APSSDC

Andhra Pradesh State Skill Development Corporation

(https://apssdc.in)

K-Means Clustering

Introduction

There are many models for **clustering** out there. In this notebook, we will be presenting the model that is considered one of the simplest models amongst them. Despite its simplicity, the **K-means** is vastly used for clustering in many data science applications, especially useful if you need to quickly discover insights from **unlabeled data**. In this notebook, you will learn how to use k-Means for customer segmentation.

Some real-world applications of k-means:

- Customer segmentation
- Understand what the visitors of a website are trying to accomplish
- Pattern recognition
- Machine learning
- Data compression

Using k-means for customer segmentation

In [4]:

```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
```

In [5]:

```
df = pd.read_csv('https://raw.githubusercontent.com/AP-State-Skill-Development-Corporation/
df.head()
```

Out[5]:

	Customer Id	Age	Edu	Years Employed	Income	Card Debt	Other Debt	Defaulted	Address	DebtIncomeRati
0	1	41	2	6	19	0.124	1.073	0.0	NBA001	6.
1	2	47	1	26	100	4.582	8.218	0.0	NBA021	12.
2	3	33	2	10	57	6.111	5.802	1.0	NBA013	20.
3	4	29	2	4	19	0.681	0.516	0.0	NBA009	6.
4	5	47	1	31	253	9.308	8.908	0.0	NBA008	7.

In [6]:

```
df.columns
```

Out[6]:

```
Index(['Customer Id', 'Age', 'Edu', 'Years Employed', 'Income', 'Card Debt',
       'Other Debt', 'Defaulted', 'Address', 'DebtIncomeRatio'],
      dtype='object')
```

Pre-processing

As you can see, **Address**, **Customer Id** in this dataset is a categorical variable. k-means algorithm isn't directly applicable to categorical variables because Euclidean distance function isn't really meaningful for discrete variables. So, lets drop this feature and run clustering.

In [7]:

```
df.drop(['Customer Id', 'Address'], axis = 1, inplace = True)

df.head()
```

Out[7]:

	Age	Edu	Years Employed	Income	Card Debt	Other Debt	Defaulted	DebtIncomeRatio
0	41	2	6	19	0.124	1.073	0.0	6.3
1	47	1	26	100	4.582	8.218	0.0	12.8
2	33	2	10	57	6.111	5.802	1.0	20.9
3	29	2	4	19	0.681	0.516	0.0	6.3
4	47	1	31	253	9.308	8.908	0.0	7.2

In [8]:

```
df.isnull().sum()
```

Out[8]:

```
Age                  0
Edu                  0
Years Employed       0
Income               0
Card Debt            0
Other Debt           0
Defaulted          150
DebtIncomeRatio      0
dtype: int64
```

In [9]:

```
df.shape
```

Out[9]:

```
(850, 8)
```

In [10]:

```
df['Defaulted'].value_counts()
```

Out[10]:

```
0.0    517
1.0    183
Name: Defaulted, dtype: int64
```

mean,median value,contant value, mode values

In [11]:

```
df.fillna(0.0, inplace = True)
df1 = df.fillna(0.0)
df.isnull().sum()
```

Out[11]:

```
Age                0
Edu                0
Years Employed     0
Income             0
Card Debt          0
Other Debt         0
Defaulted          0
DebtIncomeRatio    0
dtype: int64
```

In [12]:

```
df.duplicated().sum()
```

Out[12]:

```
0
```

In [13]:

```
df.head()
```

Out[13]:

	Age	Edu	Years Employed	Income	Card Debt	Other Debt	Defaulted	DebtIncomeRatio
0	41	2	6	19	0.124	1.073	0.0	6.3
1	47	1	26	100	4.582	8.218	0.0	12.8
2	33	2	10	57	6.111	5.802	1.0	20.9
3	29	2	4	19	0.681	0.516	0.0	6.3
4	47	1	31	253	9.308	8.908	0.0	7.2

In [14]:

```
df['Income'].max()
```

Out[14]:

```
446
```

In [15]:

```
df['Edu'].max()
```

Out[15]:

```
5
```

In [16]:

```
df['Card Debt'].max()
```

Out[16]:

```
20.561
```

1cm, 5m, 100km

0.01m, 5m, 100000m

In [18]:

```
from sklearn.preprocessing import StandardScaler

ss = StandardScaler()

scaData = ss.fit_transform(df)

scaData
```

Out[18]:

```
array([[ 0.74291541,  0.31212243, -0.37878978, ..., -0.59048916,
        -0.52379654, -0.57652509],
       [ 1.48949049, -0.76634938,  2.5737211 , ...,  1.51296181,
        -0.52379654,  0.39138677],
       [-0.25251804,  0.31212243,  0.2117124 , ...,  0.80170393,
         1.90913822,  1.59755385],
       ...,
       [-1.24795149,  2.46906604, -1.26454304, ...,  0.03863257,
         1.90913822,  3.45892281],
       [-0.37694723, -0.76634938,  0.50696349, ..., -0.70147601,
        -0.52379654, -1.08281745],
       [ 2.1116364 , -0.76634938,  1.09746566, ...,  0.16463355,
        -0.52379654, -0.2340332 ]])
```

In [19]:

```
from sklearn.cluster import KMeans

model = KMeans(n_clusters = 3)

model.fit(scaData)
```

Out[19]:

```
KMeans(n_clusters=3)
```

In [20]:

```
model.predict(scaData)
```

Out[20]:

```
array([1, 0, 2, 1, 0, 0, 1, 1, 1, 0, 2, 1, 1, 1, 2, 1, 1, 1, 0, 1, 1, 1,
       2, 0, 0, 1, 1, 1, 1, 1, 1, 0, 2, 1, 1, 1, 2, 2, 1, 0, 2, 0, 1, 0,
       1, 0, 1, 1, 1, 1, 0, 0, 2, 1, 2, 2, 2, 1, 1, 1, 0, 1, 0, 0, 1, 1,
       1, 2, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 2, 0, 1, 0, 1, 1, 1,
       2, 2, 1, 1, 2, 2, 1, 1, 1, 1, 2, 1, 2, 0, 1, 2, 2, 0, 1, 1, 1, 1,
       1, 1, 1, 2, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 0, 1, 1, 2, 1, 1, 1, 0, 2, 1,
       1, 1, 1, 0, 2, 2, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 2, 1, 2,
       1, 1, 2, 0, 2, 1, 1, 0, 2, 0, 1, 1, 1, 1, 1, 0, 1, 2, 1, 1, 1, 0,
       0, 1, 0, 1, 2, 1, 1, 2, 1, 0, 1, 2, 1, 1, 1, 1, 1, 2, 2, 0, 1, 1,
       2, 0, 1, 1, 1, 1, 0, 1, 1, 2, 1, 1, 1, 1, 0, 1, 1, 2, 0, 1, 1, 1,
       1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 0, 2, 1, 2, 1, 1, 1, 0, 1, 2,
       0, 2, 1, 0, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 1, 1, 1, 0, 1, 1, 0, 1,
       0, 1, 1, 0, 1, 1, 1, 2, 1, 1, 2, 1, 2, 0, 1, 1, 1, 1, 2, 1, 1, 2,
       2, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2, 0, 1, 2, 1, 1, 1, 2, 2, 1, 1,
       1, 0, 2, 1, 1, 2, 1, 0, 1, 1, 1, 1, 1, 2, 0, 1, 1, 1, 1, 1, 0, 1,
       1, 1, 1, 1, 0, 1, 1, 1, 0, 2, 1, 2, 1, 1, 1, 0, 0, 1, 2, 1, 0, 2,
       2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 2, 1, 2, 1, 1,
       1, 0, 1, 1, 1, 1, 2, 1, 1, 2, 2, 0, 1, 1, 1, 1, 1, 2, 2, 1, 0, 2,
       0, 1, 1, 2, 1, 1, 0, 0, 1, 2, 1, 1, 0, 1, 2, 1, 0, 1, 1, 1, 0, 1,
       1, 1, 1, 0, 1, 2, 1, 1, 1, 1, 0, 2, 1, 1, 0, 1, 2, 1, 1, 0, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 2, 1, 1, 1, 2, 1, 2, 1, 1,
       1, 1, 1, 0, 2, 2, 1, 0, 1, 0, 1, 1, 2, 0, 1, 2, 2, 2, 0, 0, 2, 1,
       1, 2, 1, 2, 2, 1, 2, 0, 1, 1, 2, 1, 2, 0, 2, 1, 1, 2, 1, 1, 2, 2,
       2, 1, 1, 1, 0, 0, 1, 1, 2, 1, 1, 2, 0, 1, 2, 1, 1, 1, 2, 1, 0, 1,
       0, 0, 1, 0, 1, 1, 0, 1, 2, 1, 1, 1, 1, 2, 2, 1, 0, 1, 0, 1, 1, 0,
       1, 2, 1, 2, 1, 2, 2, 2, 0, 2, 1, 1, 1, 2, 1, 1, 1, 0, 1, 0, 1, 2,
       2, 1, 1, 1, 1, 1, 1, 1, 2, 0, 1, 0, 1, 1, 2, 1, 1, 1, 2, 1, 1, 2,
       2, 2, 2, 1, 0, 1, 2, 2, 1, 1, 1, 1, 0, 0, 1, 2, 1, 1, 0, 1, 1, 0,
       1, 0, 1, 1, 0, 2, 0, 0, 0, 2, 1, 1, 2, 1, 0, 0, 1, 1, 1, 0, 2, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 1, 2, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1,
       2, 0, 1, 1, 2, 1, 1, 1, 1, 2, 1, 0, 1, 1, 0, 1, 1, 2, 1, 2, 1, 2,
       2, 1, 1, 1, 0, 2, 0, 1, 0, 0, 1, 2, 1, 0, 1, 0, 1, 1, 1, 1, 1, 0,
       1, 2, 1, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 0, 1,
       1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 0, 2, 0, 0, 1, 1, 1, 2, 1, 1, 1, 2,
       2, 1, 2, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0,
       0, 2, 2, 1, 2, 1, 1, 1, 1, 0, 2, 1, 1, 1, 1, 1, 0, 2, 1, 1, 1, 2,
       1, 1, 2, 1, 1, 1, 1, 1, 1, 2, 2, 0, 0, 1, 1, 1, 2, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 0])
```

In [21]:

```
df['output'] = model.predict(scaData)

df.head()
```

Out[21]:

	Age	Edu	Years Employed	Income	Card Debt	Other Debt	Defaulted	DebtIncomeRatio	output
0	41	2	6	19	0.124	1.073	0.0	6.3	1
1	47	1	26	100	4.582	8.218	0.0	12.8	0
2	33	2	10	57	6.111	5.802	1.0	20.9	2
3	29	2	4	19	0.681	0.516	0.0	6.3	1
4	47	1	31	253	9.308	8.908	0.0	7.2	0

In [22]:

```
df.groupby('output').mean()
```

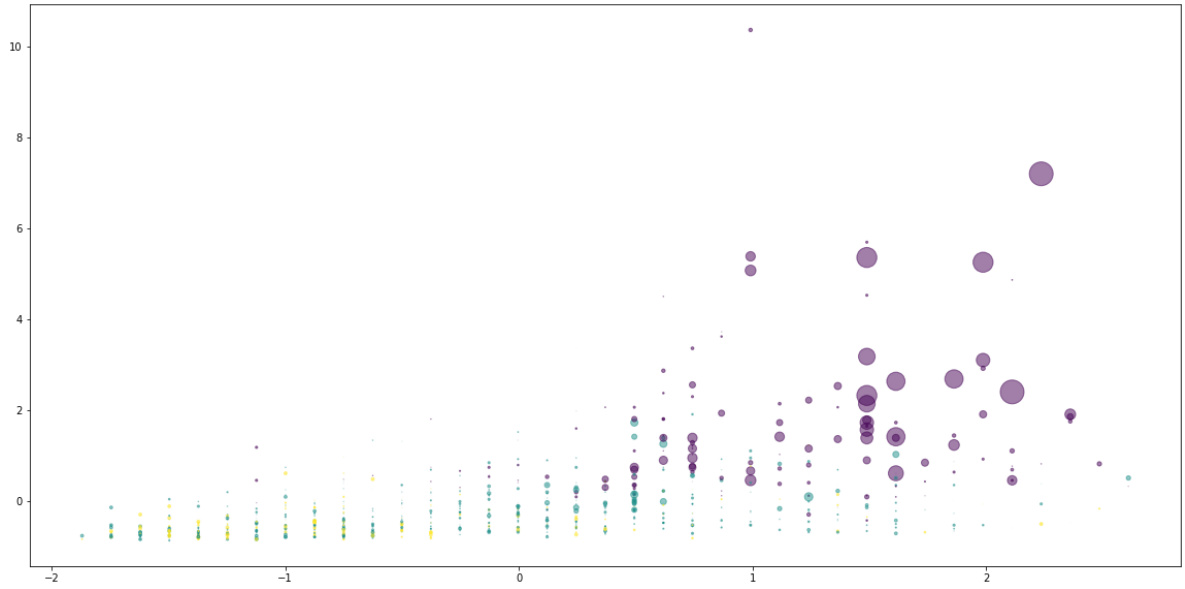
Out[22]:

output	Age	Edu	Years Employed	Income	Card Debt	Other Debt	Defaulted	DebtIncomeI
0	43.000000	1.931973	17.197279	101.959184	4.220673	7.954483	0.129252	13.91
1	33.817505	1.603352	7.625698	36.143389	0.853128	1.816855	0.000000	7.96
2	31.891566	1.861446	3.963855	31.789157	1.576675	2.843355	0.987952	13.99

In [23]:

```
import numpy as np
plt.figure(figsize = (20, 10))
shape = np.pi * (scaData[:, 2] ** 4) #pi * r ** 2
plt.scatter(scaData[:, 0], scaData[:, 3], s = shape,c = df['output'].astype('float'), alpha

plt.show()
```



In [24]:

```
from mpl_toolkits.mplot3d import Axes3D
fig = plt.figure(1, figsize=(8, 6))
plt.clf()
ax = Axes3D(fig, rect=[0, 0, .95, 1], elev=48, azim=134)

plt.cla()

ax.set_xlabel('Education')
ax.set_ylabel('Age')
ax.set_zlabel('Income')

ax.scatter(scaData[:, 1], scaData[:, 0], scaData[:, 3], c= df['output'].astype(np.float))
```

Out[24]:

```
<mpl_toolkits.mplot3d.art3d.Path3DCollection at 0x22cde276490>
```