(a) Load a dataset containing student marks in 4 subjects. Normalize the data and apply KMeans clustering to group students based on performance.

In [18]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
```

In [28]:
```
#loading dataset
df = pd.read_csv("/content/drive/MyDrive/DataVisualization_4th_sem/LabPractica
df.head(3)
```

Out[28]:

	Student	Math	Physics	Chemistry	Biology
0	Aarav	78	74	80	82
1	Aditi	65	68	70	72
2	Akash	90	88	92	91

In [29]:
```
# Normalize the data
nor_df=df.copy()
nor_df
```

Out[29]:

	Student	Math	Physics	Chemistry	Biology
0	Aarav	78	74	80	82
1	Aditi	65	68	70	72
2	Akash	90	88	92	91
3	Ananya	55	60	58	62
4	Arjun	82	79	85	87
...	...	...	...	...	...
67	Heena	58	60	59	61
68	Imran	90	88	91	92
69	Jhanvi	73	71	74	75
70	Keshav	65	67	66	68
71	Leena	92	90	93	94

72 rows × 5 columns

In [31]:

```
for col in range(1,len(nor_df.iloc[0,:])):
    #min-max Normalization
    max_col=np.max(nor_df.iloc[:,col])
    min_col=np.min(nor_df.iloc[:,col])
    for i in range(len(nor_df.iloc[:,col])):
        nor_df.iloc[i,col]=(float(nor_df.iloc[i,col]-min_col))/(float(max_col-
nor_df
```

Out[31]:

	Student	Math	Physics	Chemistry	Biology
0	Aarav	0.560976	0.444444	0.564103	0.578947
1	Aditi	0.243902	0.277778	0.307692	0.315789
2	Akash	0.853659	0.833333	0.871795	0.815789
3	Ananya	0.000000	0.055556	0.000000	0.052632
4	Arjun	0.658537	0.583333	0.692308	0.710526
...	...	...	...	...	...
67	Heena	0.073171	0.055556	0.025641	0.026316
68	Imran	0.853659	0.833333	0.846154	0.842105
69	Jhanvi	0.439024	0.361111	0.410256	0.394737
70	Keshav	0.243902	0.250000	0.205128	0.210526
71	Leena	0.902439	0.888889	0.897436	0.894737

72 rows × 5 columns

In [32]:
```
#apply KMeans clustering
#Train clustering models
kmeans=KMeans( n_clusters=3, init='k-means++', max_iter=3000, random_state=72)
kmeans
```

Out[32]:

▾ KMeans

```
KMeans(max_iter=3000, n_clusters=3, random_state=72)
```

In [33]:
```
kmeans.fit(nor_df.iloc[:,1:])
nor_df["cluster"]=kmeans.predict(nor_df.iloc[:,1:])
nor_df
```

Out[33]:

	Student	Math	Physics	Chemistry	Biology	cluster
0	Aarav	0.560976	0.444444	0.564103	0.578947	2
1	Aditi	0.243902	0.277778	0.307692	0.315789	0
2	Akash	0.853659	0.833333	0.871795	0.815789	1
3	Ananya	0.000000	0.055556	0.000000	0.052632	0
4	Arjun	0.658537	0.583333	0.692308	0.710526	1
...	...	...	...	...	...	...
67	Heena	0.073171	0.055556	0.025641	0.026316	0
68	Imran	0.853659	0.833333	0.846154	0.842105	1
69	Jhanvi	0.439024	0.361111	0.410256	0.394737	2
70	Keshav	0.243902	0.250000	0.205128	0.210526	0
71	Leena	0.902439	0.888889	0.897436	0.894737	1

72 rows × 6 columns

In [34]:
```
#Visualize clusters using PCA
from sklearn.decomposition import PCA
```

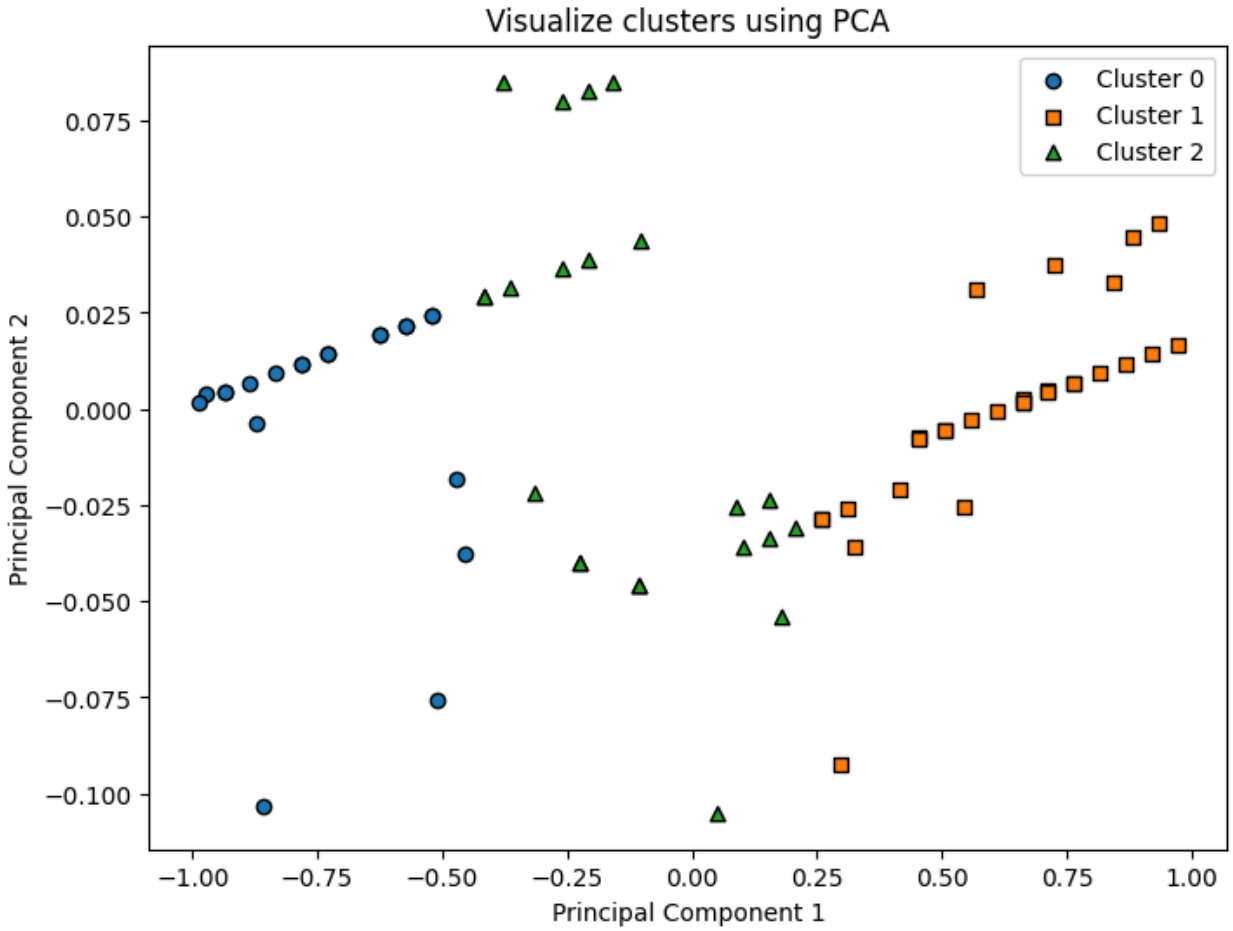
In [35]:
```
pca=PCA(n_components=2)
nor_df[["pc1","pc2"]]=pca.fit_transform(nor_df.iloc[:,1:5])
nor_df.head(3)
```

Out[35]:

	Student	Math	Physics	Chemistry	Biology	cluster	pc1	pc
0	Aarav	0.560976	0.444444	0.564103	0.578947	2	0.049750	-0.10497
1	Aditi	0.243902	0.277778	0.307692	0.315789	0	-0.452647	-0.03752
2	Akash	0.853659	0.833333	0.871795	0.815789	1	0.661412	0.00250

In [36]:
```
markers = {0: 'o', 1: 's', 2: '^'}
plt.figure(figsize=(8,6))
for cluster_id in [0, 1, 2]:
    subset = nor_df[nor_df["cluster"] == cluster_id]
    plt.scatter(
        subset["pc1"],
        subset["pc2"],
        marker=markers[cluster_id],
        edgecolor='k',
        label=f"Cluster {cluster_id}"
    )
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.title("Visualize clusters using PCA")
```

```
plt.legend()
plt.show()
```



(b)Load a dataset of employees with categorical and numerical features, encode the categorical data and train a decision tree to predict job satisfaction.

In [71]:
```
#Load a dataset of employees
df = pd.read_csv("/content/drive/MyDrive/DataVisualization_4th_sem/LabPractica
df=pd.DataFrame(df)
df.drop(columns=["ID"],axis=1,inplace=True)
```

In [72]:
```
df.head(3)
```

Out[72]:

	Department	Gender	Age	Salary	Satisfaction_Level
0	Marketing	Female	22	75891	High
1	HR	Female	43	85026	Medium
2	Sales	Male	34	44650	Medium

In [73]:
```
#One-hot encoding Department.
df=pd.get_dummies(df,columns=["Department"],drop_first=False)
df.head(3)
```

Out[73]:

	Gender	Age	Salary	Satisfaction_Level	Department_Finance	Department_HI
0	Female	22	75891	High	False	Fals
1	Female	43	85026	Medium	False	Tru
2	Male	34	44650	Medium	False	Fals

In [74]:
```
#One-hot encoding Gender.
df=pd.get_dummies(df,columns=["Gender"],drop_first=False)
df.head(3)
```

Out[74]:

	Age	Salary	Satisfaction_Level	Department_Finance	Department_HR	Depart
0	22	75891	High	False	False	
1	43	85026	Medium	False	True	
2	34	44650	Medium	False	False	

In [75]:
```
df.iloc[1,:]
```

Out[75]:

	1
Age	43
Salary	85026
Satisfaction_Level	Medium
Department_Finance	False
Department_HR	True
Department_IT	False
Department_Marketing	False
Department_Sales	False
Gender_Female	True
Gender_Male	False

dtype: object

In [76]:
```
#encoding satisfaction feature
from sklearn.preprocessing import OrdinalEncoder
ordinal = OrdinalEncoder(categories=[["Low", "Medium", "High"]])
df["Satisfaction_Level"] = ordinal.fit_transform(df[["Satisfaction_Level"]])
df.head(3)
```

Out[76]:

	Age	Salary	Satisfaction_Level	Department_Finance	Department_HR	Depart
0	22	75891	2.0	False	False	
1	43	85026	1.0	False	True	
2	34	44650	1.0	False	False	

In [77]:
```
#Split Dataset into X and y
X = df.drop("Satisfaction_Level", axis=1)
X = X.astype(int)
y = df["Satisfaction_Level"]
print("X shape:", X.shape)
print("y shape:", y.shape)
```

```
X shape: (40, 9)
y shape: (40,)
```

In [78]:
```
X.head(4)
```

Out[78]:

	Age	Salary	Department_Finance	Department_HR	Department_IT	Departme
0	22	75891	0	0	0	
1	43	85026	0	1	0	
2	34	44650	0	0	0	
3	59	46921	0	0	0	

In [79]:
```
#train-test split
from sklearn.model_selection import train_test_split
xtrain, xtest, ytrain, ytest = train_test_split( X, y, test_size=0.3, random_s
```

In [80]:
```
xtrain.head(3)
```

Out[80]:

	Age	Salary	Department_Finance	Department_HR	Department_IT	Departm
9	39	82000	1	0	0	
3	59	46921	0	0	0	
18	53	73000	0	0	0	

In [81]:
```
#Normalize numerical ones if needed.
num_cols = ["Age", "Salary"]
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
xtrain[num_cols] = scaler.fit_transform(xtrain[num_cols])
xtest[num_cols] = scaler.transform(xtest[num_cols])
```

In [82]:
```
xtrain.head(3)
```

Out[82]:

	Age	Salary	Department_Finance	Department_HR	Department_IT	I
9	-0.018631	1.143879	1	0	0	
3	2.068090	-0.709180	0	0	0	
18	1.442074	0.668451	0	0	0	

In [83]:
```
ytrain.head(3)
```

Out[83]:

	Satisfaction_Level
9	2.0
3	0.0
18	2.0

dtype: float64

In [89]:
```
#Train a Decision Tree classifier.
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
```

In [87]:
```
dt= DecisionTreeClassifier(random_state=72)
dt
```

Out[87]:

DecisionTreeClassifier

DecisionTreeClassifier(random_state=72)

In [88]:
```
dt.fit(xtrain, ytrain)
```

Out[88]:

DecisionTreeClassifier

DecisionTreeClassifier(random_state=72)

In [91]:
```
#Print accuracy on train data.
ytrain_pred=dt.predict(xtrain)
print("Decision Tree Accuracy(Training):", accuracy_score(ytrain,ytrain_pred))
```

```
Decision Tree Accuracy(Training): 1.0
```

In [92]:
```
#Print accuracy on test data.
ytest_pred=dt.predict(xtest)
print("Decision Tree Accuracy(Test):", accuracy_score(ytest,ytest_pred))
```

```
Decision Tree Accuracy(Test): 0.3333333333333333
```

In [ ]:
```

```

Learning Outcome

Learned how to normalize student performance data and apply KMeans clustering with PCA visualization to group students based on academic marks.

Understood how to encode categorical employee features and train a Decision Tree model to predict job satisfaction with accuracy evaluation.
