[1]:
```
!pip install scikit-learn
```

```
Requirement already satisfied: scikit-learn in c:\users\vinatha\appdata\local\programs\python\python313\lib\site-packages (1.7.2)
Requirement already satisfied: numpy>=1.22.0 in c:\users\vinatha\appdata\local\programs\python\python313\lib\site-packages (from scikit-learn) (2.3.3)
Requirement already satisfied: scipy>=1.8.0 in c:\users\vinatha\appdata\local\programs\python\python313\lib\site-packages (from scikit-learn) (1.16.2)
Requirement already satisfied: joblib>=1.2.0 in c:\users\vinatha\appdata\local\programs\python\python313\lib\site-packages (from scikit-learn) (1.5.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in c:\users\vinatha\appdata\local\programs\python\python313\lib\site-packages (from scikit-learn)
(3.6.0)
```

[2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import classification_report, accuracy_score, confusion_matrix
```

[8]:
```
df = pd.read_csv("bank.csv", delimiter=";")
```

[9]:
```
print(df.head())
print(df.info())
```

```
   age          job  marital  education default  balance housing loan  \
0   30   unemployed  married    primary      no     1787      no   no
1   33     services  married  secondary      no     4789     yes  yes
2   35   management   single   tertiary      no     1350     yes   no
3   30   management  married   tertiary      no     1476     yes  yes
4   59  blue-collar  married  secondary      no        0     yes   no

    contact  day month  duration  campaign  pdays  previous poutcome   y
0  cellular   19   oct        79         1     -1         0  unknown  no
1  cellular   11   may       220         1    339         4  failure  no
2  cellular   16   apr       185         1    330         1  failure  no
3   unknown    3   jun       199         4     -1         0  unknown  no
4   unknown    5   may       226         1     -1         0  unknown  no
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4521 entries, 0 to 4520
Data columns (total 17 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   age        4521 non-null   int64
 1   job        4521 non-null   object
 2   marital    4521 non-null   object
 3   education  4521 non-null   object
 4   default    4521 non-null   object
 5   balance    4521 non-null   int64
 6   housing    4521 non-null   object
 7   loan       4521 non-null   object
 8   contact    4521 non-null   object
 9   day        4521 non-null   int64
 10  month      4521 non-null   object
 11  duration   4521 non-null   int64
 12  campaign   4521 non-null   int64
 13  pdays      4521 non-null   int64
 14  previous   4521 non-null   int64
 15  poutcome   4521 non-null   object
 16  y          4521 non-null   object
dtypes: int64(7), object(10)
memory usage: 600.6+ KB
None
```

[10]:
```
df_encoded = pd.get_dummies(df, drop_first=True)
```

[11]:
```
X = df_encoded.drop("y_yes", axis=1)   # target column "y" (yes/no) becomes y_yes after encoding
y = df_encoded["y_yes"]
```

[12]:
```
X_train, X_test, y_train, y_test = train_test_split( X, y, test_size=0.2, random_state=42 )
```

[13]:
```
clf = DecisionTreeClassifier(criterion="entropy", max_depth=5, random_state=42)
```

[14]:
```
clf.fit(X_train, y_train)
```

[14]:
DecisionTreeClassifier

▶ Parameters

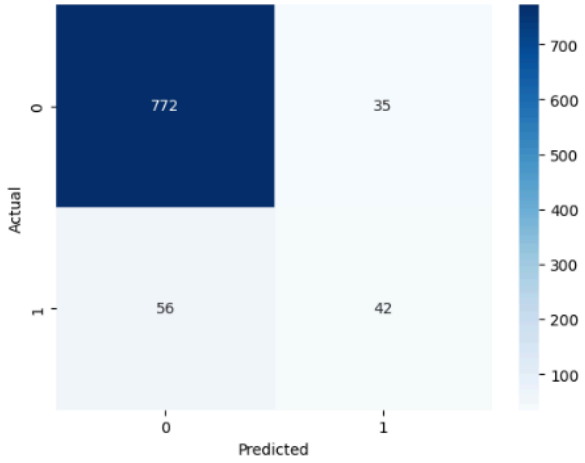
[18]:
```
y_pred = clf.predict(X_test)
print("Accuracy:", accuracy_score(y_test, y_pred))
print("\nClassification Report:\n", classification_report(y_test, y_pred))
cm = confusion_matrix(y_test, y_pred)
sns.heatmap(cm, annot=True, fmt="d", cmap="Blues")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()
```

```
Accuracy: 0.8994475138121547

Classification Report:
              precision    recall  f1-score   support

       False       0.93      0.96      0.94       807
        True       0.55      0.43      0.48        98

    accuracy                           0.90       905
   macro avg       0.74      0.69      0.71       905
weighted avg       0.89      0.90      0.89       905
```



[16]:
```
plt.figure(figsize=(20,10))
plot_tree(clf, feature_names=X.columns, class_names=["No", "Yes"], filled=True)
plt.show()
```