```
[16]: Item          adjustment  afternoon with the baker  alfajores  argentina night  \
Transaction
1              0              0              0              0
2              0              0              0              0
3              0              0              0              0
4              0              0              0              0
5              0              0              0              0
...
9680          ...              ...              ...              ...
9681          0              0              0              0
9682          0              0              0              0
9683          0              0              0              0
9684          0              0              0              0
```

```
Item          art tray  bacon  baguette  bakewell  bare popcorn  basket  ...  \
Transaction
1              0        0        0        0              0        0  ...
2              0        0        0        0              0        0  ...
3              0        0        0        0              0        0  ...
4              0        0        0        0              0        0  ...
5              0        0        0        0              0        0  ...
...
9680          ...      ...      ...      ...      ...      ...
9681          0        0        0        0              0        0  ...
9682          0        0        0        0              0        0  ...
9683          0        0        0        0              0        0  ...
9684          0        0        0        0              0        0  ...
```

```
Item          the bart  the nomad  tiffin  toast  truffles  tshirt  \
Transaction
1              0        0        0        0              0        0
2              0        0        0        0              0        0
3              0        0        0        0              0        0
4              0        0        0        0              0        0
5              0        0        0        0              0        0
...
9680          ...      ...      ...      ...      ...      ...
9681          0        0        0        0              1        0
9682          0        0        0        0              0        0
9683          0        0        0        0              0        0
9684          0        0        0        0              0        0
```

Item Transaction	valentine's card	vegan feast	vegan mincepie	victorian sponge
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
...
9680	0	0	0	0
9681	0	0	0	0
9682	0	0	0	0
9683	0	0	0	0
9684	0	0	0	0

[9465 rows x 94 columns]

```
[17]: large_dataset=apriori(my_new_basket,min_support=0.01,use_colnames=True)
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
    and should_run_async(code)
/usr/local/lib/python3.10/dist-
packages/mlxtend/frequent_patterns/fpcommon.py:110: DeprecationWarning:
DataFrames with non-bool types result in worse computationalperformance and
their support might be discontinued in the future.Please use a DataFrame with
bool type
    warnings.warn(
```

```
[18]: large_dataset
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
    and should_run_async(code)
```

```
[18]:      support      itemsets
0  0.036344      (alfajores)
1  0.016059      (baguette)
2  0.327205      (bread)
3  0.040042      (brownie)
4  0.103856      (cake)
..      ...      ...
```



```

56 0.023666      (toast, coffee)
57 0.014369      (tea, sandwich)
58 0.010037      (cake, coffee, bread)
59 0.011199      (coffee, pastry, bread)
60 0.010037      (cake, coffee, tea)

```

[61 rows x 2 columns]

```
[19]: rules=association_rules(large_dataset,min_threshold=1,metric="lift")
      rules
```

```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```

```

[19]: antecedents      consequents  antecedent support \
0      (coffee)      (alfajores)      0.478394
1      (alfajores)      (coffee)      0.036344
2      (pastry)      (bread)      0.086107
3      (bread)      (pastry)      0.327205
4      (brownie)      (coffee)      0.040042
5      (coffee)      (brownie)      0.478394
6      (cake)      (coffee)      0.103856
7      (coffee)      (cake)      0.478394
8      (cake)      (hot chocolate)      0.103856
9      (hot chocolate)      (cake)      0.058320
10     (cake)      (tea)      0.103856
11     (tea)      (cake)      0.142631
12     (coffee)      (cookies)      0.478394
13     (cookies)      (coffee)      0.054411
14     (coffee)      (hot chocolate)      0.478394
15     (hot chocolate)      (coffee)      0.058320
16     (coffee)      (juice)      0.478394
17     (juice)      (coffee)      0.038563
18     (medialuna)      (coffee)      0.061807
19     (coffee)      (medialuna)      0.478394
20     (muffin)      (coffee)      0.038457
21     (coffee)      (muffin)      0.478394
22     (pastry)      (coffee)      0.086107
23     (coffee)      (pastry)      0.478394
24     (coffee)      (sandwich)      0.478394
25     (sandwich)      (coffee)      0.071844
26     (scone)      (coffee)      0.034548
27     (coffee)      (scone)      0.478394

```

28	(coffee)	(spanish brunch)	0.478394
29	(spanish brunch)	(coffee)	0.018172
30	(toast)	(coffee)	0.033597
31	(coffee)	(toast)	0.478394
32	(tea)	(sandwich)	0.142631
33	(sandwich)	(tea)	0.071844
34	(coffee, bread)	(cake)	0.090016
35	(cake)	(coffee, bread)	0.103856
36	(coffee, bread)	(pastry)	0.090016
37	(pastry)	(coffee, bread)	0.086107
38	(cake, coffee)	(tea)	0.054728
39	(tea, coffee)	(cake)	0.049868
40	(cake)	(tea, coffee)	0.103856
41	(tea)	(cake, coffee)	0.142631

	consequent	support	support	confidence	lift	leverage	conviction \
0		0.036344	0.019651	0.041078	1.130235	0.002264	1.004936
1		0.478394	0.019651	0.540698	1.130235	0.002264	1.135648
2		0.327205	0.029160	0.338650	1.034977	0.000985	1.017305
3		0.086107	0.029160	0.089119	1.034977	0.000985	1.003306
4		0.478394	0.019651	0.490765	1.025860	0.000495	1.024293
5		0.040042	0.019651	0.041078	1.025860	0.000495	1.001080
6		0.478394	0.054728	0.526958	1.101515	0.005044	1.102664
7		0.103856	0.054728	0.114399	1.101515	0.005044	1.011905
8		0.058320	0.011410	0.109868	1.883874	0.005354	1.057910
9		0.103856	0.011410	0.195652	1.883874	0.005354	1.114125
10		0.142631	0.023772	0.228891	1.604781	0.008959	1.111865
11		0.103856	0.023772	0.166667	1.604781	0.008959	1.075372
12		0.054411	0.028209	0.058966	1.083723	0.002179	1.004841
13		0.478394	0.028209	0.518447	1.083723	0.002179	1.083174
14		0.058320	0.029583	0.061837	1.060311	0.001683	1.003749
15		0.478394	0.029583	0.507246	1.060311	0.001683	1.058553
16		0.038563	0.020602	0.043065	1.116750	0.002154	1.004705
17		0.478394	0.020602	0.534247	1.116750	0.002154	1.119919
18		0.478394	0.035182	0.569231	1.189878	0.005614	1.210871
19		0.061807	0.035182	0.073542	1.189878	0.005614	1.012667
20		0.478394	0.018806	0.489011	1.022193	0.000408	1.020777
21		0.038457	0.018806	0.039311	1.022193	0.000408	1.000888
22		0.478394	0.047544	0.552147	1.154168	0.006351	1.164682
23		0.086107	0.047544	0.099382	1.154168	0.006351	1.014740
24		0.071844	0.038246	0.079947	1.112792	0.003877	1.008807
25		0.478394	0.038246	0.532353	1.112792	0.003877	1.115384
26		0.478394	0.018067	0.522936	1.093107	0.001539	1.093366
27		0.034548	0.018067	0.037765	1.093107	0.001539	1.003343
28		0.018172	0.010882	0.022747	1.251766	0.002189	1.004682
29		0.478394	0.010882	0.598837	1.251766	0.002189	1.300235
30		0.478394	0.023666	0.704403	1.472431	0.007593	1.764582

31	0.033597	0.023666	0.049470	1.472431	0.007593	1.016699
32	0.071844	0.014369	0.100741	1.402222	0.004122	1.032134
33	0.142631	0.014369	0.200000	1.402222	0.004122	1.071712
34	0.103856	0.010037	0.111502	1.073621	0.000688	1.008606
35	0.090016	0.010037	0.096643	1.073621	0.000688	1.007336
36	0.086107	0.011199	0.124413	1.444872	0.003448	1.043749
37	0.090016	0.011199	0.130061	1.444872	0.003448	1.046033
38	0.142631	0.010037	0.183398	1.285822	0.002231	1.049923
39	0.103856	0.010037	0.201271	1.937977	0.004858	1.121962
40	0.049868	0.010037	0.096643	1.937977	0.004858	1.051779
41	0.054728	0.010037	0.070370	1.285822	0.002231	1.016827

zhangs_metric

0	0.220910
1	0.119574
2	0.036980
3	0.050231
4	0.026259
5	0.048327
6	0.102840
7	0.176684
8	0.523553
9	0.498236
10	0.420538
11	0.439556
12	0.148110
13	0.081700
14	0.109048
15	0.060403
16	0.200428
17	0.108738
18	0.170091
19	0.305936
20	0.022579
21	0.041623
22	0.146161
23	0.256084
24	0.194321
25	0.109205
26	0.088224
27	0.163296
28	0.385594
29	0.204851
30	0.332006
31	0.615122
32	0.334566
33	0.309050

```

34      0.075356
35      0.076520
36      0.338354
37      0.336907
38      0.235157
39      0.509401
40      0.540090
41      0.259266

```

ii) Using reatail_dataset

```

[20]: import pandas as pd
import numpy as np
from mlxtend.preprocessing import TransactionEncoder
from mlxtend.frequent_patterns import apriori, association_rules
import matplotlib.pyplot as plt
import seaborn as sns

```

```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```

```

[21]: df = pd.read_csv('retail_dataset.csv')
df.head()

```

```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```

```

[21]:
      0      1      2      3      4      5      6
0  Bread  Wine  Eggs  Meat  Cheese  Pencil  Diaper
1  Bread  Cheese  Meat  Diaper  Wine  Milk  Pencil
2  Cheese  Meat  Eggs  Milk  Wine  NaN  NaN
3  Cheese  Meat  Eggs  Milk  Wine  NaN  NaN
4  Meat  Pencil  Wine  NaN  NaN  NaN  NaN

```

```

[23]: df.fillna('!',inplace=True)
trans = df.values.tolist()
trans

```

```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`

```

automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during the transform in `preprocessing_exc_tuple` in IPython 7.17 and above.

```
and should_run_async(code)
```

```
[23]: [['Bread', 'Wine', 'Eggs', 'Meat', 'Cheese', 'Pencil', 'Diaper'],
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```

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['Eggs', 'Wine', 'Bagel', 'Bread', 'Meat', '!', '!']

```

```

[24]: for i in range(len(trans)):
      trans[i] = [x for x in trans[i] if not x=='!']
      trans

```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during the transform in

`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```
[24]: [['Bread', 'Wine', 'Eggs', 'Meat', 'Cheese', 'Pencil', 'Diaper'],
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```

```

[25]: from mlxtend.preprocessing import TransactionEncoder
te = TransactionEncoder()
te_ary = te.fit(trans).transform(trans)
transactions = pd.DataFrame(te_ary, columns=te.columns_)
transactions

```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during the transform in

```
`preprocessing_exc_tuple` in IPython 7.17 and above.  
and should_run_async(code)
```

```
[25]:      Bagel  Bread  Cheese  Diaper  Eggs  Meat  Milk  Pencil  Wine  
0      False  True    True    True   True  True  False   True   True  
1      False  True    True    True  False  True  True    True   True  
2      False  False   True   False  True  True  True    False  True  
3      False  False   True   False  True  True  True    False  True  
4      False  False  False   False  False False  True  False   True   True  
..  
310     False  True    True   False  True  False False  False  False  
311     False  False  False   False  False True  True   True  False  
312     False  True    True    True  True  True  False  True   True  
313     False  False   True   False  False True  False False  False  
314      True  True    False  False  True  True  False False  True  
  
[315 rows x 9 columns]
```

Q4.Implement K-means algorithm with PCA and without PCA on mall_customers dataset.

```
[46]: import pandas as pd  
import matplotlib.pyplot as plt  
from sklearn.cluster import KMeans  
from sklearn.decomposition import PCA  
from sklearn.preprocessing import StandardScaler
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:  
DeprecationWarning: `should_run_async` will not call `transform_cell`  
automatically in the future. Please pass the result to `transformed_cell`  
argument and any exception that happen during thetransform in  
`preprocessing_exc_tuple` in IPython 7.17 and above.  
and should_run_async(code)
```

```
[47]: df=pd.read_csv('Mall_Customers.csv')  
df.head()
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:  
DeprecationWarning: `should_run_async` will not call `transform_cell`  
automatically in the future. Please pass the result to `transformed_cell`  
argument and any exception that happen during thetransform in  
`preprocessing_exc_tuple` in IPython 7.17 and above.  
and should_run_async(code)
```

```
[47]:      CustomerID  Genre  Age  Annual Income (k$)  Spending Score (1-100)  
0              1   Male   19                15                39  
1              2   Male   21                15                81  
2              3  Female   20                16                 6
```

3	4	Female	23	16	77
4	5	Female	31	17	40

```
[48]: X = df[['Age', 'Annual Income (k$)', 'Spending Score (1-100)']]
```

```
# Standardize the data
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
    and should_run_async(code)
```

```
[50]: # K-means without PCA
kmeans = KMeans(n_clusters=3, random_state=42)
kmeans.fit(X_scaled)
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
    and should_run_async(code)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
    warnings.warn(
```

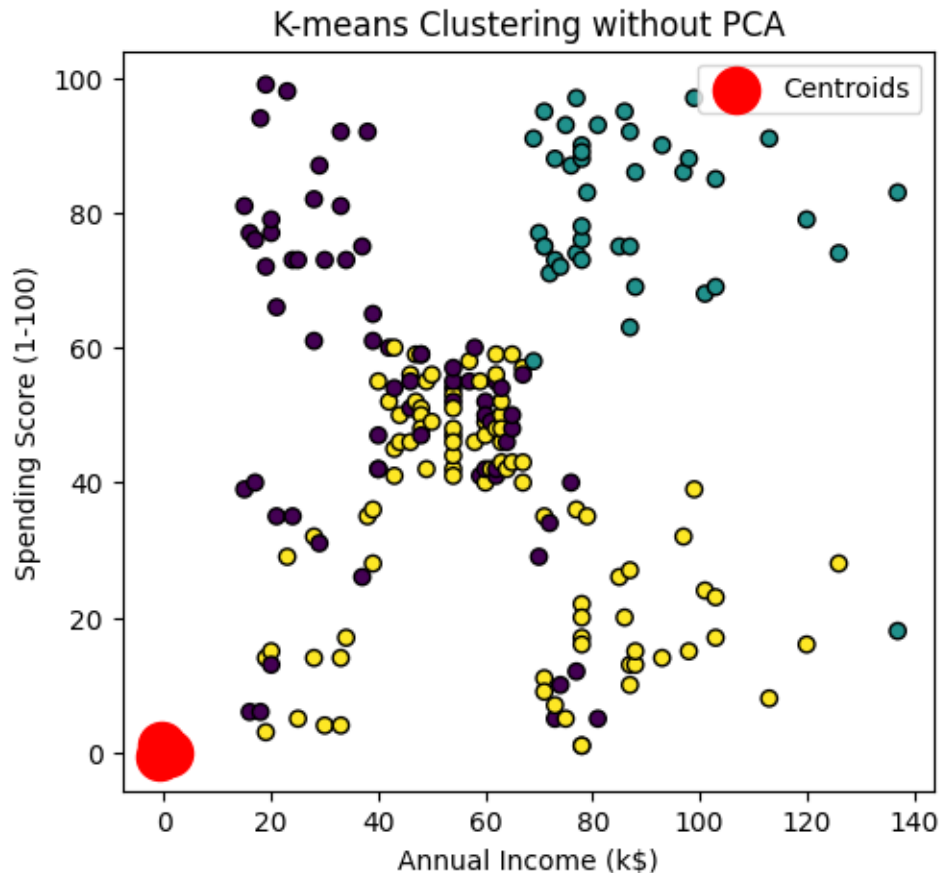
```
[50]: KMeans(n_clusters=3, random_state=42)
```

```
[51]: # Without PCA visualization
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.scatter(X['Annual Income (k$)'], X['Spending Score (1-100)'], c=kmeans.
    ↪labels_, cmap='viridis', edgecolor='k')
plt.title('K-means Clustering without PCA')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.scatter(kmeans.cluster_centers_[0], kmeans.cluster_centers_[1],
    ↪s=300, c='red', label='Centroids')
plt.legend()
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
```

argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

[51]: <matplotlib.legend.Legend at 0x78724985fbb0>



```
[52]: #K-means with PCA
pca = PCA(n_components=2)
X_pca = pca.fit_transform(X_scaled)
kmeans_pca = KMeans(n_clusters=3, random_state=42)
kmeans_pca.fit(X_pca)
```

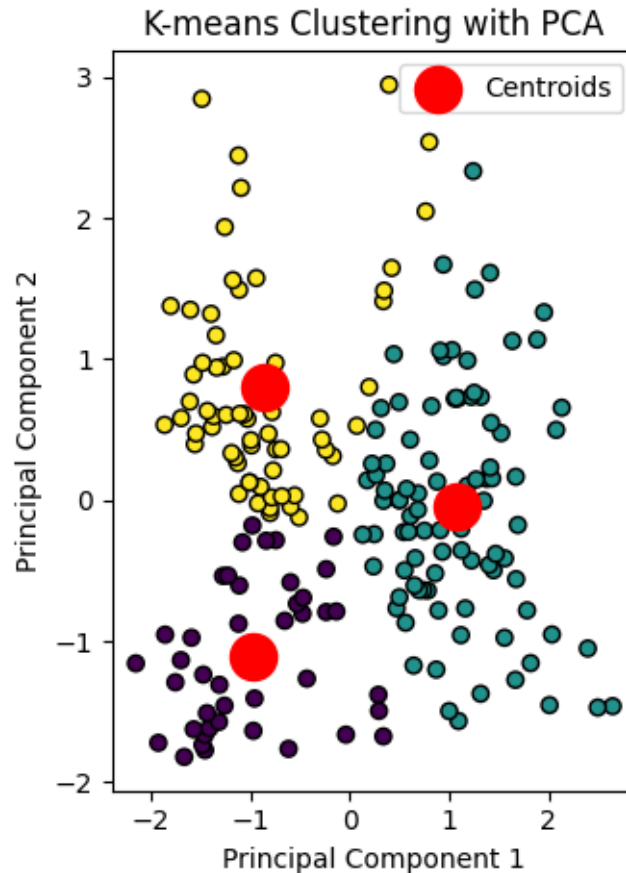
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in

1.4. Set the value of ``n_init`` explicitly to suppress the warning
`warnings.warn(`

```
[52]: KMeans(n_clusters=3, random_state=42)
```

```
[53]: # with PCA visualization
plt.subplot(1, 2, 2)
plt.scatter(X_pca[:, 0], X_pca[:, 1], c=kmeans_pca.labels_, cmap='viridis',
            edgecolor='k')
plt.title('K-means Clustering with PCA')
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.scatter(kmeans_pca.cluster_centers_[0], kmeans_pca.cluster_centers_[1],
            s=300, c='red', label='Centroids')
plt.legend()
plt.tight_layout()
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during the transform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)
```



Q5. Implement different types of anomaly detection methods on your favourite datasets.

```
[54]: from sklearn.datasets import load_iris
      from sklearn.ensemble import IsolationForest
      from sklearn.neighbors import LocalOutlierFactor
      import matplotlib.pyplot as plt
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
    and should_run_async(code)
```

```
[61]: iris = load_iris()
      X, y = iris.data, iris.target
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
```

automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during the transform in `preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```
[56]: # Isolation Forest for anomaly detection
iso_forest = IsolationForest(contamination=0.1, random_state=42)
iso_forest.fit(X)
```

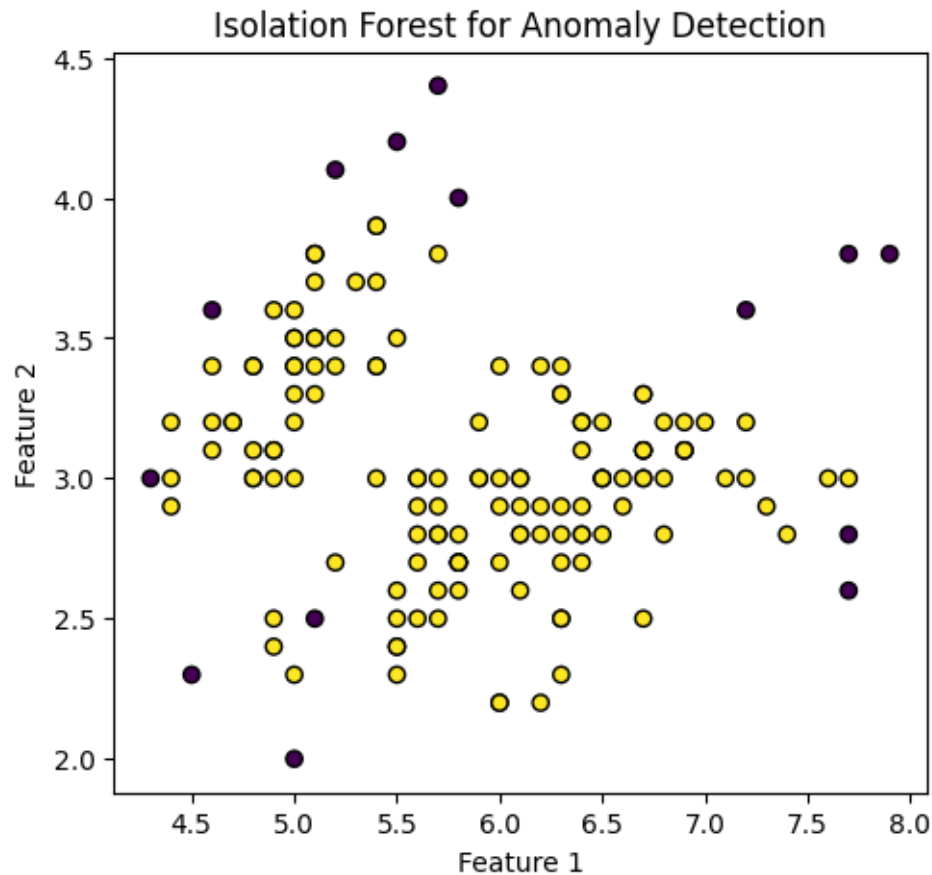
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during the transform in `preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```
[56]: IsolationForest(contamination=0.1, random_state=42)
```

```
[57]: # Plotting the results for Isolation Forest
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.scatter(X[:, 0], X[:, 1], c=iso_forest.predict(X), cmap='viridis',
            edgecolor='k')
plt.title('Isolation Forest for Anomaly Detection')
plt.xlabel('Feature 1')
plt.ylabel('Feature 2')
```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during the transform in `preprocessing_exc_tuple` in IPython 7.17 and above.
and should_run_async(code)

```
[57]: Text(0, 0.5, 'Feature 2')
```

```
[58]: # Local Outlier Factor (LOF) for anomaly detection
lof = LocalOutlierFactor(n_neighbors=20, contamination=0.1)
outliers_lof = lof.fit_predict(X)
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:
DeprecationWarning: `should_run_async` will not call `transform_cell`
automatically in the future. Please pass the result to `transformed_cell`
argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
    and should_run_async(code)
```

```
[62]: # Plotting the results for Local Outlier Factor (LOF)
plt.subplot(1, 2, 2)
plt.scatter(X[:, 0], X[:, 1], c=outliers_lof, cmap='viridis', edgecolor='k')
plt.title('Local Outlier Factor (LOF) for Anomaly Detection')
plt.xlabel('Feature 1')
plt.ylabel('Feature 2')

plt.tight_layout()
```

```
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283:  
DeprecationWarning: `should_run_async` will not call `transform_cell`  
automatically in the future. Please pass the result to `transformed_cell`  
argument and any exception that happen during the transform in  
`preprocessing_exc_tuple` in IPython 7.17 and above.  
and should_run_async(code)
```

Local Outlier Factor (LOF) for Anomaly Detection

