[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[4]:
```
df=pd.read_csv(r"C:\Users\SAI\Downloads\data_banknote_authentication..zip")
df
```

[4]:

	3.6216	8.6661	-2.8073	-0.44699	0
0	4.54590	8.16740	-2.4586	-1.46210	0
1	3.86600	-2.63830	1.9242	0.10645	0
2	3.45660	9.52280	-4.0112	-3.59440	0
3	0.32924	-4.45520	4.5718	-0.98880	0
4	4.36840	9.67180	-3.9606	-3.16250	0
...	...	...	...	...	...
1366	0.40614	1.34920	-1.4501	-0.55949	1
1367	-1.38870	-4.87730	6.4774	0.34179	1
1368	-3.75030	-13.45860	17.5932	-2.77710	1
1369	-3.56370	-8.38270	12.3930	-1.28230	1
1370	-2.54190	-0.65804	2.6842	1.19520	1

1371 rows × 5 columns

[5]:
```
X = df.iloc[:, :-1].values
X
```

[5]:
```
array([[  4.5459 ,   8.1674 ,  -2.4586 ,  -1.4621 ],
       [  3.866  ,  -2.6383 ,   1.9242 ,   0.10645],
       [  3.4566 ,   9.5228 ,  -4.0112 ,  -3.5944 ],
       ...,
       [ -3.7503 , -13.4586 ,  17.5932 ,  -2.7771 ],
       [ -3.5637 ,  -8.3827 ,  12.393  ,  -1.2823 ],
       [ -2.5419 ,  -0.65804,   2.6842 ,   1.1952 ]])
```

[6]:
```
y = df.iloc[:, -1].values
y
```

[6]:
```
array([0, 0, 0, ..., 1, 1, 1])
```

[9]:
```
from sklearn.model_selection import train_test_split
xtrain,xtest,ytrain,ytest=train_test_split(X,y,test_size=0.2)
```

[12]:
```
from sklearn.neural_network import MLPClassifier
model=MLPClassifier(hidden_layer_sizes=(10,10),activation='relu',solver='adam',max_iter=500,early_stopping=True,validation_fraction=0.1,random_state=42)
model.fit(xtrain,ytrain)
```

[12]:
```
MLPClassifier(early_stopping=True, hidden_layer_sizes=(10, 10), max_iter=500,
              random_state=42)
```

[15]:
```
ypred=model.predict(xtest)
```

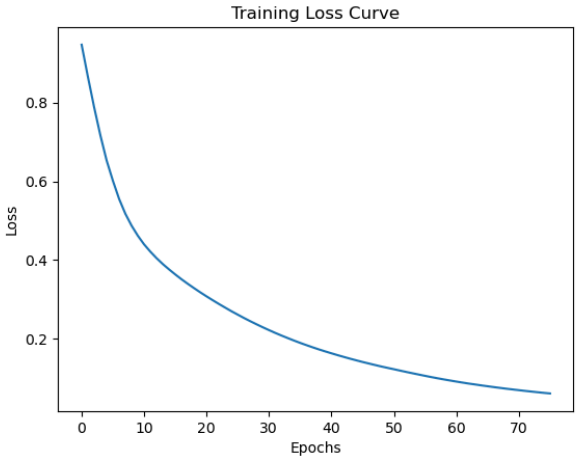
[16]:
```
from sklearn.metrics import confusion_matrix, accuracy_score, precision_score,recall_score,f1_score
```

[18]:
```
cm=confusion_matrix(ytest,ypred)
```

[20]:
```
acc = accuracy_score(ytest,ypred)
pre = precision_score(ytest,ypred)
rec = recall_score(ytest,ypred)
f1 = f1_score(ytest,ypred)
print("Confusion Matrix: ")
print(cm)
print(f"Accuracy :{acc}")
print(f"Precision :{pre}")
print(f"Recall :{rec}")
print(f"F1 Score :{f1}")
```

```
Confusion Matrix:
[[159   0]
 [  6 110]]
Accuracy :0.9781818181818182
Precision :1.0
Recall :0.9482758620689655
F1 Score :0.9734513274336283
```

[22]:
```
plt.plot(model.loss_curve_)
plt.title("Training Loss Curve")
plt.xlabel("Epochs")
plt.ylabel("Loss")
plt.show()
```



26]:
```
for act in ['tanh', 'logistic', 'identity']:
    model_alt = MLPClassifier(hidden_layer_sizes=(10,10),activation=act,solver='adam',max_iter=500,early_stopping=True,validation_fraction=0.1,random_state
    model_alt.fit(xtrain, ytrain)
    ypred_alt = model_alt.predict(xtest)
    print(f"\nActivation: {act}")
    print("Accuracy:", accuracy_score(ytest, ypred_alt))
```

```
Activation: tanh
Accuracy: 0.9927272727272727

Activation: logistic
Accuracy: 0.5781818181818181

Activation: identity
Accuracy: 0.9309090909090909
```