Lab 4: Implement Decision tree algorithm for cassification

import libraries

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

import dataset

In [2]:

```
dataset = pd.read_csv('bill_authentication.csv')
```

EDA Steps

In [3]:

```
dataset.head()
```

Out[3]:

	Variance	Skewness	Curtosis	Entropy	Class
0	3.62160	8.6661	-2.8073	-0.44699	0
1	4.54590	8.1674	-2.4586	-1.46210	0
2	3.86600	-2.6383	1.9242	0.10645	0
3	3.45660	9.5228	-4.0112	-3.59440	0
4	0.32924	-4.4552	4.5718	-0.98880	0

In [4]:

```
dataset.shape
```

Out[4]:

```
(1372, 5)
```

In [5]:

```
dataset.columns
```

Out[5]:

```
Index(['Variance', 'Skewness', 'Curtosis', 'Entropy', 'Class'], dtype='obj
ect')
```

In [6]:

```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1372 entries, 0 to 1371
Data columns (total 5 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   Variance  1372 non-null   float64
 1   Skewness  1372 non-null   float64
 2   Curtosis  1372 non-null   float64
 3   Entropy   1372 non-null   float64
 4   Class     1372 non-null   int64  
dtypes: float64(4), int64(1)
memory usage: 53.7 KB
```

In [7]:

```
dataset.describe()
```

Out[7]:

	Variance	Skewness	Curtosis	Entropy	Class
count	1372.000000	1372.000000	1372.000000	1372.000000	1372.000000
mean	0.433735	1.922353	1.397627	-1.191657	0.444606
std	2.842763	5.869047	4.310030	2.101013	0.497103
min	-7.042100	-13.773100	-5.286100	-8.548200	0.000000
25%	-1.773000	-1.708200	-1.574975	-2.413450	0.000000
50%	0.496180	2.319650	0.616630	-0.586650	0.000000
75%	2.821475	6.814625	3.179250	0.394810	1.000000
max	6.824800	12.951600	17.927400	2.449500	1.000000

Preprocessing steps

In [8]:

```
# step 1 : Separate input and output variable
X= dataset.iloc[:,:-1].values
Y= dataset.iloc[:,-1].values
```

In [9]:

```
print(X)
print(Y)
```

```
[[  3.6216    8.6661   -2.8073   -0.44699]
 [  4.5459    8.1674   -2.4586   -1.4621 ]
 [  3.866    -2.6383    1.9242    0.10645]
 ...
 [ -3.7503  -13.4586   17.5932   -2.7771 ]
 [ -3.5637   -8.3827   12.393    -1.2823 ]
 [ -2.5419   -0.65804   2.6842    1.1952 ]]
[0 0 0 ... 1 1 1]
```

In [10]:

```
# Step 4 : splitting the data into training and testing

from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X,Y,test_size=0.25,random_state=1)
```

In [11]:

```
print(X_train.shape)
print(X_test.shape)
```

```
(1029, 4)
(343, 4)
```

In [12]:

```
# Step 5: Feature Scaling
from sklearn.preprocessing import StandardScaler
sc= StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.fit_transform(X_test)
```

In [13]:

```
print(X_test)
```

```
[[-1.34123414e+00  8.74671962e-04 -2.92947099e-01 -5.39332443e-01]
 [ 3.26039628e-01  4.24971975e-01  1.43889718e-01  7.18511675e-01]
 [-1.50112427e+00 -1.63231673e+00  2.25057518e+00 -6.59738358e-02]
 ...
 [-7.26498948e-01  1.35941991e-01 -8.56626235e-01 -4.41726408e-01]
 [-1.06380094e+00  1.52214995e+00  1.94871291e-01 -2.01988721e+00]
 [-6.85489171e-01  2.34930561e-01 -6.90329694e-01 -1.06944313e+00]]
```

Training the decision tree classification model on the training set

In [14]:

```
from sklearn.tree import DecisionTreeClassifier
classifier = DecisionTreeClassifier(criterion = 'entropy', random_state = 0)
classifier.fit(X_train, Y_train)
```

Out[14]:

```
DecisionTreeClassifier(criterion='entropy', random_state=0)
```

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Predicting the test result

In [15]:

```
ypred = classifier.predict(X_test)
```

Compare the predicted and actual output

In [23]:

```
print(np.concatenate(( ypred.reshape(len(ypred),1), Y_test.reshape(len(Y_test),1)), 1))
```

```
[[1 1]
 [0 0]
 [1 1]
 [1 1]
 [0 0]
 [0 0]
 [0 0]
 [0 0]
 [0 0]
 [0 0]
 [0 0]
 [1 1]
 [0 0]
 [1 1]
 [1 1]
 [0 0]
 [0 0]
 [0 0]
 [0 0]
```

Making the confusion matrix

In [17]:

```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(Y_test,ypred)
print(cm)
```

```
[[188   5]
 [  2 148]]
```

In [18]:

```
print("Accuracy: ", (189+145)/343*100)
```

```
Accuracy:  97.37609329446065
```

In [19]:

```
# Build the classification report

from sklearn.metrics import classification_report
print(classification_report(Y_test,ypred))
```

```
              precision    recall  f1-score   support

           0       0.99      0.97      0.98       193
           1       0.97      0.99      0.98       150

    accuracy                           0.98       343
   macro avg       0.98      0.98      0.98       343
weighted avg       0.98      0.98      0.98       343
```

Visualizing the Training Set Result

Visualize Text Representation

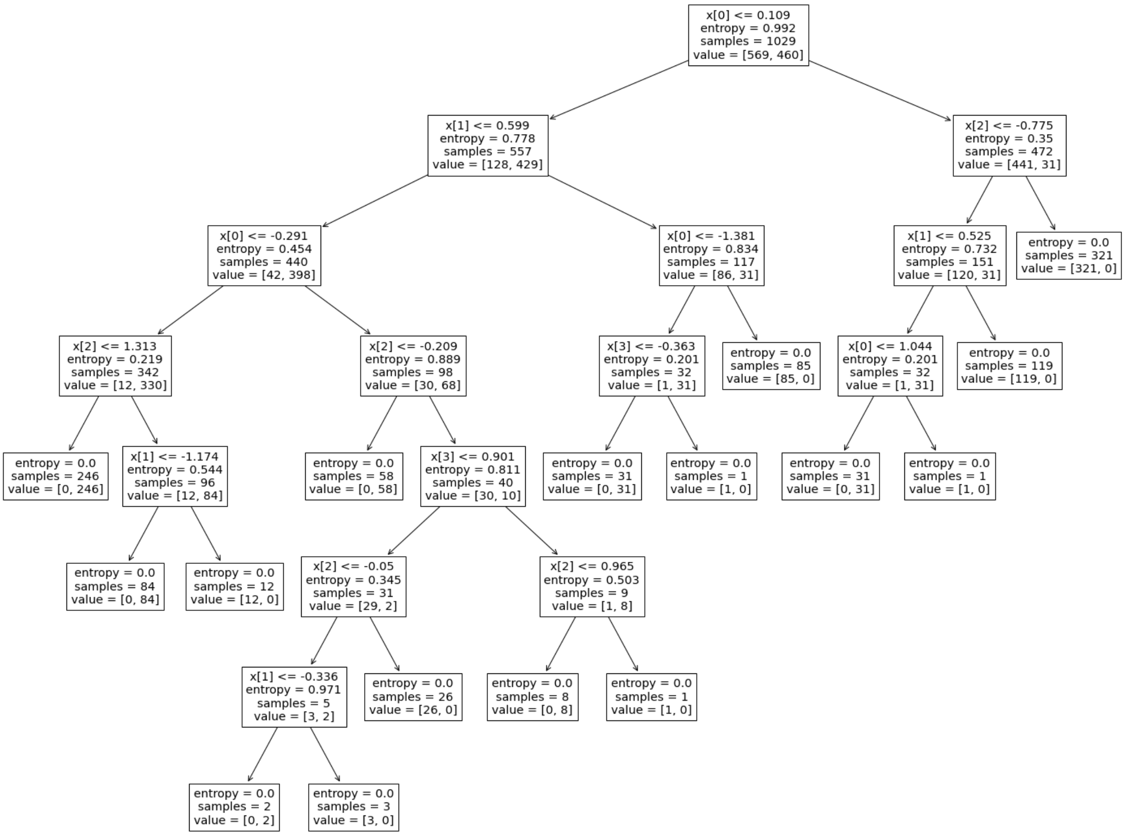
In [21]:

```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```

```
|--- feature_0 <= 0.11
|   |--- feature_1 <= 0.60
|   |   |--- feature_0 <= -0.29
|   |   |   |--- feature_2 <= 1.31
|   |   |   |   |--- class: 1
|   |   |   |--- feature_2 >  1.31
|   |   |   |   |--- feature_1 <= -1.17
|   |   |   |   |   |--- class: 1
|   |   |   |   |--- feature_1 >  -1.17
|   |   |   |   |   |--- class: 0
|   |   |--- feature_0 >  -0.29
|   |   |   |--- feature_2 <= -0.21
|   |   |   |   |--- class: 1
|   |   |   |--- feature_2 >  -0.21
|   |   |   |   |--- feature_3 <= 0.90
|   |   |   |   |   |--- feature_2 <= -0.05
|   |   |   |   |   |   |--- feature_1 <= -0.34
|   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_1 >  -0.34
|   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_2 >  -0.05
|   |   |   |   |   |   |--- class: 0
|   |   |   |   |--- feature_3 >  0.90
|   |   |   |   |   |--- feature_2 <= 0.96
|   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |--- feature_2 >  0.96
|   |   |   |   |   |   |--- class: 0
|   |--- feature_1 >  0.60
|   |   |--- feature_0 <= -1.38
|   |   |   |--- feature_3 <= -0.36
|   |   |   |   |--- class: 1
|   |   |   |--- feature_3 >  -0.36
|   |   |   |   |--- class: 0
|   |   |--- feature_0 >  -1.38
|   |   |   |--- class: 0
|--- feature_0 >  0.11
|   |--- feature_2 <= -0.78
|   |   |--- feature_1 <= 0.52
|   |   |   |--- feature_0 <= 1.04
|   |   |   |   |--- class: 1
|   |   |   |--- feature_0 >  1.04
|   |   |   |   |--- class: 0
|   |   |--- feature_1 >  0.52
|   |   |   |--- class: 0
|   |--- feature_2 >  -0.78
|   |   |--- class: 0
```

In [22]:

```
from sklearn import tree
fig = plt.figure(figsize=(25,20))
tree.plot_tree(classifier)
plt.show()
```



In [ ]:

```

```

Test your Knowledge

Q] Crete the model with following settings a. Criterion = log_loss b. Splitter = random c. max_features = sqrt d. random_state = any number of your choice

In [29]:

```
from sklearn.tree import DecisionTreeClassifier
classifier2 = DecisionTreeClassifier(criterion = 'log_loss', splitter='random' ,
                                    max_features='sqrt', random_state = 57)
classifier2.fit(X_train, Y_train)
```

Out[29]:

```
DecisionTreeClassifier(criterion='log_loss', max_features='sqrt',
                       random_state=57, splitter='random')
```

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In [30]:

```
ypred = classifier2.predict(X_test)
```

In [31]:

```
# classification report

from sklearn.metrics import classification_report
print(classification_report(Y_test,ypred))
```

```
              precision    recall  f1-score   support

           0       0.99      0.98      0.98       193
           1       0.97      0.99      0.98       150

    accuracy                           0.98       343
   macro avg       0.98      0.98      0.98       343
weighted avg       0.98      0.98      0.98       343
```