

```
In [2]: import os
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from scipy import stats
```

```
In [3]: df=pd.read_csv('datasets/US_graduates/US_graduates.csv')
```

Question 1: To derive job satisfaction from our dataset, we calculate probabilities for different employment statuses and reasons within each major. By determining the likelihood of individuals being employed, unemployed, or working outside their field due to reasons like "Career Change" or "No Job Available," we can create a satisfaction profile. High satisfaction is assigned where the probability of employment in chosen roles is high, moderate satisfaction where there's a significant rate of "Career Change," and low satisfaction when unemployment or working out of necessity is common. This method provides a `Satisfaction_Label` based on observed employment trends and job alignment within each major.

```
In [4]: q1_df=df.copy()
q1_df['Total_Employment'] = q1_df[['Employment.Status.Employed', 'Employment.Status.Unemployed', 'Employment.Status.Working_Outside_Field']].sum(axis=1)

q1_df['P_Employed'] = q1_df['Employment.Status.Employed'] / q1_df['Total_Employment']
q1_df['P_Career_Change'] = q1_df['Employment.Reason Working Outside Field.Career Change'] / q1_df['Total_Employment']
q1_df['P_No_Job_Available'] = q1_df['Employment.Reason Working Outside Field.No Job Available'] / q1_df['Total_Employment']

conditions = [
    (q1_df['P_Employed'] > 0.7) & (q1_df['P_Career_Change'] < 0.1),
    (q1_df['P_Employed'] > 0.5) & (q1_df['P_Career_Change'] >= 0.1),
    (q1_df['P_No_Job_Available'] > 0.2)
]
choices = ['Happy', 'Satisfied', 'Not Satisfied']

q1_df['Satisfaction_Label'] = np.select(conditions, choices, default='Unknown')
```

```
In [5]: from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, classification_report
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
import matplotlib.pyplot as plt
from sklearn.tree import plot_tree
```

```
In [6]: from sklearn.metrics import confusion_matrix

categorical_cols = q1_df.select_dtypes(include=['object']).columns
```

```
for col in categorical_cols:
    le = LabelEncoder()
    q1_df[col] = le.fit_transform(q1_df[col])

q1_df['Satisfaction_Label_Encoded'] = LabelEncoder().fit_transform(q1_df['Satisfact
X = q1_df.drop(columns=['Satisfaction_Label', 'Satisfaction_Label_Encoded']) # dro
y = q1_df['Satisfaction_Label_Encoded']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_sta
dt_model = DecisionTreeClassifier(random_state=42)
dt_model.fit(X_train, y_train)

y_pred = dt_model.predict(X_test)
print("Accuracy:", accuracy_score(y_test, y_pred))
print("Classification Report:\n", classification_report(y_test, y_pred))
conf_matrix=confusion_matrix(y_test, y_pred)
print("\nConfusion Matrix:\n", conf_matrix)

plt.figure(figsize=(20, 10)) # Adjust size for better clarity
plot_tree(dt_model, filled=True, feature_names=X.columns, class_names=[ 'Not Satisfi
plt.show()
```

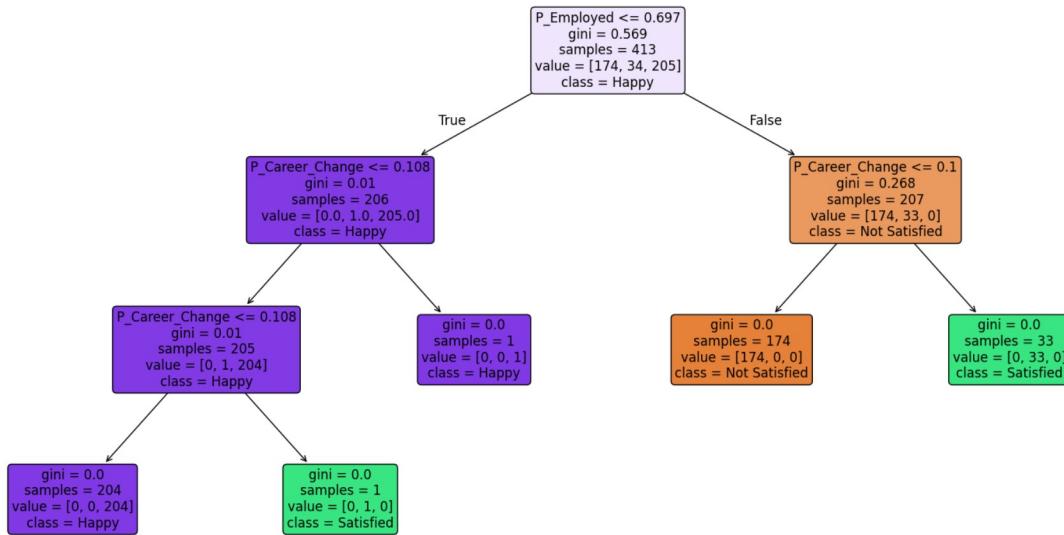
Accuracy: 0.9903846153846154

Classification Report:

	precision	recall	f1-score	support
0	1.00	1.00	1.00	36
1	1.00	0.90	0.95	10
2	0.98	1.00	0.99	58
accuracy			0.99	104
macro avg	0.99	0.97	0.98	104
weighted avg	0.99	0.99	0.99	104

Confusion Matrix:

```
[[36  0  0]
 [ 0  9  1]
 [ 0  0 58]]
```



The Decision Tree is well-suited for this dataset due to its interpretability, offering a clear visual structure that shows how features like employment and career change influence satisfaction levels. This model is also practical as it handles mixed data types without extensive preprocessing, making it easier to implement. Additionally, Decision Trees can capture non-linear relationships, which likely exist within real-world satisfaction data. Overall, this makes the Decision Tree an effective, interpretable, and efficient model choice for this classification task.

Question 2: Given an individual's educational major and other demographic factors, it is possible to predict their expected salary range or employment status.

```
In [7]: from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.utils import to_categorical
```

```
In [8]: df['Salary_Range'] = pd.cut(df['Salaries.Mean'], bins=[-np.inf, 50000, 100000, np.i
```

```
X = df.drop(['Salaries.Mean', 'Salary_Range', 'Employment.Status.Employed', 'Employment.Status.Unemployed'], axis=1)
y = df['Salary_Range']
X = pd.get_dummies(X, drop_first=True)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
y_train = to_categorical(y_train)
y_test = to_categorical(y_test)
model = Sequential()
model.add(Dense(64, input_dim=X_train.shape[1], activation='relu'))
model.add(Dropout(0.3))
model.add(Dense(32, activation='relu'))
model.add(Dropout(0.2))
model.add(Dense(16, activation='relu'))
model.add(Dense(y_train.shape[1], activation='softmax'))
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
history = model.fit(X_train, y_train, validation_data=(X_test, y_test), epochs=500,
loss, accuracy = model.evaluate(X_test, y_test)
print(f"Test Accuracy: {accuracy}")
```

C:\Users\athar\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.12_qbz5n2kfr-a8p0\LocalCache\local-packages\Python312\site-packages\keras\src\layers\core\dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

```
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

Epoch 1/500
13/13 1s 18ms/step - accuracy: 0.5781 - loss: 0.8907 - val_accuracy: 0.7500 - val_loss: 0.6275
Epoch 2/500
13/13 0s 4ms/step - accuracy: 0.6777 - loss: 0.7114 - val_accuracy: 0.7692 - val_loss: 0.5204
Epoch 3/500
13/13 0s 3ms/step - accuracy: 0.7150 - loss: 0.6149 - val_accuracy: 0.8269 - val_loss: 0.4467
Epoch 4/500
13/13 0s 4ms/step - accuracy: 0.7471 - loss: 0.5607 - val_accuracy: 0.9038 - val_loss: 0.3829
Epoch 5/500
13/13 0s 4ms/step - accuracy: 0.7825 - loss: 0.4805 - val_accuracy: 0.8846 - val_loss: 0.3375
Epoch 6/500
13/13 0s 3ms/step - accuracy: 0.7988 - loss: 0.4702 - val_accuracy: 0.8942 - val_loss: 0.2923
Epoch 7/500
13/13 0s 3ms/step - accuracy: 0.8646 - loss: 0.3702 - val_accuracy: 0.9231 - val_loss: 0.2552
Epoch 8/500
13/13 0s 5ms/step - accuracy: 0.8941 - loss: 0.3471 - val_accuracy: 0.9231 - val_loss: 0.2275
Epoch 9/500
13/13 0s 3ms/step - accuracy: 0.8729 - loss: 0.3284 - val_accuracy: 0.9231 - val_loss: 0.2101
Epoch 10/500
13/13 0s 4ms/step - accuracy: 0.8879 - loss: 0.2703 - val_accuracy: 0.9327 - val_loss: 0.1995
Epoch 11/500
13/13 0s 3ms/step - accuracy: 0.9133 - loss: 0.2366 - val_accuracy: 0.9327 - val_loss: 0.1887
Epoch 12/500
13/13 0s 3ms/step - accuracy: 0.9131 - loss: 0.2146 - val_accuracy: 0.9231 - val_loss: 0.1732
Epoch 13/500
13/13 0s 4ms/step - accuracy: 0.9205 - loss: 0.2344 - val_accuracy: 0.9327 - val_loss: 0.1524
Epoch 14/500
13/13 0s 3ms/step - accuracy: 0.9466 - loss: 0.1822 - val_accuracy: 0.9327 - val_loss: 0.1465
Epoch 15/500
13/13 0s 3ms/step - accuracy: 0.9352 - loss: 0.1683 - val_accuracy: 0.9423 - val_loss: 0.1420
Epoch 16/500
13/13 0s 3ms/step - accuracy: 0.9206 - loss: 0.1810 - val_accuracy: 0.9231 - val_loss: 0.1426
Epoch 17/500
13/13 0s 4ms/step - accuracy: 0.9594 - loss: 0.1249 - val_accuracy: 0.9231 - val_loss: 0.1418
Epoch 18/500
13/13 0s 4ms/step - accuracy: 0.9463 - loss: 0.1468 - val_accuracy: 0.9135 - val_loss: 0.1472
Epoch 19/500
13/13 0s 4ms/step - accuracy: 0.9610 - loss: 0.1321 - val_accuracy:

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acy: 0.9327 - val_loss: 0.1512
Epoch 20/500
13/13 0s 4ms/step - accuracy: 0.9383 - loss: 0.1487 - val_accur
acy: 0.9327 - val_loss: 0.1437
Epoch 21/500
13/13 0s 3ms/step - accuracy: 0.9590 - loss: 0.1161 - val_accur
acy: 0.9231 - val_loss: 0.1531
Epoch 22/500
13/13 0s 4ms/step - accuracy: 0.9549 - loss: 0.1120 - val_accur
acy: 0.9231 - val_loss: 0.1567
Epoch 23/500
13/13 0s 3ms/step - accuracy: 0.9572 - loss: 0.0907 - val_accur
acy: 0.9231 - val_loss: 0.1468
Epoch 24/500
13/13 0s 3ms/step - accuracy: 0.9575 - loss: 0.1219 - val_accur
acy: 0.9231 - val_loss: 0.1453
Epoch 25/500
13/13 0s 4ms/step - accuracy: 0.9601 - loss: 0.1079 - val_accur
acy: 0.9231 - val_loss: 0.1607
Epoch 26/500
13/13 0s 3ms/step - accuracy: 0.9736 - loss: 0.0888 - val_accur
acy: 0.9135 - val_loss: 0.1948
Epoch 27/500
13/13 0s 3ms/step - accuracy: 0.9701 - loss: 0.0858 - val_accur
acy: 0.9135 - val_loss: 0.1976
Epoch 28/500
13/13 0s 4ms/step - accuracy: 0.9573 - loss: 0.1138 - val_accur
acy: 0.9231 - val_loss: 0.1886
Epoch 29/500
13/13 0s 4ms/step - accuracy: 0.9617 - loss: 0.0792 - val_accur
acy: 0.9327 - val_loss: 0.1798
Epoch 30/500
13/13 0s 4ms/step - accuracy: 0.9758 - loss: 0.0818 - val_accur
acy: 0.9231 - val_loss: 0.1883
Epoch 31/500
13/13 0s 4ms/step - accuracy: 0.9739 - loss: 0.0682 - val_accur
acy: 0.9231 - val_loss: 0.2034
Epoch 32/500
13/13 0s 3ms/step - accuracy: 0.9641 - loss: 0.0805 - val_accur
acy: 0.9135 - val_loss: 0.1855
Epoch 33/500
13/13 0s 5ms/step - accuracy: 0.9608 - loss: 0.0896 - val_accur
acy: 0.9135 - val_loss: 0.1943
Epoch 34/500
13/13 0s 3ms/step - accuracy: 0.9849 - loss: 0.0533 - val_accur
acy: 0.9231 - val_loss: 0.1949
Epoch 35/500
13/13 0s 5ms/step - accuracy: 0.9730 - loss: 0.0605 - val_accur
acy: 0.9231 - val_loss: 0.2069
Epoch 36/500
13/13 0s 3ms/step - accuracy: 0.9657 - loss: 0.0744 - val_accur
acy: 0.9327 - val_loss: 0.1977
Epoch 37/500
13/13 0s 3ms/step - accuracy: 0.9764 - loss: 0.0632 - val_accur
acy: 0.9231 - val_loss: 0.2025
Epoch 38/500
```

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13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9834 - loss: 0.0513 - val_accuracy: 0.9231 - val_loss: 0.2027
Epoch 39/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9747 - loss: 0.0516 - val_accuracy: 0.9327 - val_loss: 0.2109
Epoch 40/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9772 - loss: 0.0507 - val_accuracy: 0.9327 - val_loss: 0.2199
Epoch 41/500
13/13 ━━━━━━ 0s 15ms/step - accuracy: 0.9866 - loss: 0.0533 - val_accuracy: 0.9327 - val_loss: 0.2297
Epoch 42/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9817 - loss: 0.0668 - val_accuracy: 0.9231 - val_loss: 0.2333
Epoch 43/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9841 - loss: 0.0402 - val_accuracy: 0.9327 - val_loss: 0.2234
Epoch 44/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9866 - loss: 0.0519 - val_accuracy: 0.9423 - val_loss: 0.2143
Epoch 45/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9879 - loss: 0.0387 - val_accuracy: 0.9423 - val_loss: 0.2210
Epoch 46/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9786 - loss: 0.0563 - val_accuracy: 0.9423 - val_loss: 0.2107
Epoch 47/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9842 - loss: 0.0424 - val_accuracy: 0.9423 - val_loss: 0.2100
Epoch 48/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9735 - loss: 0.0523 - val_accuracy: 0.9231 - val_loss: 0.2319
Epoch 49/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9799 - loss: 0.0769 - val_accuracy: 0.9327 - val_loss: 0.2484
Epoch 50/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9702 - loss: 0.0482 - val_accuracy: 0.9423 - val_loss: 0.2390
Epoch 51/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9745 - loss: 0.0631 - val_accuracy: 0.9519 - val_loss: 0.2208
Epoch 52/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9902 - loss: 0.0474 - val_accuracy: 0.9519 - val_loss: 0.2213
Epoch 53/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9866 - loss: 0.0389 - val_accuracy: 0.9519 - val_loss: 0.2236
Epoch 54/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9900 - loss: 0.0298 - val_accuracy: 0.9519 - val_loss: 0.2294
Epoch 55/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9879 - loss: 0.0403 - val_accuracy: 0.9519 - val_loss: 0.2276
Epoch 56/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9886 - loss: 0.0312 - val_accuracy: 0.9519 - val_loss: 0.2230
```

Epoch 57/500
13/13 0s 3ms/step - accuracy: 0.9825 - loss: 0.0494 - val_accuracy: 0.9423 - val_loss: 0.2316
Epoch 58/500
13/13 0s 3ms/step - accuracy: 0.9852 - loss: 0.0354 - val_accuracy: 0.9423 - val_loss: 0.2448
Epoch 59/500
13/13 0s 3ms/step - accuracy: 0.9887 - loss: 0.0279 - val_accuracy: 0.9327 - val_loss: 0.2436
Epoch 60/500
13/13 0s 3ms/step - accuracy: 0.9728 - loss: 0.0621 - val_accuracy: 0.9519 - val_loss: 0.2159
Epoch 61/500
13/13 0s 4ms/step - accuracy: 0.9825 - loss: 0.0402 - val_accuracy: 0.9519 - val_loss: 0.2228
Epoch 62/500
13/13 0s 3ms/step - accuracy: 0.9890 - loss: 0.0300 - val_accuracy: 0.9519 - val_loss: 0.2351
Epoch 63/500
13/13 0s 3ms/step - accuracy: 0.9765 - loss: 0.0487 - val_accuracy: 0.9519 - val_loss: 0.2351
Epoch 64/500
13/13 0s 3ms/step - accuracy: 0.9737 - loss: 0.0480 - val_accuracy: 0.9423 - val_loss: 0.2424
Epoch 65/500
13/13 0s 3ms/step - accuracy: 0.9828 - loss: 0.0442 - val_accuracy: 0.9519 - val_loss: 0.2480
Epoch 66/500
13/13 0s 3ms/step - accuracy: 0.9824 - loss: 0.0452 - val_accuracy: 0.9519 - val_loss: 0.2321
Epoch 67/500
13/13 0s 3ms/step - accuracy: 0.9902 - loss: 0.0331 - val_accuracy: 0.9519 - val_loss: 0.2373
Epoch 68/500
13/13 0s 3ms/step - accuracy: 0.9851 - loss: 0.0315 - val_accuracy: 0.9519 - val_loss: 0.2553
Epoch 69/500
13/13 0s 3ms/step - accuracy: 0.9945 - loss: 0.0234 - val_accuracy: 0.9423 - val_loss: 0.2703
Epoch 70/500
13/13 0s 3ms/step - accuracy: 0.9937 - loss: 0.0193 - val_accuracy: 0.9423 - val_loss: 0.2639
Epoch 71/500
13/13 0s 3ms/step - accuracy: 0.9830 - loss: 0.0564 - val_accuracy: 0.9519 - val_loss: 0.2430
Epoch 72/500
13/13 0s 3ms/step - accuracy: 0.9972 - loss: 0.0212 - val_accuracy: 0.9423 - val_loss: 0.2507
Epoch 73/500
13/13 0s 3ms/step - accuracy: 0.9956 - loss: 0.0145 - val_accuracy: 0.9423 - val_loss: 0.2486
Epoch 74/500
13/13 0s 3ms/step - accuracy: 0.9952 - loss: 0.0158 - val_accuracy: 0.9519 - val_loss: 0.2460
Epoch 75/500
13/13 0s 3ms/step - accuracy: 0.9849 - loss: 0.0246 - val_accuracy:

```
acy: 0.9519 - val_loss: 0.2582
Epoch 76/500
13/13 0s 4ms/step - accuracy: 0.9898 - loss: 0.0293 - val_accur
acy: 0.9423 - val_loss: 0.2712
Epoch 77/500
13/13 0s 3ms/step - accuracy: 0.9966 - loss: 0.0162 - val_accur
acy: 0.9519 - val_loss: 0.2533
Epoch 78/500
13/13 0s 3ms/step - accuracy: 0.9876 - loss: 0.0207 - val_accur
acy: 0.9519 - val_loss: 0.2543
Epoch 79/500
13/13 0s 3ms/step - accuracy: 0.9950 - loss: 0.0284 - val_accur
acy: 0.9519 - val_loss: 0.2682
Epoch 80/500
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0204 - val_accur
acy: 0.9519 - val_loss: 0.2808
Epoch 81/500
13/13 0s 3ms/step - accuracy: 0.9881 - loss: 0.0466 - val_accur
acy: 0.9423 - val_loss: 0.2899
Epoch 82/500
13/13 0s 3ms/step - accuracy: 0.9862 - loss: 0.0237 - val_accur
acy: 0.9519 - val_loss: 0.2732
Epoch 83/500
13/13 0s 3ms/step - accuracy: 0.9928 - loss: 0.0158 - val_accur
acy: 0.9519 - val_loss: 0.2788
Epoch 84/500
13/13 0s 3ms/step - accuracy: 0.9861 - loss: 0.0265 - val_accur
acy: 0.9519 - val_loss: 0.2849
Epoch 85/500
13/13 0s 3ms/step - accuracy: 0.9901 - loss: 0.0255 - val_accur
acy: 0.9519 - val_loss: 0.2878
Epoch 86/500
13/13 0s 3ms/step - accuracy: 0.9792 - loss: 0.0382 - val_accur
acy: 0.9519 - val_loss: 0.2821
Epoch 87/500
13/13 0s 3ms/step - accuracy: 0.9883 - loss: 0.0472 - val_accur
acy: 0.9519 - val_loss: 0.2881
Epoch 88/500
13/13 0s 3ms/step - accuracy: 0.9906 - loss: 0.0187 - val_accur
acy: 0.9423 - val_loss: 0.3127
Epoch 89/500
13/13 0s 3ms/step - accuracy: 0.9849 - loss: 0.0299 - val_accur
acy: 0.9519 - val_loss: 0.3145
Epoch 90/500
13/13 0s 3ms/step - accuracy: 0.9948 - loss: 0.0116 - val_accur
acy: 0.9519 - val_loss: 0.3031
Epoch 91/500
13/13 0s 3ms/step - accuracy: 0.9949 - loss: 0.0204 - val_accur
acy: 0.9519 - val_loss: 0.3128
Epoch 92/500
13/13 0s 3ms/step - accuracy: 0.9927 - loss: 0.0245 - val_accur
acy: 0.9519 - val_loss: 0.3157
Epoch 93/500
13/13 0s 3ms/step - accuracy: 0.9932 - loss: 0.0284 - val_accur
acy: 0.9519 - val_loss: 0.2947
Epoch 94/500
```

```
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9924 - loss: 0.0141 - val_accuracy: 0.9519 - val_loss: 0.2891
Epoch 95/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9908 - loss: 0.0129 - val_accuracy: 0.9519 - val_loss: 0.2906
Epoch 96/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9969 - loss: 0.0163 - val_accuracy: 0.9519 - val_loss: 0.2923
Epoch 97/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9901 - loss: 0.0345 - val_accuracy: 0.9519 - val_loss: 0.2905
Epoch 98/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9970 - loss: 0.0147 - val_accuracy: 0.9519 - val_loss: 0.2892
Epoch 99/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9870 - loss: 0.0333 - val_accuracy: 0.9423 - val_loss: 0.3213
Epoch 100/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9915 - loss: 0.0195 - val_accuracy: 0.9423 - val_loss: 0.3355
Epoch 101/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9946 - loss: 0.0144 - val_accuracy: 0.9423 - val_loss: 0.3185
Epoch 102/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9910 - loss: 0.0165 - val_accuracy: 0.9519 - val_loss: 0.3078
Epoch 103/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9974 - loss: 0.0158 - val_accuracy: 0.9519 - val_loss: 0.3082
Epoch 104/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9951 - loss: 0.0141 - val_accuracy: 0.9519 - val_loss: 0.3188
Epoch 105/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0073 - val_accuracy: 0.9519 - val_loss: 0.3204
Epoch 106/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0039 - val_accuracy: 0.9519 - val_loss: 0.3234
Epoch 107/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9961 - loss: 0.0155 - val_accuracy: 0.9519 - val_loss: 0.3140
Epoch 108/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9979 - loss: 0.0186 - val_accuracy: 0.9519 - val_loss: 0.3109
Epoch 109/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9952 - loss: 0.0129 - val_accuracy: 0.9519 - val_loss: 0.3238
Epoch 110/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9772 - loss: 0.0353 - val_accuracy: 0.9519 - val_loss: 0.3224
Epoch 111/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9897 - loss: 0.0200 - val_accuracy: 0.9519 - val_loss: 0.3150
Epoch 112/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9948 - loss: 0.0126 - val_accuracy: 0.9519 - val_loss: 0.3170
```

Epoch 113/500
13/13 0s 3ms/step - accuracy: 0.9987 - loss: 0.0074 - val_accuracy: 0.9519 - val_loss: 0.3158
Epoch 114/500
13/13 0s 3ms/step - accuracy: 0.9983 - loss: 0.0084 - val_accuracy: 0.9423 - val_loss: 0.3409
Epoch 115/500
13/13 0s 3ms/step - accuracy: 0.9941 - loss: 0.0194 - val_accuracy: 0.9423 - val_loss: 0.3364
Epoch 116/500
13/13 0s 3ms/step - accuracy: 0.9939 - loss: 0.0213 - val_accuracy: 0.9519 - val_loss: 0.3358
Epoch 117/500
13/13 0s 3ms/step - accuracy: 0.9955 - loss: 0.0139 - val_accuracy: 0.9423 - val_loss: 0.3539
Epoch 118/500
13/13 0s 4ms/step - accuracy: 0.9981 - loss: 0.0096 - val_accuracy: 0.9519 - val_loss: 0.3484
Epoch 119/500
13/13 0s 3ms/step - accuracy: 0.9976 - loss: 0.0090 - val_accuracy: 0.9519 - val_loss: 0.3465
Epoch 120/500
13/13 0s 3ms/step - accuracy: 0.9884 - loss: 0.0259 - val_accuracy: 0.9519 - val_loss: 0.3509
Epoch 121/500
13/13 0s 4ms/step - accuracy: 0.9995 - loss: 0.0147 - val_accuracy: 0.9423 - val_loss: 0.3590
Epoch 122/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0095 - val_accuracy: 0.9519 - val_loss: 0.3568
Epoch 123/500
13/13 0s 3ms/step - accuracy: 0.9937 - loss: 0.0135 - val_accuracy: 0.9519 - val_loss: 0.3584
Epoch 124/500
13/13 0s 4ms/step - accuracy: 0.9990 - loss: 0.0085 - val_accuracy: 0.9519 - val_loss: 0.3609
Epoch 125/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0058 - val_accuracy: 0.9519 - val_loss: 0.3608
Epoch 126/500
13/13 0s 3ms/step - accuracy: 0.9895 - loss: 0.0216 - val_accuracy: 0.9519 - val_loss: 0.3554
Epoch 127/500
13/13 0s 3ms/step - accuracy: 0.9877 - loss: 0.0167 - val_accuracy: 0.9519 - val_loss: 0.3604
Epoch 128/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0032 - val_accuracy: 0.9519 - val_loss: 0.3622
Epoch 129/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0086 - val_accuracy: 0.9519 - val_loss: 0.3616
Epoch 130/500
13/13 0s 3ms/step - accuracy: 0.9901 - loss: 0.0136 - val_accuracy: 0.9519 - val_loss: 0.3650
Epoch 131/500
13/13 0s 3ms/step - accuracy: 0.9968 - loss: 0.0139 - val_accuracy:

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acy: 0.9519 - val_loss: 0.3695
Epoch 132/500
13/13 0s 3ms/step - accuracy: 0.9954 - loss: 0.0145 - val_accur
acy: 0.9519 - val_loss: 0.3692
Epoch 133/500
13/13 0s 3ms/step - accuracy: 0.9857 - loss: 0.0161 - val_accur
acy: 0.9519 - val_loss: 0.3756
Epoch 134/500
13/13 0s 3ms/step - accuracy: 0.9960 - loss: 0.0108 - val_accur
acy: 0.9423 - val_loss: 0.3921
Epoch 135/500
13/13 0s 3ms/step - accuracy: 0.9826 - loss: 0.0484 - val_accur
acy: 0.9519 - val_loss: 0.3716
Epoch 136/500
13/13 0s 3ms/step - accuracy: 0.9910 - loss: 0.0162 - val_accur
acy: 0.9519 - val_loss: 0.3604
Epoch 137/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0075 - val_accur
acy: 0.9519 - val_loss: 0.3549
Epoch 138/500
13/13 0s 3ms/step - accuracy: 0.9907 - loss: 0.0349 - val_accur
acy: 0.9519 - val_loss: 0.3516
Epoch 139/500
13/13 0s 3ms/step - accuracy: 0.9993 - loss: 0.0097 - val_accur
acy: 0.9519 - val_loss: 0.3480
Epoch 140/500
13/13 0s 3ms/step - accuracy: 0.9956 - loss: 0.0168 - val_accur
acy: 0.9519 - val_loss: 0.3447
Epoch 141/500
13/13 0s 3ms/step - accuracy: 0.9992 - loss: 0.0062 - val_accur
acy: 0.9519 - val_loss: 0.3491
Epoch 142/500
13/13 0s 3ms/step - accuracy: 0.9983 - loss: 0.0042 - val_accur
acy: 0.9519 - val_loss: 0.3508
Epoch 143/500
13/13 0s 3ms/step - accuracy: 0.9950 - loss: 0.0099 - val_accur
acy: 0.9519 - val_loss: 0.3454
Epoch 144/500
13/13 0s 3ms/step - accuracy: 0.9871 - loss: 0.0350 - val_accur
acy: 0.9519 - val_loss: 0.3518
Epoch 145/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0057 - val_accur
acy: 0.9423 - val_loss: 0.3999
Epoch 146/500
13/13 0s 4ms/step - accuracy: 0.9888 - loss: 0.0137 - val_accur
acy: 0.9423 - val_loss: 0.4046
Epoch 147/500
13/13 0s 3ms/step - accuracy: 0.9874 - loss: 0.0205 - val_accur
acy: 0.9423 - val_loss: 0.4048
Epoch 148/500
13/13 0s 3ms/step - accuracy: 0.9938 - loss: 0.0143 - val_accur
acy: 0.9423 - val_loss: 0.3856
Epoch 149/500
13/13 0s 3ms/step - accuracy: 0.9984 - loss: 0.0052 - val_accur
acy: 0.9519 - val_loss: 0.3690
Epoch 150/500
```

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13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9918 - loss: 0.0236 - val_accuracy: 0.9519 - val_loss: 0.3745
Epoch 151/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9985 - loss: 0.0084 - val_accuracy: 0.9519 - val_loss: 0.3706
Epoch 152/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9988 - loss: 0.0059 - val_accuracy: 0.9519 - val_loss: 0.3787
Epoch 153/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9988 - loss: 0.0071 - val_accuracy: 0.9423 - val_loss: 0.3979
Epoch 154/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9997 - loss: 0.0053 - val_accuracy: 0.9519 - val_loss: 0.3875
Epoch 155/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9926 - loss: 0.0179 - val_accuracy: 0.9519 - val_loss: 0.3942
Epoch 156/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9984 - loss: 0.0038 - val_accuracy: 0.9519 - val_loss: 0.3935
Epoch 157/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9942 - loss: 0.0142 - val_accuracy: 0.9519 - val_loss: 0.3917
Epoch 158/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0037 - val_accuracy: 0.9423 - val_loss: 0.3927
Epoch 159/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9914 - loss: 0.0177 - val_accuracy: 0.9519 - val_loss: 0.4053
Epoch 160/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0021 - val_accuracy: 0.9519 - val_loss: 0.4253
Epoch 161/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9927 - loss: 0.0150 - val_accuracy: 0.9519 - val_loss: 0.4309
Epoch 162/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9985 - loss: 0.0043 - val_accuracy: 0.9519 - val_loss: 0.4256
Epoch 163/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0043 - val_accuracy: 0.9519 - val_loss: 0.4236
Epoch 164/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0082 - val_accuracy: 0.9519 - val_loss: 0.4251
Epoch 165/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9982 - loss: 0.0063 - val_accuracy: 0.9423 - val_loss: 0.4534
Epoch 166/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9990 - loss: 0.0054 - val_accuracy: 0.9423 - val_loss: 0.4854
Epoch 167/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9991 - loss: 0.0088 - val_accuracy: 0.9423 - val_loss: 0.4545
Epoch 168/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9944 - loss: 0.0200 - val_accuracy: 0.9519 - val_loss: 0.4361
```

Epoch 169/500
13/13 0s 4ms/step - accuracy: 0.9988 - loss: 0.0045 - val_accuracy: 0.9519 - val_loss: 0.4196
Epoch 170/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0025 - val_accuracy: 0.9519 - val_loss: 0.4184
Epoch 171/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0084 - val_accuracy: 0.9519 - val_loss: 0.4158
Epoch 172/500
13/13 0s 3ms/step - accuracy: 0.9855 - loss: 0.0167 - val_accuracy: 0.9519 - val_loss: 0.4291
Epoch 173/500
13/13 0s 3ms/step - accuracy: 0.9909 - loss: 0.0275 - val_accuracy: 0.9423 - val_loss: 0.4419
Epoch 174/500
13/13 0s 3ms/step - accuracy: 0.9990 - loss: 0.0017 - val_accuracy: 0.9423 - val_loss: 0.4367
Epoch 175/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0037 - val_accuracy: 0.9519 - val_loss: 0.4289
Epoch 176/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0077 - val_accuracy: 0.9519 - val_loss: 0.4314
Epoch 177/500
13/13 0s 3ms/step - accuracy: 0.9931 - loss: 0.0118 - val_accuracy: 0.9519 - val_loss: 0.4354
Epoch 178/500
13/13 0s 3ms/step - accuracy: 0.9961 - loss: 0.0077 - val_accuracy: 0.9519 - val_loss: 0.4405
Epoch 179/500
13/13 0s 3ms/step - accuracy: 0.9982 - loss: 0.0167 - val_accuracy: 0.9519 - val_loss: 0.4246
Epoch 180/500
13/13 0s 3ms/step - accuracy: 0.9990 - loss: 0.0084 - val_accuracy: 0.9519 - val_loss: 0.4304
Epoch 181/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0072 - val_accuracy: 0.9519 - val_loss: 0.4256
Epoch 182/500
13/13 0s 3ms/step - accuracy: 0.9970 - loss: 0.0062 - val_accuracy: 0.9519 - val_loss: 0.4264
Epoch 183/500
13/13 0s 3ms/step - accuracy: 0.9935 - loss: 0.0142 - val_accuracy: 0.9519 - val_loss: 0.4405
Epoch 184/500
13/13 0s 3ms/step - accuracy: 0.9974 - loss: 0.0074 - val_accuracy: 0.9423 - val_loss: 0.4412
Epoch 185/500
13/13 0s 3ms/step - accuracy: 0.9924 - loss: 0.0261 - val_accuracy: 0.9423 - val_loss: 0.4589
Epoch 186/500
13/13 0s 3ms/step - accuracy: 0.9920 - loss: 0.0186 - val_accuracy: 0.9519 - val_loss: 0.4438
Epoch 187/500
13/13 0s 3ms/step - accuracy: 0.9942 - loss: 0.0112 - val_accuracy:

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acy: 0.9423 - val_loss: 0.4509
Epoch 188/500
13/13 0s 3ms/step - accuracy: 0.9935 - loss: 0.0272 - val_accur
acy: 0.9519 - val_loss: 0.4405
Epoch 189/500
13/13 0s 3ms/step - accuracy: 0.9974 - loss: 0.0058 - val_accur
acy: 0.9519 - val_loss: 0.4486
Epoch 190/500
13/13 0s 4ms/step - accuracy: 0.9929 - loss: 0.0228 - val_accur
acy: 0.9519 - val_loss: 0.4603
Epoch 191/500
13/13 0s 3ms/step - accuracy: 0.9973 - loss: 0.0105 - val_accur
acy: 0.9519 - val_loss: 0.4437
Epoch 192/500
13/13 0s 4ms/step - accuracy: 0.9923 - loss: 0.0124 - val_accur
acy: 0.9519 - val_loss: 0.4451
Epoch 193/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0033 - val_accur
acy: 0.9519 - val_loss: 0.4541
Epoch 194/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0033 - val_accur
acy: 0.9519 - val_loss: 0.4557
Epoch 195/500
13/13 0s 4ms/step - accuracy: 0.9968 - loss: 0.0071 - val_accur
acy: 0.9519 - val_loss: 0.4432
Epoch 196/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0060 - val_accur
acy: 0.9519 - val_loss: 0.4415
Epoch 197/500
13/13 0s 3ms/step - accuracy: 0.9934 - loss: 0.0142 - val_accur
acy: 0.9519 - val_loss: 0.4484
Epoch 198/500
13/13 0s 3ms/step - accuracy: 0.9993 - loss: 0.0040 - val_accur
acy: 0.9423 - val_loss: 0.4646
Epoch 199/500
13/13 0s 3ms/step - accuracy: 0.9988 - loss: 0.0053 - val_accur
acy: 0.9423 - val_loss: 0.4626
Epoch 200/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0030 - val_accur
acy: 0.9519 - val_loss: 0.4460
Epoch 201/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0051 - val_accur
acy: 0.9519 - val_loss: 0.4410
Epoch 202/500
13/13 0s 3ms/step - accuracy: 0.9923 - loss: 0.0106 - val_accur
acy: 0.9519 - val_loss: 0.4492
Epoch 203/500
13/13 0s 3ms/step - accuracy: 0.9918 - loss: 0.0171 - val_accur
acy: 0.9519 - val_loss: 0.4568
Epoch 204/500
13/13 0s 3ms/step - accuracy: 0.9955 - loss: 0.0094 - val_accur
acy: 0.9519 - val_loss: 0.4587
Epoch 205/500
13/13 0s 3ms/step - accuracy: 0.9993 - loss: 0.0041 - val_accur
acy: 0.9519 - val_loss: 0.4641
Epoch 206/500
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13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0046 - val_accuracy: 0.9519 - val_loss: 0.4638
Epoch 207/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9985 - loss: 0.0113 - val_accuracy: 0.9519 - val_loss: 0.4602
Epoch 208/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0023 - val_accuracy: 0.9519 - val_loss: 0.4593
Epoch 209/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accuracy: 0.9519 - val_loss: 0.4632
Epoch 210/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9939 - loss: 0.0205 - val_accuracy: 0.9519 - val_loss: 0.4676
Epoch 211/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9950 - loss: 0.0069 - val_accuracy: 0.9519 - val_loss: 0.4601
Epoch 212/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9941 - loss: 0.0079 - val_accuracy: 0.9519 - val_loss: 0.4613
Epoch 213/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9942 - loss: 0.0134 - val_accuracy: 0.9519 - val_loss: 0.4709
Epoch 214/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0028 - val_accuracy: 0.9519 - val_loss: 0.4734
Epoch 215/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9950 - loss: 0.0131 - val_accuracy: 0.9519 - val_loss: 0.4808
Epoch 216/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9968 - loss: 0.0134 - val_accuracy: 0.9519 - val_loss: 0.4688
Epoch 217/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0056 - val_accuracy: 0.9519 - val_loss: 0.4680
Epoch 218/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0053 - val_accuracy: 0.9519 - val_loss: 0.4746
Epoch 219/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9982 - loss: 0.0051 - val_accuracy: 0.9519 - val_loss: 0.4872
Epoch 220/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9990 - loss: 0.0076 - val_accuracy: 0.9519 - val_loss: 0.4812
Epoch 221/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9978 - loss: 0.0084 - val_accuracy: 0.9519 - val_loss: 0.4764
Epoch 222/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9971 - loss: 0.0383 - val_accuracy: 0.9519 - val_loss: 0.4794
Epoch 223/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9961 - loss: 0.0113 - val_accuracy: 0.9519 - val_loss: 0.5168
Epoch 224/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9997 - loss: 0.0053 - val_accuracy: 0.9519 - val_loss: 0.5268
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Epoch 225/500
13/13 0s 4ms/step - accuracy: 0.9883 - loss: 0.0118 - val_accuracy: 0.9519 - val_loss: 0.5255
Epoch 226/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0035 - val_accuracy: 0.9519 - val_loss: 0.5279
Epoch 227/500
13/13 0s 5ms/step - accuracy: 0.9972 - loss: 0.0060 - val_accuracy: 0.9519 - val_loss: 0.5326
Epoch 228/500
13/13 0s 3ms/step - accuracy: 0.9943 - loss: 0.0111 - val_accuracy: 0.9519 - val_loss: 0.5344
Epoch 229/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0049 - val_accuracy: 0.9519 - val_loss: 0.5342
Epoch 230/500
13/13 0s 4ms/step - accuracy: 0.9961 - loss: 0.0043 - val_accuracy: 0.9423 - val_loss: 0.5473
Epoch 231/500
13/13 0s 4ms/step - accuracy: 0.9963 - loss: 0.0067 - val_accuracy: 0.9423 - val_loss: 0.5662
Epoch 232/500
13/13 0s 4ms/step - accuracy: 0.9933 - loss: 0.0107 - val_accuracy: 0.9519 - val_loss: 0.5419
Epoch 233/500
13/13 0s 4ms/step - accuracy: 0.9985 - loss: 0.0043 - val_accuracy: 0.9519 - val_loss: 0.5338
Epoch 234/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 4.0410e-04 - val_accuracy: 0.9519 - val_loss: 0.5311
Epoch 235/500
13/13 0s 4ms/step - accuracy: 0.9970 - loss: 0.0047 - val_accuracy: 0.9519 - val_loss: 0.5414
Epoch 236/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0036 - val_accuracy: 0.9519 - val_loss: 0.5721
Epoch 237/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0032 - val_accuracy: 0.9519 - val_loss: 0.5869
Epoch 238/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0011 - val_accuracy: 0.9519 - val_loss: 0.5938
Epoch 239/500
13/13 0s 3ms/step - accuracy: 0.9968 - loss: 0.0032 - val_accuracy: 0.9519 - val_loss: 0.6025
Epoch 240/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0030 - val_accuracy: 0.9519 - val_loss: 0.6030
Epoch 241/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0027 - val_accuracy: 0.9519 - val_loss: 0.5992
Epoch 242/500
13/13 0s 4ms/step - accuracy: 0.9978 - loss: 0.0044 - val_accuracy: 0.9519 - val_loss: 0.5955
Epoch 243/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 9.6895e-04 - val_accuracy: 0.9519 - val_loss: 0.5955

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accuracy: 0.9519 - val_loss: 0.5986
Epoch 244/500
13/13 ━━━━━━━━ 0s 5ms/step - accuracy: 0.9997 - loss: 0.0022 - val_accuracy: 0.9519 - val_loss: 0.5992
Epoch 245/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9923 - loss: 0.0152 - val_accuracy: 0.9519 - val_loss: 0.6132
Epoch 246/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9848 - loss: 0.0186 - val_accuracy: 0.9519 - val_loss: 0.5951
Epoch 247/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9978 - loss: 0.0113 - val_accuracy: 0.9519 - val_loss: 0.5497
Epoch 248/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9942 - loss: 0.0147 - val_accuracy: 0.9519 - val_loss: 0.5479
Epoch 249/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9892 - loss: 0.0155 - val_accuracy: 0.9519 - val_loss: 0.5584
Epoch 250/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9981 - loss: 0.0084 - val_accuracy: 0.9519 - val_loss: 0.5565
Epoch 251/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9970 - loss: 0.0207 - val_accuracy: 0.9423 - val_loss: 0.5711
Epoch 252/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0018 - val_accuracy: 0.9519 - val_loss: 0.5340
Epoch 253/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9938 - loss: 0.0109 - val_accuracy: 0.9519 - val_loss: 0.5397
Epoch 254/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0015 - val_accuracy: 0.9519 - val_loss: 0.5475
Epoch 255/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9996 - loss: 0.0033 - val_accuracy: 0.9519 - val_loss: 0.5515
Epoch 256/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9978 - loss: 0.0095 - val_accuracy: 0.9519 - val_loss: 0.5487
Epoch 257/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9895 - loss: 0.0135 - val_accuracy: 0.9519 - val_loss: 0.5442
Epoch 258/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9888 - loss: 0.0212 - val_accuracy: 0.9519 - val_loss: 0.5576
Epoch 259/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9974 - loss: 0.0074 - val_accuracy: 0.9519 - val_loss: 0.5524
Epoch 260/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9950 - loss: 0.0084 - val_accuracy: 0.9519 - val_loss: 0.5594
Epoch 261/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9911 - loss: 0.0162 - val_accuracy: 0.9519 - val_loss: 0.5533
Epoch 262/500
```

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13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0021 - val_accuracy: 0.9519 - val_loss: 0.5625
Epoch 263/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9930 - loss: 0.0133 - val_accuracy: 0.9519 - val_loss: 0.5519
Epoch 264/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9976 - loss: 0.0139 - val_accuracy: 0.9519 - val_loss: 0.5613
Epoch 265/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9962 - loss: 0.0139 - val_accuracy: 0.9519 - val_loss: 0.5582
Epoch 266/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9950 - loss: 0.0116 - val_accuracy: 0.9519 - val_loss: 0.5510
Epoch 267/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0048 - val_accuracy: 0.9519 - val_loss: 0.5599
Epoch 268/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9974 - loss: 0.0046 - val_accuracy: 0.9519 - val_loss: 0.5674
Epoch 269/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9970 - loss: 0.0054 - val_accuracy: 0.9519 - val_loss: 0.5619
Epoch 270/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0023 - val_accuracy: 0.9519 - val_loss: 0.5547
Epoch 271/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accuracy: 0.9519 - val_loss: 0.5564
Epoch 272/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9974 - loss: 0.0042 - val_accuracy: 0.9519 - val_loss: 0.5817
Epoch 273/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9984 - loss: 0.0036 - val_accuracy: 0.9519 - val_loss: 0.6029
Epoch 274/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9912 - loss: 0.0257 - val_accuracy: 0.9519 - val_loss: 0.6088
Epoch 275/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9974 - loss: 0.0037 - val_accuracy: 0.9519 - val_loss: 0.6141
Epoch 276/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0035 - val_accuracy: 0.9519 - val_loss: 0.6142
Epoch 277/500
13/13 ━━━━━━ 0s 4ms/step - accuracy: 0.9961 - loss: 0.0138 - val_accuracy: 0.9519 - val_loss: 0.6221
Epoch 278/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0038 - val_accuracy: 0.9519 - val_loss: 0.6258
Epoch 279/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 0.9982 - loss: 0.0048 - val_accuracy: 0.9519 - val_loss: 0.6308
Epoch 280/500
13/13 ━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 4.9294e-04 - val_accuracy: 0.9519 - val_loss: 0.6332
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Epoch 281/500
13/13 0s 3ms/step - accuracy: 0.9993 - loss: 0.0030 - val_accuracy: 0.9519 - val_loss: 0.6352
Epoch 282/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0042 - val_accuracy: 0.9519 - val_loss: 0.6416
Epoch 283/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0011 - val_accuracy: 0.9519 - val_loss: 0.6436
Epoch 284/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accuracy: 0.9519 - val_loss: 0.6389
Epoch 285/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0026 - val_accuracy: 0.9519 - val_loss: 0.6401
Epoch 286/500
13/13 0s 5ms/step - accuracy: 0.9950 - loss: 0.0107 - val_accuracy: 0.9519 - val_loss: 0.6293
Epoch 287/500
13/13 0s 3ms/step - accuracy: 0.9997 - loss: 0.0030 - val_accuracy: 0.9519 - val_loss: 0.6351
Epoch 288/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0038 - val_accuracy: 0.9519 - val_loss: 0.6538
Epoch 289/500
13/13 0s 4ms/step - accuracy: 0.9993 - loss: 0.0026 - val_accuracy: 0.9519 - val_loss: 0.6466
Epoch 290/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 5.4755e-04 - val_accuracy: 0.9519 - val_loss: 0.6318
Epoch 291/500
13/13 0s 3ms/step - accuracy: 0.9978 - loss: 0.0085 - val_accuracy: 0.9519 - val_loss: 0.6314
Epoch 292/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0021 - val_accuracy: 0.9519 - val_loss: 0.6343
Epoch 293/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0034 - val_accuracy: 0.9519 - val_loss: 0.6300
Epoch 294/500
13/13 0s 3ms/step - accuracy: 0.9988 - loss: 0.0026 - val_accuracy: 0.9519 - val_loss: 0.6249
Epoch 295/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0017 - val_accuracy: 0.9519 - val_loss: 0.6258
Epoch 296/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0025 - val_accuracy: 0.9519 - val_loss: 0.6281
Epoch 297/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0016 - val_accuracy: 0.9519 - val_loss: 0.6295
Epoch 298/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0031 - val_accuracy: 0.9519 - val_loss: 0.6330
Epoch 299/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0018 - val_accuracy:

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acy: 0.9519 - val_loss: 0.6416
Epoch 300/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0054 - val_accur
acy: 0.9519 - val_loss: 0.6461
Epoch 301/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0010 - val_accur
acy: 0.9519 - val_loss: 0.6471
Epoch 302/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0015 - val_accur
acy: 0.9519 - val_loss: 0.6475
Epoch 303/500
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0057 - val_accur
acy: 0.9519 - val_loss: 0.6524
Epoch 304/500
13/13 0s 3ms/step - accuracy: 0.9968 - loss: 0.0052 - val_accur
acy: 0.9519 - val_loss: 0.6439
Epoch 305/500
13/13 0s 3ms/step - accuracy: 0.9961 - loss: 0.0151 - val_accur
acy: 0.9519 - val_loss: 0.6520
Epoch 306/500
13/13 0s 3ms/step - accuracy: 0.9974 - loss: 0.0038 - val_accur
acy: 0.9519 - val_loss: 0.6600
Epoch 307/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0028 - val_accur
acy: 0.9519 - val_loss: 0.6659
Epoch 308/500
13/13 0s 3ms/step - accuracy: 0.9961 - loss: 0.0076 - val_accur
acy: 0.9519 - val_loss: 0.6706
Epoch 309/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0013 - val_accur
acy: 0.9519 - val_loss: 0.6763
Epoch 310/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0012 - val_accur
acy: 0.9519 - val_loss: 0.6783
Epoch 311/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0014 - val_accur
acy: 0.9519 - val_loss: 0.6762
Epoch 312/500
13/13 0s 3ms/step - accuracy: 0.9993 - loss: 0.0017 - val_accur
acy: 0.9519 - val_loss: 0.6799
Epoch 313/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 2.0540e-04 - val_accur
accuracy: 0.9519 - val_loss: 0.6865
Epoch 314/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0014 - val_accur
acy: 0.9519 - val_loss: 0.6911
Epoch 315/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 4.2127e-04 - val_accur
accuracy: 0.9519 - val_loss: 0.6923
Epoch 316/500
13/13 0s 3ms/step - accuracy: 0.9988 - loss: 0.0020 - val_accur
acy: 0.9519 - val_loss: 0.6969
Epoch 317/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0011 - val_accur
acy: 0.9519 - val_loss: 0.6993
Epoch 318/500
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13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9974 - loss: 0.0045 - val_accuracy: 0.9519 - val_loss: 0.7037
Epoch 319/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0031 - val_accuracy: 0.9519 - val_loss: 0.7060
Epoch 320/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0018 - val_accuracy: 0.9519 - val_loss: 0.7058
Epoch 321/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 5.4085e-04 - val_accuracy: 0.9519 - val_loss: 0.7070
Epoch 322/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 1.3061e-04 - val_accuracy: 0.9519 - val_loss: 0.7074
Epoch 323/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0036 - val_accuracy: 0.9519 - val_loss: 0.7086
Epoch 324/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0026 - val_accuracy: 0.9519 - val_loss: 0.7230
Epoch 325/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9985 - loss: 0.0024 - val_accuracy: 0.9519 - val_loss: 0.7277
Epoch 326/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9997 - loss: 0.0010 - val_accuracy: 0.9519 - val_loss: 0.7245
Epoch 327/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0017 - val_accuracy: 0.9519 - val_loss: 0.7230
Epoch 328/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9959 - loss: 0.0051 - val_accuracy: 0.9519 - val_loss: 0.7145
Epoch 329/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9955 - loss: 0.0117 - val_accuracy: 0.9519 - val_loss: 0.7107
Epoch 330/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9950 - loss: 0.0055 - val_accuracy: 0.9519 - val_loss: 0.7081
Epoch 331/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9968 - loss: 0.0045 - val_accuracy: 0.9519 - val_loss: 0.7062
Epoch 332/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9927 - loss: 0.0089 - val_accuracy: 0.9519 - val_loss: 0.7022
Epoch 333/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0020 - val_accuracy: 0.9519 - val_loss: 0.7039
Epoch 334/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9961 - loss: 0.0062 - val_accuracy: 0.9519 - val_loss: 0.7067
Epoch 335/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0015 - val_accuracy: 0.9519 - val_loss: 0.7095
Epoch 336/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9988 - loss: 0.0021 - val_accuracy: 0.9519 - val_loss: 0.7169
```

Epoch 337/500
13/13 0s 3ms/step - accuracy: 0.9989 - loss: 0.0038 - val_accuracy: 0.9519 - val_loss: 0.7208
Epoch 338/500
13/13 0s 3ms/step - accuracy: 0.9988 - loss: 0.0037 - val_accuracy: 0.9423 - val_loss: 0.7233
Epoch 339/500
13/13 0s 3ms/step - accuracy: 0.9952 - loss: 0.0101 - val_accuracy: 0.9423 - val_loss: 0.7268
Epoch 340/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0026 - val_accuracy: 0.9423 - val_loss: 0.7417
Epoch 341/500
13/13 0s 3ms/step - accuracy: 0.9997 - loss: 0.0021 - val_accuracy: 0.9423 - val_loss: 0.7414
Epoch 342/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 6.3633e-04 - val_accuracy: 0.9519 - val_loss: 0.7119
Epoch 343/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0040 - val_accuracy: 0.9519 - val_loss: 0.7041
Epoch 344/500
13/13 0s 3ms/step - accuracy: 0.9987 - loss: 0.0048 - val_accuracy: 0.9519 - val_loss: 0.6772
Epoch 345/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0024 - val_accuracy: 0.9519 - val_loss: 0.6715
Epoch 346/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0021 - val_accuracy: 0.9519 - val_loss: 0.6765
Epoch 347/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0018 - val_accuracy: 0.9519 - val_loss: 0.6886
Epoch 348/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0020 - val_accuracy: 0.9519 - val_loss: 0.7010
Epoch 349/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 8.3918e-04 - val_accuracy: 0.9423 - val_loss: 0.7124
Epoch 350/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0033 - val_accuracy: 0.9519 - val_loss: 0.7130
Epoch 351/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0030 - val_accuracy: 0.9519 - val_loss: 0.7044
Epoch 352/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0010 - val_accuracy: 0.9519 - val_loss: 0.7065
Epoch 353/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 9.4226e-04 - val_accuracy: 0.9519 - val_loss: 0.7105
Epoch 354/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 7.9643e-04 - val_accuracy: 0.9519 - val_loss: 0.7138
Epoch 355/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 6.1316e-04 - val_accuracy: 0.9519 - val_loss: 0.7138

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accuracy: 0.9519 - val_loss: 0.7151
Epoch 356/500
13/13 0s 3ms/step - accuracy: 0.9961 - loss: 0.0064 - val_accuracy: 0.9519 - val_loss: 0.7257
Epoch 357/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 4.7072e-04 - val_accuracy: 0.9519 - val_loss: 0.7320
Epoch 358/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 9.9285e-04 - val_accuracy: 0.9519 - val_loss: 0.7365
Epoch 359/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 8.6872e-04 - val_accuracy: 0.9423 - val_loss: 0.7810
Epoch 360/500
13/13 0s 3ms/step - accuracy: 0.9974 - loss: 0.0025 - val_accuracy: 0.9423 - val_loss: 0.8693
Epoch 361/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0011 - val_accuracy: 0.9423 - val_loss: 0.8751
Epoch 362/500
13/13 0s 3ms/step - accuracy: 0.9978 - loss: 0.0333 - val_accuracy: 0.9519 - val_loss: 0.7136
Epoch 363/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0011 - val_accuracy: 0.9519 - val_loss: 0.6977
Epoch 364/500
13/13 0s 3ms/step - accuracy: 0.9982 - loss: 0.0081 - val_accuracy: 0.9519 - val_loss: 0.7019
Epoch 365/500
13/13 0s 3ms/step - accuracy: 0.9964 - loss: 0.0170 - val_accuracy: 0.9519 - val_loss: 0.7150
Epoch 366/500
13/13 0s 5ms/step - accuracy: 1.0000 - loss: 0.0016 - val_accuracy: 0.9519 - val_loss: 0.7214
Epoch 367/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0036 - val_accuracy: 0.9519 - val_loss: 0.7249
Epoch 368/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 5.4894e-04 - val_accuracy: 0.9519 - val_loss: 0.7255
Epoch 369/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0012 - val_accuracy: 0.9519 - val_loss: 0.7300
Epoch 370/500
13/13 0s 3ms/step - accuracy: 0.9991 - loss: 0.0051 - val_accuracy: 0.9519 - val_loss: 0.7340
Epoch 371/500
13/13 0s 3ms/step - accuracy: 0.9988 - loss: 0.0068 - val_accuracy: 0.9423 - val_loss: 0.7338
Epoch 372/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0037 - val_accuracy: 0.9423 - val_loss: 0.8059
Epoch 373/500
13/13 0s 3ms/step - accuracy: 0.9952 - loss: 0.0499 - val_accuracy: 0.9519 - val_loss: 0.7158
Epoch 374/500
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13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9949 - loss: 0.0168 - val_accuracy: 0.9519 - val_loss: 0.7240
Epoch 375/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9940 - loss: 0.0348 - val_accuracy: 0.9519 - val_loss: 0.7145
Epoch 376/500
13/13 ━━━━━━━━ 0s 5ms/step - accuracy: 0.9985 - loss: 0.0033 - val_accuracy: 0.9423 - val_loss: 0.7258
Epoch 377/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9855 - loss: 0.0440 - val_accuracy: 0.9519 - val_loss: 0.7069
Epoch 378/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9903 - loss: 0.0172 - val_accuracy: 0.9519 - val_loss: 0.6820
Epoch 379/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9972 - loss: 0.0123 - val_accuracy: 0.9519 - val_loss: 0.6922
Epoch 380/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0097 - val_accuracy: 0.9423 - val_loss: 0.7050
Epoch 381/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0023 - val_accuracy: 0.9423 - val_loss: 0.7124
Epoch 382/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9982 - loss: 0.0036 - val_accuracy: 0.9423 - val_loss: 0.7231
Epoch 383/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0013 - val_accuracy: 0.9423 - val_loss: 0.7261
Epoch 384/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9988 - loss: 0.0027 - val_accuracy: 0.9423 - val_loss: 0.7275
Epoch 385/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9907 - loss: 0.0126 - val_accuracy: 0.9519 - val_loss: 0.7152
Epoch 386/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9953 - loss: 0.0066 - val_accuracy: 0.9519 - val_loss: 0.6927
Epoch 387/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9978 - loss: 0.0071 - val_accuracy: 0.9423 - val_loss: 0.7356
Epoch 388/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9968 - loss: 0.0116 - val_accuracy: 0.9423 - val_loss: 0.7233
Epoch 389/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9959 - loss: 0.0160 - val_accuracy: 0.9423 - val_loss: 0.7197
Epoch 390/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0015 - val_accuracy: 0.9423 - val_loss: 0.7321
Epoch 391/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9974 - loss: 0.0063 - val_accuracy: 0.9423 - val_loss: 0.7303
Epoch 392/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9993 - loss: 0.0022 - val_accuracy: 0.9423 - val_loss: 0.7168
```

Epoch 393/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0015 - val_accuracy: 0.9423 - val_loss: 0.6987
Epoch 394/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 5.8260e-04 - val_accuracy: 0.9423 - val_loss: 0.6947
Epoch 395/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0033 - val_accuracy: 0.9519 - val_loss: 0.6912
Epoch 396/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0018 - val_accuracy: 0.9423 - val_loss: 0.6992
Epoch 397/500
13/13 0s 3ms/step - accuracy: 0.9978 - loss: 0.0032 - val_accuracy: 0.9423 - val_loss: 0.7063
Epoch 398/500
13/13 0s 4ms/step - accuracy: 0.9993 - loss: 0.0013 - val_accuracy: 0.9423 - val_loss: 0.7094
Epoch 399/500
13/13 0s 3ms/step - accuracy: 0.9973 - loss: 0.0081 - val_accuracy: 0.9423 - val_loss: 0.6981
Epoch 400/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accuracy: 0.9423 - val_loss: 0.6977
Epoch 401/500
13/13 0s 3ms/step - accuracy: 0.9951 - loss: 0.0073 - val_accuracy: 0.9327 - val_loss: 0.7020
Epoch 402/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 5.0992e-04 - val_accuracy: 0.9423 - val_loss: 0.6978
Epoch 403/500
13/13 0s 4ms/step - accuracy: 0.9968 - loss: 0.0065 - val_accuracy: 0.9423 - val_loss: 0.7076
Epoch 404/500
13/13 0s 3ms/step - accuracy: 0.9997 - loss: 0.0029 - val_accuracy: 0.9423 - val_loss: 0.7130
Epoch 405/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 9.9279e-04 - val_accuracy: 0.9423 - val_loss: 0.7107
Epoch 406/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 7.7553e-04 - val_accuracy: 0.9423 - val_loss: 0.7108
Epoch 407/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 8.7991e-04 - val_accuracy: 0.9423 - val_loss: 0.7151
Epoch 408/500
13/13 0s 4ms/step - accuracy: 0.9974 - loss: 0.0061 - val_accuracy: 0.9423 - val_loss: 0.7157
Epoch 409/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0013 - val_accuracy: 0.9519 - val_loss: 0.7107
Epoch 410/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 7.9555e-04 - val_accuracy: 0.9519 - val_loss: 0.7123
Epoch 411/500
13/13 0s 3ms/step - accuracy: 0.9947 - loss: 0.0124 - val_accuracy:

```
acy: 0.9423 - val_loss: 0.7387
Epoch 412/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0011 - val_accur
acy: 0.9423 - val_loss: 0.7560
Epoch 413/500
13/13 0s 5ms/step - accuracy: 0.9968 - loss: 0.0075 - val_accur
acy: 0.9423 - val_loss: 0.7219
Epoch 414/500
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0049 - val_accur
acy: 0.9423 - val_loss: 0.7180
Epoch 415/500
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0022 - val_accur
acy: 0.9423 - val_loss: 0.7181
Epoch 416/500
13/13 0s 4ms/step - accuracy: 0.9948 - loss: 0.0141 - val_accur
acy: 0.9519 - val_loss: 0.7204
Epoch 417/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0038 - val_accur
acy: 0.9519 - val_loss: 0.7112
Epoch 418/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accur
acy: 0.9519 - val_loss: 0.7032
Epoch 419/500
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0045 - val_accur
acy: 0.9519 - val_loss: 0.7088
Epoch 420/500
13/13 0s 3ms/step - accuracy: 0.9955 - loss: 0.0116 - val_accur
acy: 0.9423 - val_loss: 0.7217
Epoch 421/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0025 - val_accur
acy: 0.9519 - val_loss: 0.7146
Epoch 422/500
13/13 0s 3ms/step - accuracy: 0.9940 - loss: 0.0079 - val_accur
acy: 0.9519 - val_loss: 0.7046
Epoch 423/500
13/13 0s 3ms/step - accuracy: 0.9997 - loss: 0.0013 - val_accur
acy: 0.9519 - val_loss: 0.7052
Epoch 424/500
13/13 0s 5ms/step - accuracy: 0.9995 - loss: 0.0058 - val_accur
acy: 0.9519 - val_loss: 0.7005
Epoch 425/500
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0033 - val_accur
acy: 0.9423 - val_loss: 0.7280
Epoch 426/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 0.0014 - val_accur
acy: 0.9423 - val_loss: 0.7385
Epoch 427/500
13/13 0s 3ms/step - accuracy: 0.9990 - loss: 0.0039 - val_accur
acy: 0.9423 - val_loss: 0.7122
Epoch 428/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 9.9100e-04 - val_accur
acy: 0.9519 - val_loss: 0.7027
Epoch 429/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 3.1951e-04 - val_accur
acy: 0.9519 - val_loss: 0.7015
Epoch 430/500
```

```
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 8.0791e-04 - val_accuracy: 0.9519 - val_loss: 0.7029
Epoch 431/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 8.9401e-04 - val_accuracy: 0.9519 - val_loss: 0.7079
Epoch 432/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9974 - loss: 0.0053 - val_accuracy: 0.9423 - val_loss: 0.7245
Epoch 433/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9982 - loss: 0.0034 - val_accuracy: 0.9519 - val_loss: 0.7185
Epoch 434/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 8.1185e-04 - val_accuracy: 0.9519 - val_loss: 0.7148
Epoch 435/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accuracy: 0.9519 - val_loss: 0.7120
Epoch 436/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 1.0000 - loss: 3.7135e-04 - val_accuracy: 0.9519 - val_loss: 0.7108
Epoch 437/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0021 - val_accuracy: 0.9519 - val_loss: 0.7129
Epoch 438/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9918 - loss: 0.0104 - val_accuracy: 0.9519 - val_loss: 0.7265
Epoch 439/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9974 - loss: 0.0027 - val_accuracy: 0.9519 - val_loss: 0.7417
Epoch 440/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 3.7068e-04 - val_accuracy: 0.9519 - val_loss: 0.7473
Epoch 441/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9968 - loss: 0.0102 - val_accuracy: 0.9519 - val_loss: 0.7531
Epoch 442/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0035 - val_accuracy: 0.9519 - val_loss: 0.7416
Epoch 443/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9961 - loss: 0.0044 - val_accuracy: 0.9519 - val_loss: 0.7224
Epoch 444/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9950 - loss: 0.0064 - val_accuracy: 0.9519 - val_loss: 0.7339
Epoch 445/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9919 - loss: 0.0080 - val_accuracy: 0.9519 - val_loss: 0.7316
Epoch 446/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 1.0000 - loss: 0.0026 - val_accuracy: 0.9519 - val_loss: 0.7352
Epoch 447/500
13/13 ━━━━━━━━ 0s 4ms/step - accuracy: 0.9979 - loss: 0.0025 - val_accuracy: 0.9519 - val_loss: 0.7319
Epoch 448/500
13/13 ━━━━━━━━ 0s 3ms/step - accuracy: 0.9960 - loss: 0.0056 - val_accuracy: 0.9519 - val_loss: 0.7359
```

Epoch 449/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0027 - val_accuracy: 0.9519 - val_loss: 0.7400
Epoch 450/500
13/13 0s 3ms/step - accuracy: 0.9968 - loss: 0.0067 - val_accuracy: 0.9519 - val_loss: 0.7517
Epoch 451/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 3.4550e-04 - val_accuracy: 0.9519 - val_loss: 0.7558
Epoch 452/500
13/13 0s 4ms/step - accuracy: 1.0000 - loss: 6.0174e-04 - val_accuracy: 0.9519 - val_loss: 0.7579
Epoch 453/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 2.3297e-04 - val_accuracy: 0.9519 - val_loss: 0.7607
Epoch 454/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0015 - val_accuracy: 0.9519 - val_loss: 0.7629
Epoch 455/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0019 - val_accuracy: 0.9519 - val_loss: 0.7716
Epoch 456/500
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0015 - val_accuracy: 0.9519 - val_loss: 0.7749
Epoch 457/500
13/13 0s 3ms/step - accuracy: 0.9983 - loss: 0.0069 - val_accuracy: 0.9519 - val_loss: 0.7749
Epoch 458/500
13/13 0s 3ms/step - accuracy: 0.9993 - loss: 0.0035 - val_accuracy: 0.9423 - val_loss: 0.7780
Epoch 459/500
13/13 0s 4ms/step - accuracy: 0.9997 - loss: 0.0023 - val_accuracy: 0.9423 - val_loss: 0.7626
Epoch 460/500
13/13 0s 3ms/step - accuracy: 0.9927 - loss: 0.0413 - val_accuracy: 0.9519 - val_loss: 0.7060
Epoch 461/500
13/13 0s 3ms/step - accuracy: 0.9987 - loss: 0.0080 - val_accuracy: 0.9519 - val_loss: 0.7011
Epoch 462/500
13/13 0s 3ms/step - accuracy: 0.9997 - loss: 8.4945e-04 - val_accuracy: 0.9423 - val_loss: 0.7317
Epoch 463/500
13/13 0s 3ms/step - accuracy: 0.9960 - loss: 0.0059 - val_accuracy: 0.9519 - val_loss: 0.7146
Epoch 464/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0013 - val_accuracy: 0.9519 - val_loss: 0.7135
Epoch 465/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 6.7308e-04 - val_accuracy: 0.9519 - val_loss: 0.7135
Epoch 466/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0020 - val_accuracy: 0.9519 - val_loss: 0.7102
Epoch 467/500
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 5.6412e-04 - val_accuracy: 0.9519 - val_loss: 0.7102

```
accuracy: 0.9519 - val_loss: 0.7106
Epoch 468/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 4.7733e-04 - val_a
ccuracy: 0.9519 - val_loss: 0.7131
Epoch 469/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 0.0024 - val_accur
acy: 0.9519 - val_loss: 0.7142
Epoch 470/500
13/13 ————— 0s 5ms/step - accuracy: 1.0000 - loss: 2.5531e-04 - val_a
ccuracy: 0.9519 - val_loss: 0.7163
Epoch 471/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 0.0014 - val_accur
acy: 0.9519 - val_loss: 0.7207
Epoch 472/500
13/13 ————— 0s 3ms/step - accuracy: 0.9978 - loss: 0.0049 - val_accur
acy: 0.9423 - val_loss: 0.7534
Epoch 473/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 6.2372e-04 - val_a
ccuracy: 0.9423 - val_loss: 0.7752
Epoch 474/500
13/13 ————— 0s 3ms/step - accuracy: 0.9995 - loss: 0.0012 - val_accur
acy: 0.9423 - val_loss: 0.7663
Epoch 475/500
13/13 ————— 0s 3ms/step - accuracy: 0.9914 - loss: 0.0220 - val_accur
acy: 0.9519 - val_loss: 0.7228
Epoch 476/500
13/13 ————— 0s 4ms/step - accuracy: 0.9927 - loss: 0.0176 - val_accur
acy: 0.9423 - val_loss: 0.7380
Epoch 477/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 0.0014 - val_accur
acy: 0.9423 - val_loss: 0.7438
Epoch 478/500
13/13 ————— 0s 3ms/step - accuracy: 0.9978 - loss: 0.0034 - val_accur
acy: 0.9423 - val_loss: 0.7761
Epoch 479/500
13/13 ————— 0s 3ms/step - accuracy: 0.9961 - loss: 0.0048 - val_accur
acy: 0.9423 - val_loss: 0.7677
Epoch 480/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 4.8801e-04 - val_a
ccuracy: 0.9423 - val_loss: 0.7389
Epoch 481/500
13/13 ————— 0s 5ms/step - accuracy: 0.9968 - loss: 0.0056 - val_accur
acy: 0.9423 - val_loss: 0.7466
Epoch 482/500
13/13 ————— 0s 3ms/step - accuracy: 0.9988 - loss: 0.0084 - val_accur
acy: 0.9423 - val_loss: 0.7315
Epoch 483/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 0.0012 - val_accur
acy: 0.9519 - val_loss: 0.7156
Epoch 484/500
13/13 ————— 0s 4ms/step - accuracy: 1.0000 - loss: 2.6328e-04 - val_a
ccuracy: 0.9519 - val_loss: 0.7115
Epoch 485/500
13/13 ————— 0s 3ms/step - accuracy: 1.0000 - loss: 0.0034 - val_accur
acy: 0.9519 - val_loss: 0.7267
Epoch 486/500
```

```
13/13 ----- 0s 3ms/step - accuracy: 1.0000 - loss: 6.3966e-04 - val_accuracy: 0.9519 - val_loss: 0.7336
Epoch 487/500
13/13 ----- 0s 3ms/step - accuracy: 1.0000 - loss: 8.9399e-04 - val_accuracy: 0.9519 - val_loss: 0.7336
Epoch 488/500
13/13 ----- 0s 4ms/step - accuracy: 1.0000 - loss: 7.0198e-04 - val_accuracy: 0.9519 - val_loss: 0.7292
Epoch 489/500
13/13 ----- 0s 5ms/step - accuracy: 1.0000 - loss: 7.0655e-04 - val_accuracy: 0.9519 - val_loss: 0.7340
Epoch 490/500
13/13 ----- 0s 4ms/step - accuracy: 1.0000 - loss: 2.4746e-04 - val_accuracy: 0.9519 - val_loss: 0.7378
Epoch 491/500
13/13 ----- 0s 4ms/step - accuracy: 1.0000 - loss: 4.2740e-04 - val_accuracy: 0.9519 - val_loss: 0.7431
Epoch 492/500
13/13 ----- 0s 4ms/step - accuracy: 1.0000 - loss: 5.1591e-04 - val_accuracy: 0.9423 - val_loss: 0.7607
Epoch 493/500
13/13 ----- 0s 4ms/step - accuracy: 1.0000 - loss: 0.0028 - val_accuracy: 0.9423 - val_loss: 0.7713
Epoch 494/500
13/13 ----- 0s 3ms/step - accuracy: 1.0000 - loss: 5.3020e-04 - val_accuracy: 0.9423 - val_loss: 0.7742
Epoch 495/500
13/13 ----- 0s 3ms/step - accuracy: 0.9946 - loss: 0.0099 - val_accuracy: 0.9423 - val_loss: 0.7825
Epoch 496/500
13/13 ----- 0s 3ms/step - accuracy: 0.9975 - loss: 0.0045 - val_accuracy: 0.9423 - val_loss: 0.8168
Epoch 497/500
13/13 ----- 0s 3ms/step - accuracy: 1.0000 - loss: 0.0017 - val_accuracy: 0.9423 - val_loss: 0.8162
Epoch 498/500
13/13 ----- 0s 3ms/step - accuracy: 0.9997 - loss: 0.0023 - val_accuracy: 0.9423 - val_loss: 0.7950
Epoch 499/500
13/13 ----- 0s 3ms/step - accuracy: 0.9990 - loss: 0.0012 - val_accuracy: 0.9519 - val_loss: 0.7440
Epoch 500/500
13/13 ----- 0s 3ms/step - accuracy: 0.9994 - loss: 0.0027 - val_accuracy: 0.9519 - val_loss: 0.7404
4/4 ----- 0s 4ms/step - accuracy: 0.9516 - loss: 0.8899
Test Accuracy: 0.9519230723381042
```

```
In [9]: import matplotlib.pyplot as plt
```

```
# Assuming you have a history object from model.fit()
history = model.fit(X_train, y_train, epochs=20, validation_data=(X_test, y_test))

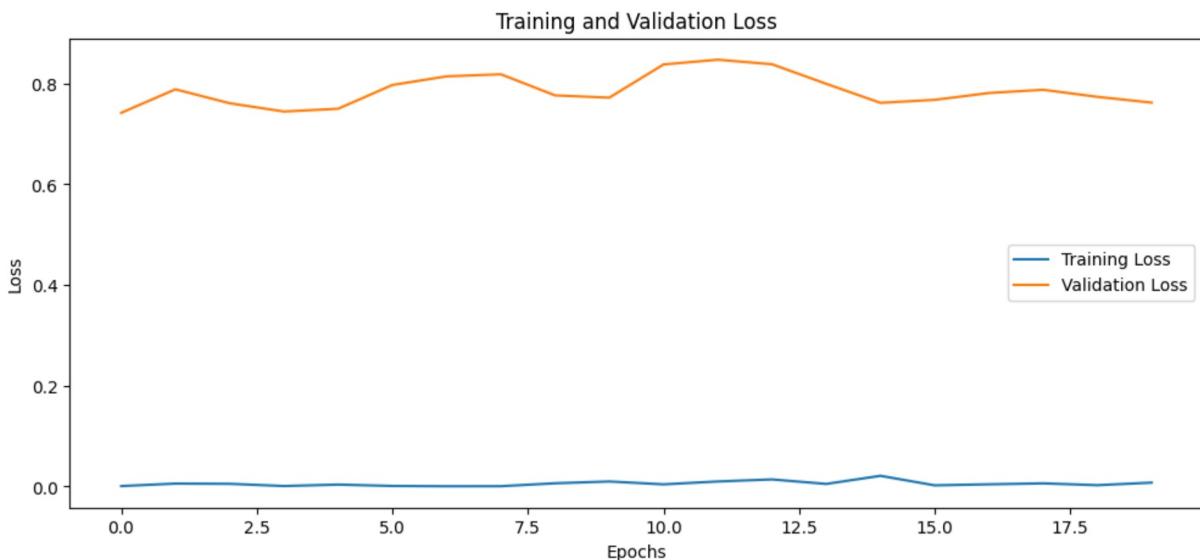
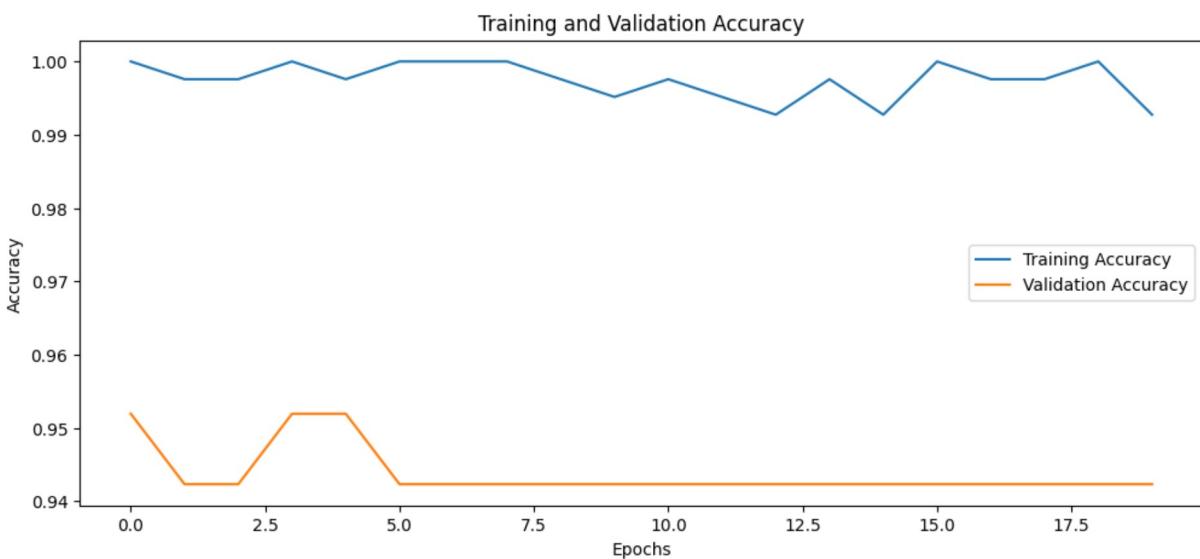
# Plotting Accuracy
plt.figure(figsize=(12, 5))
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
```

```
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.title('Training and Validation Accuracy')
plt.legend()
plt.show()

# Plotting Loss
plt.figure(figsize=(12, 5))
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.title('Training and Validation Loss')
plt.legend()
plt.show()
```

Epoch 1/20
13/13 0s 6ms/step - accuracy: 1.0000 - loss: 7.3297e-04 - val_accuracy: 0.9519 - val_loss: 0.7417
Epoch 2/20
13/13 0s 3ms/step - accuracy: 0.9968 - loss: 0.0071 - val_accuracy: 0.9423 - val_loss: 0.7885
Epoch 3/20
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0040 - val_accuracy: 0.9423 - val_loss: 0.7608
Epoch 4/20
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0018 - val_accuracy: 0.9519 - val_loss: 0.7444
Epoch 5/20
13/13 0s 5ms/step - accuracy: 0.9957 - loss: 0.0043 - val_accuracy: 0.9519 - val_loss: 0.7498
Epoch 6/20
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 6.2510e-04 - val_accuracy: 0.9423 - val_loss: 0.7971
Epoch 7/20
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 6.6905e-04 - val_accuracy: 0.9423 - val_loss: 0.8141
Epoch 8/20
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 4.7439e-04 - val_accuracy: 0.9423 - val_loss: 0.8183
Epoch 9/20
13/13 0s 3ms/step - accuracy: 0.9988 - loss: 0.0039 - val_accuracy: 0.9423 - val_loss: 0.7764
Epoch 10/20
13/13 0s 3ms/step - accuracy: 0.9985 - loss: 0.0037 - val_accuracy: 0.9423 - val_loss: 0.7719
Epoch 11/20
13/13 0s 3ms/step - accuracy: 0.9995 - loss: 0.0017 - val_accuracy: 0.9423 - val_loss: 0.8378
Epoch 12/20
13/13 0s 3ms/step - accuracy: 0.9970 - loss: 0.0065 - val_accuracy: 0.9423 - val_loss: 0.8472
Epoch 13/20
13/13 0s 3ms/step - accuracy: 0.9941 - loss: 0.0184 - val_accuracy: 0.9423 - val_loss: 0.8382
Epoch 14/20
13/13 0s 4ms/step - accuracy: 0.9982 - loss: 0.0037 - val_accuracy: 0.9423 - val_loss: 0.7994
Epoch 15/20
13/13 0s 5ms/step - accuracy: 0.9951 - loss: 0.0102 - val_accuracy: 0.9423 - val_loss: 0.7616
Epoch 16/20
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0014 - val_accuracy: 0.9423 - val_loss: 0.7676
Epoch 17/20
13/13 0s 3ms/step - accuracy: 0.9974 - loss: 0.0043 - val_accuracy: 0.9423 - val_loss: 0.7811
Epoch 18/20
13/13 0s 3ms/step - accuracy: 0.9968 - loss: 0.0068 - val_accuracy: 0.9423 - val_loss: 0.7875
Epoch 19/20
13/13 0s 3ms/step - accuracy: 1.0000 - loss: 0.0026 - val_accuracy:

```
acy: 0.9423 - val_loss: 0.7735
Epoch 20/20
13/13 - 0s 3ms/step - accuracy: 0.9936 - loss: 0.0058 - val_accur
acy: 0.9423 - val_loss: 0.7620
```



Training and Validation Accuracy Plot: This plot shows that the training accuracy quickly reaches nearly 100%, while validation accuracy stabilizes around 94-95%. This indicates potential overfitting, as the model performs better on the training data than on the validation set

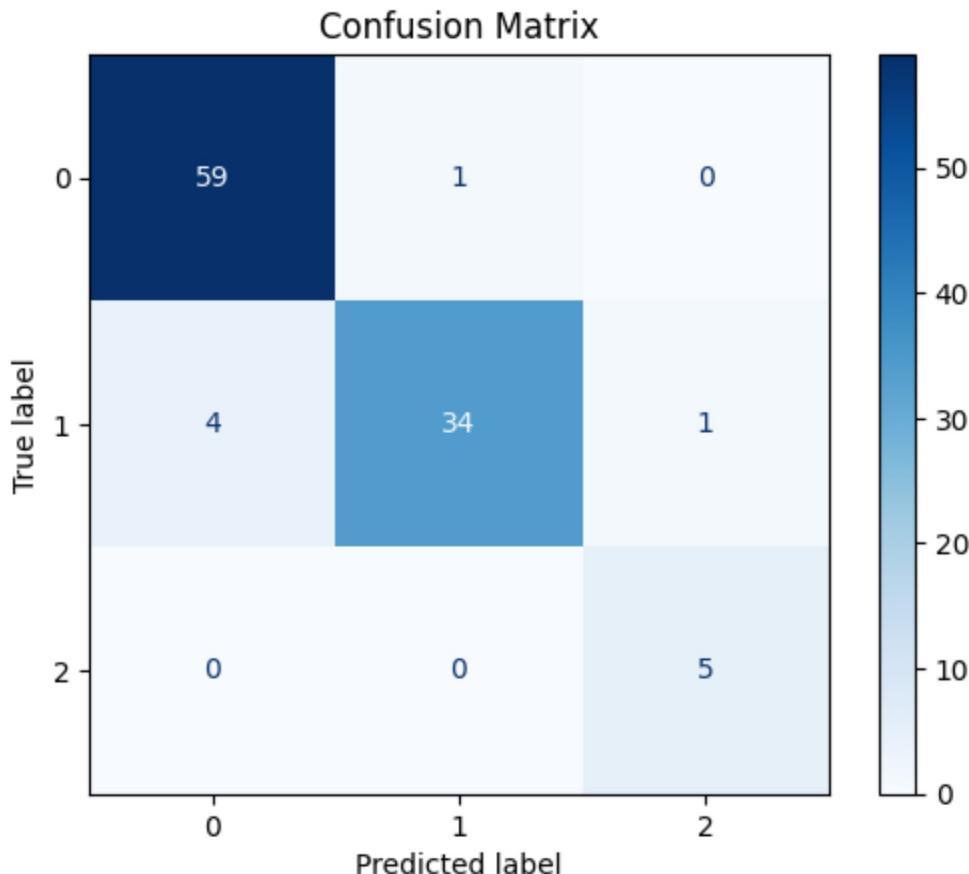
Training and Validation Loss Plot: The training loss remains very low, while the validation loss is significantly higher and slowly increases. This suggests that the model may be overfitting, as it fits the training data well but generalizes less effectively to new data.

```
In [10]: from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
```

```
# Predicting on test data
y_pred = model.predict(X_test)
y_pred_classes = y_pred.argmax(axis=1) # For multi-class classification
y_test_classes = y_test.argmax(axis=1) # True Labels in categorical form
```

```
# Generating Confusion Matrix
conf_matrix = confusion_matrix(y_test_classes, y_pred_classes)
ConfusionMatrixDisplay(conf_matrix).plot(cmap='Blues')
plt.title("Confusion Matrix")
plt.show()
```

4/4 ————— 0s 18ms/step



Confusion Matrix: The matrix shows the model's classification performance, with the majority of predictions along the diagonal, indicating correct classifications. A few misclassifications occur, primarily in classifying "Medium well payed" and "Low pay".

```
In [11]: from sklearn.metrics import roc_curve, auc
from sklearn.preprocessing import label_binarize

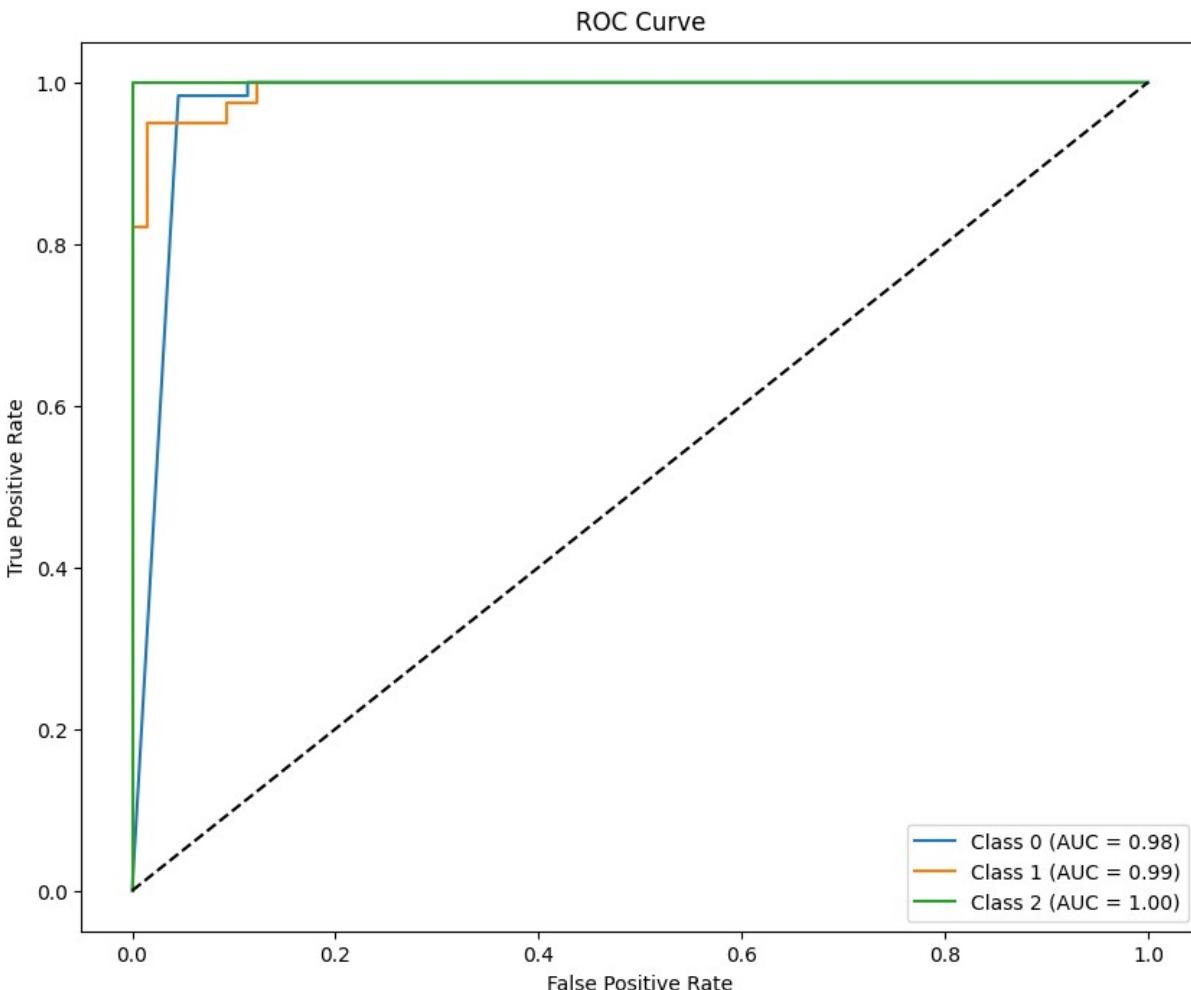
# Binarize the labels for multi-class ROC
y_test_bin = label_binarize(y_test_classes, classes=[0, 1, 2]) # Adjust classes as
y_pred_bin = model.predict(X_test)

# Plot ROC for each class
plt.figure(figsize=(10, 8))
for i in range(y_test_bin.shape[1]):
    fpr, tpr, _ = roc_curve(y_test_bin[:, i], y_pred_bin[:, i])
    roc_auc = auc(fpr, tpr)
    plt.plot(fpr, tpr, label=f'Class {i} (AUC = {roc_auc:.2f})')

plt.plot([0, 1], [0, 1], 'k--') # Diagonal line for random guessing
```

```
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve')
plt.legend()
plt.show()
```

4/4 ————— 0s 9ms/step



ROC Curve: The ROC curves for each class show high performance, with AUC values close to 1.0, indicating that the model is effective at distinguishing between the classes.

The problem involves classifying jobs into categories of "High," "Medium," and "Low" pay based on various features. The neural network model performed well, achieving high accuracy with strong class separation, though some overfitting is indicated by a higher validation loss compared to training loss. Despite minor misclassifications, the model effectively distinguishes between pay categories, as shown by high AUC scores across all classes.

Justification for using Neural Networks: Neural networks are ideal for this problem due to their ability to learn complex, non-linear relationships and model interactions between features automatically. While the current results show that only a few features (like Satisfaction_Label_Encoded and P_Career_Change) are influential, the neural network can still uncover hidden patterns with further training or hyperparameter tuning. Additionally, neural

networks are scalable and can handle large, high-dimensional datasets, making them a good choice for future improvements or more complex datasets. Despite the current feature importance, the model's flexibility suggests it can adapt to and improve with more optimization.

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