Node Classification using Graph Convolutional Networks

This node classification task uses CORA dataset from https://linqs.soe.ucsc.edu/data

The dataset consists of **2708** nodes which correspond to scientific publications.

The nodes are classified into **7** categories indicating the topics of each document.

The edges indicate whether a document is cited by the other or vice versa.

Each node has **1433** features which is described by a 0/1-valued vector, indicating the bag-of-words from the dictionary.

This is an undirected graph problem

```python
#importing dependencies

import numpy as np
import os
import networkx as nx
from keras.utils import to_categorical
from sklearn.preprocessing import LabelEncoder
from sklearn.utils import shuffle
from sklearn.metrics import classification_report

from spektral.layers import GraphConv

from tensorflow.keras.models import Model
from tensorflow.keras.layers import Input, Dropout, Dense
from tensorflow.keras import Sequential
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import TensorBoard, EarlyStopping
import tensorflow as tf
from tensorflow.keras.regularizers import l2

from collections import Counter
from sklearn.manifold import TSNE
import matplotlib.pyplot as plt
```

Data Loading and Preprocessing

We are going to use the edges connecting the (from file **cora.cites**).

The nodes are loaded from file **cora.content**.

```python
#Loading the data

all_data = []
all_edges = []

for root,dirs,files in os.walk('./cora'):
    for file in files:
        if '.content' in file:
            with open(os.path.join(root,file),'r') as f:
                all_data.extend(f.read().splitlines())
        elif 'cites' in file:
            with open(os.path.join(root,file),'r') as f:
                all_edges.extend(f.read().splitlines())


    #Shuffle the data because the raw data is ordered based on the label
    random_state = 77
    all_data = shuffle(all_data,random_state=random_state)
```

In **cora.content** file:

The **first** element indicates the **node name**

The **second** until the last second elements indicate the **node features**

The **last** element indicates the **label of that particular node**

In **cora.cites** file:

Each line indicates the tuple of connected nodes

Parsing the data

```
In [ ]:  #parse the data
         labels = []
         nodes = []
         X = []

         for i,data in enumerate(all_data):
             elements = data.split('\t')
             labels.append(elements[-1])
             X.append(elements[1:-1])
             nodes.append(elements[0])

         X = np.array(X,dtype=int)
         N = X.shape[0] #the number of nodes
         F = X.shape[1] #the size of node features
         print('X shape: ', X.shape)


         #parse the edge
         edge_list=[]
         for edge in all_edges:
             e = edge.split('\t')
             edge_list.append((e[0],e[1]))

         print('\nNumber of nodes (N): ', N)
         print('\nNumber of features (F) of each node: ', F)
         print('\nCategories: ', set(labels))

         num_classes = len(set(labels))
         print('\nNumber of classes: ', num_classes)
```

```
X shape:  (2708, 1433)

Number of nodes (N):  2708

Number of features (F) of each node:  1433

Categories:  {'Neural_Networks', 'Genetic_Algorithms', 'Reinforcement_Learning', 'Rule_Learning', 'Probabilis
tic_Methods', 'Theory', 'Case_Based'}

Number of classes:  7
```

Select examples for training, validation, and test then set the mask

```
In [ ]:  def limit_data(labels,limit=20,val_num=500,test_num=1000):
             '''
             Get the index of train, validation, and test data
             '''
             label_counter = dict((l, 0) for l in labels)
             train_idx = []

             for i in range(len(labels)):
                 label = labels[i]
                 if label_counter[label]<limit:
                     #add the example to the training data
                     train_idx.append(i)
                     label_counter[label]+=1

                 #exit the loop once we found 20 examples for each class
                 if all(count == limit for count in label_counter.values()):
                     break
```

```
    #get the indices that do not go to traning data
    rest_idx = [x for x in range(len(labels)) if x not in train_idx]
    #get the first val_num
    val_idx = rest_idx[:val_num]
    test_idx = rest_idx[val_num:(val_num+test_num)]
    return train_idx, val_idx,test_idx


train_idx,val_idx,test_idx = limit_data(labels)
```

In [ ]:
```
#set the mask
train_mask = np.zeros((N,),dtype=bool)
train_mask[train_idx] = True

val_mask = np.zeros((N,),dtype=bool)
val_mask[val_idx] = True

test_mask = np.zeros((N,),dtype=bool)
test_mask[test_idx] = True
```

Show Data Distribution

In [ ]:
```
print("All Data Distribution: \n{}".format(Counter(labels)))
```

```
All Data Distribution:
Counter({'Neural_Networks': 818, 'Probabilistic_Methods': 426, 'Genetic_Algorithms': 418, 'Theory': 351, 'Cas
e_Based': 298, 'Reinforcement_Learning': 217, 'Rule_Learning': 180})
```

In [ ]:
```
print("Training Data Distribution: \n{}".format(Counter([labels[i] for i in train_idx])))
```

```
Training Data Distribution:
Counter({'Reinforcement_Learning': 20, 'Probabilistic_Methods': 20, 'Neural_Networks': 20, 'Case_Based': 20,
'Theory': 20, 'Genetic_Algorithms': 20, 'Rule_Learning': 20})
```

In [ ]:
```
print("Validation Data Distribution: \n{}".format(Counter([labels[i] for i in val_idx])))
```

```
Validation Data Distribution:
Counter({'Neural_Networks': 172, 'Genetic_Algorithms': 78, 'Probabilistic_Methods': 72, 'Theory': 63, 'Case_B
ased': 58, 'Reinforcement_Learning': 35, 'Rule_Learning': 22})
```

Convert the labels to one hot encoding

In [ ]:
```
def encode_label(labels):
    label_encoder = LabelEncoder()
    labels = label_encoder.fit_transform(labels)
    labels = to_categorical(labels)
    return labels, label_encoder.classes_

labels_encoded, classes = encode_label(labels)
```

Build a graph on NetworkX using the obtained nodes and edges list

In [ ]:
```
#build the graph
G = nx.Graph()
G.add_nodes_from(nodes)
G.add_edges_from(edge_list)

#obtain the adjacency matrix (A)
A = nx.adjacency_matrix(G)
print('Graph info: ', nx.info(G))
```

```
Graph info:  Name:
Type: Graph
Number of nodes: 2708
Number of edges: 5278
Average degree:   3.8981
```

Building and Training Graph Convolutional Networks

```python
In [ ]:  # Parameters
         channels = 16          # Number of channels in the first layer
         dropout = 0.5          # Dropout rate for the features
         l2_reg = 5e-4          # L2 regularization rate
         learning_rate = 1e-2   # Learning rate
         epochs = 800           # Number of training epochs
         es_patience = 400       # Patience for early stopping

         # Preprocessing operations
         A = GraphConv.preprocess(A).astype('f4')

         # Model definition
         X_in = Input(shape=(F, ))
         fltr_in = Input((N, ), sparse=True)

         dropout_1 = Dropout(dropout)(X_in)
         graph_conv_1 = GraphConv(channels,
                                  activation='relu',
                                  kernel_regularizer=l2(l2_reg),
                                  use_bias=False)([dropout_1, fltr_in])

         dropout_2 = Dropout(dropout)(graph_conv_1)
         graph_conv_2 = GraphConv(num_classes,
                                  activation='softmax',
                                  use_bias=False)([dropout_2, fltr_in])

         # Build model
         model = Model(inputs=[X_in, fltr_in], outputs=graph_conv_2)
         optimizer = Adam(lr=learning_rate)
         model.compile(optimizer=optimizer,
                       loss='categorical_crossentropy',
                       weighted_metrics=['acc'])
         model.summary()

         tbCallBack_GCN = tf.keras.callbacks.TensorBoard(
             log_dir='./Tensorboard_GCN_cora',
         )
         callback_GCN = [tbCallBack_GCN]
```

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 1433)]	0	
dropout (Dropout)	(None, 1433)	0	input_1[0][0]
input_2 (InputLayer)	[(None, 2708)]	0	
graph_conv (GraphConv)	(None, 16)	22928	dropout[0][0] input_2[0][0]
dropout_1 (Dropout)	(None, 16)	0	graph_conv[0][0]
graph_conv_1 (GraphConv)	(None, 7)	112	dropout_1[0][0] input_2[0][0]

```
Total params: 23,040
Trainable params: 23,040
Non-trainable params: 0
```

```python
In [ ]:  # Train model
         validation_data = ([X, A], labels_encoded, val_mask)
         model.fit([X, A],
                   labels_encoded,
                   sample_weight=train_mask,
                   epochs=epochs,
```

```
        batch_size=N,
        validation_data=validation_data,
        shuffle=False,
        callbacks=[
            EarlyStopping(patience=es_patience,  restore_best_weights=True),
            tbCallBack_GCN
        ])
```

```
Epoch 1/800
1/1 [==============================] - 0s 370ms/step - loss: 0.1165 - acc: 0.1500 - val_loss: 0.3659 - val_ac
c: 0.3400
Epoch 2/800
1/1 [==============================] - ETA: 0s - loss: 0.1091 - acc: 0.4000WARNING:tensorflow:Method (on_trai
n_batch_end) is slow compared to the batch update (0.174698). Check your callbacks.
1/1 [==============================] - 0s 178ms/step - loss: 0.1091 - acc: 0.4000 - val_loss: 0.3557 - val_ac
c: 0.4420
Epoch 3/800
1/1 [==============================] - 0s 171ms/step - loss: 0.1034 - acc: 0.6000 - val_loss: 0.3452 - val_ac
c: 0.4680
Epoch 4/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0967 - acc: 0.6500 - val_loss: 0.3356 - val_ac
c: 0.4660
Epoch 5/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0911 - acc: 0.7071 - val_loss: 0.3275 - val_ac
c: 0.4600
Epoch 6/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0868 - acc: 0.6357 - val_loss: 0.3206 - val_ac
c: 0.4640
Epoch 7/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0829 - acc: 0.6429 - val_loss: 0.3145 - val_ac
c: 0.4760
Epoch 8/800
1/1 [==============================] - 0s 184ms/step - loss: 0.0788 - acc: 0.7500 - val_loss: 0.3072 - val_ac
c: 0.4920
Epoch 9/800
1/1 [==============================] - 0s 219ms/step - loss: 0.0756 - acc: 0.7429 - val_loss: 0.2988 - val_ac
c: 0.5420
Epoch 10/800
1/1 [==============================] - 0s 234ms/step - loss: 0.0752 - acc: 0.7571 - val_loss: 0.2900 - val_ac
c: 0.5920
Epoch 11/800
1/1 [==============================] - 0s 245ms/step - loss: 0.0716 - acc: 0.8000 - val_loss: 0.2817 - val_ac
c: 0.6380
Epoch 12/800
1/1 [==============================] - 0s 256ms/step - loss: 0.0688 - acc: 0.8500 - val_loss: 0.2742 - val_ac
c: 0.6540
Epoch 13/800
1/1 [==============================] - 0s 225ms/step - loss: 0.0692 - acc: 0.8643 - val_loss: 0.2671 - val_ac
c: 0.6740
Epoch 14/800
1/1 [==============================] - 0s 236ms/step - loss: 0.0668 - acc: 0.8714 - val_loss: 0.2604 - val_ac
c: 0.6800
Epoch 15/800
1/1 [==============================] - 0s 228ms/step - loss: 0.0653 - acc: 0.8714 - val_loss: 0.2540 - val_ac
c: 0.6980
Epoch 16/800
1/1 [==============================] - 0s 219ms/step - loss: 0.0610 - acc: 0.8714 - val_loss: 0.2485 - val_ac
c: 0.7140
Epoch 17/800
1/1 [==============================] - 0s 220ms/step - loss: 0.0605 - acc: 0.8786 - val_loss: 0.2434 - val_ac
c: 0.7180
Epoch 18/800
1/1 [==============================] - 0s 263ms/step - loss: 0.0590 - acc: 0.9000 - val_loss: 0.2387 - val_ac
c: 0.7220
Epoch 19/800
1/1 [==============================] - 0s 234ms/step - loss: 0.0588 - acc: 0.8714 - val_loss: 0.2343 - val_ac
c: 0.7280
Epoch 20/800
1/1 [==============================] - 0s 226ms/step - loss: 0.0573 - acc: 0.9357 - val_loss: 0.2300 - val_ac
c: 0.7380
Epoch 21/800
1/1 [==============================] - 0s 222ms/step - loss: 0.0594 - acc: 0.9143 - val_loss: 0.2259 - val_ac
c: 0.7480
Epoch 22/800
1/1 [==============================] - 0s 222ms/step - loss: 0.0581 - acc: 0.9071 - val_loss: 0.2218 - val_ac
c: 0.7560
Epoch 23/800
1/1 [==============================] - 0s 207ms/step - loss: 0.0541 - acc: 0.9143 - val_loss: 0.2177 - val_ac
c: 0.7560
```

```
Epoch 24/800
1/1 [==============================] - 0s 239ms/step - loss: 0.0537 - acc: 0.8857 - val_loss: 0.2135 - val_ac
c: 0.7540
Epoch 25/800
1/1 [==============================] - 0s 251ms/step - loss: 0.0528 - acc: 0.9286 - val_loss: 0.2096 - val_ac
c: 0.7580
Epoch 26/800
1/1 [==============================] - 0s 219ms/step - loss: 0.0543 - acc: 0.8929 - val_loss: 0.2060 - val_ac
c: 0.7580
Epoch 27/800
1/1 [==============================] - 0s 231ms/step - loss: 0.0505 - acc: 0.9429 - val_loss: 0.2029 - val_ac
c: 0.7640
Epoch 28/800
1/1 [==============================] - 0s 254ms/step - loss: 0.0478 - acc: 0.9643 - val_loss: 0.1998 - val_ac
c: 0.7680
Epoch 29/800
1/1 [==============================] - 0s 221ms/step - loss: 0.0477 - acc: 0.9714 - val_loss: 0.1969 - val_ac
c: 0.7700
Epoch 30/800
1/1 [==============================] - 0s 212ms/step - loss: 0.0482 - acc: 0.9286 - val_loss: 0.1942 - val_ac
c: 0.7700
Epoch 31/800
1/1 [==============================] - 0s 220ms/step - loss: 0.0487 - acc: 0.9071 - val_loss: 0.1920 - val_ac
c: 0.7700
Epoch 32/800
1/1 [==============================] - 0s 222ms/step - loss: 0.0475 - acc: 0.9214 - val_loss: 0.1904 - val_ac
c: 0.7760
Epoch 33/800
1/1 [==============================] - 0s 222ms/step - loss: 0.0497 - acc: 0.9286 - val_loss: 0.1895 - val_ac
c: 0.7800
Epoch 34/800
1/1 [==============================] - 0s 212ms/step - loss: 0.0478 - acc: 0.9143 - val_loss: 0.1881 - val_ac
c: 0.7860
Epoch 35/800
1/1 [==============================] - 0s 192ms/step - loss: 0.0454 - acc: 0.9357 - val_loss: 0.1874 - val_ac
c: 0.7900
Epoch 36/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0440 - acc: 0.9429 - val_loss: 0.1869 - val_ac
c: 0.7780
Epoch 37/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0459 - acc: 0.9357 - val_loss: 0.1863 - val_ac
c: 0.7720
Epoch 38/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0419 - acc: 0.9571 - val_loss: 0.1851 - val_ac
c: 0.7720
Epoch 39/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0443 - acc: 0.9429 - val_loss: 0.1834 - val_ac
c: 0.7740
Epoch 40/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0439 - acc: 0.9429 - val_loss: 0.1817 - val_ac
c: 0.7800
Epoch 41/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0432 - acc: 0.9357 - val_loss: 0.1803 - val_ac
c: 0.7820
Epoch 42/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0389 - acc: 0.9357 - val_loss: 0.1785 - val_ac
c: 0.7860
Epoch 43/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0406 - acc: 0.9500 - val_loss: 0.1772 - val_ac
c: 0.7820
Epoch 44/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0400 - acc: 0.9429 - val_loss: 0.1758 - val_ac
c: 0.7760
Epoch 45/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0434 - acc: 0.9357 - val_loss: 0.1747 - val_ac
c: 0.7760
Epoch 46/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0403 - acc: 0.9857 - val_loss: 0.1740 - val_ac
c: 0.7760
Epoch 47/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0449 - acc: 0.8786 - val_loss: 0.1733 - val_ac
```

```
                    c: 0.7800
                    Epoch 48/800
                    1/1 [==============================] - 0s 164ms/step - loss: 0.0408 - acc: 0.9714 - val_loss: 0.1727 - val_ac
                    c: 0.7840
                    Epoch 49/800
                    1/1 [==============================] - 0s 179ms/step - loss: 0.0371 - acc: 0.9643 - val_loss: 0.1717 - val_ac
                    c: 0.7860
                    Epoch 50/800
                    1/1 [==============================] - 0s 175ms/step - loss: 0.0379 - acc: 0.9643 - val_loss: 0.1709 - val_ac
                    c: 0.7840
                    Epoch 51/800
                    1/1 [==============================] - 0s 171ms/step - loss: 0.0367 - acc: 0.9643 - val_loss: 0.1703 - val_ac
                    c: 0.7860
                    Epoch 52/800
                    1/1 [==============================] - 0s 178ms/step - loss: 0.0409 - acc: 0.9214 - val_loss: 0.1699 - val_ac
                    c: 0.7760
                    Epoch 53/800
                    1/1 [==============================] - 0s 175ms/step - loss: 0.0367 - acc: 0.9714 - val_loss: 0.1695 - val_ac
                    c: 0.7700
                    Epoch 54/800
                    1/1 [==============================] - 0s 169ms/step - loss: 0.0361 - acc: 0.9500 - val_loss: 0.1700 - val_ac
                    c: 0.7640
                    Epoch 55/800
                    1/1 [==============================] - 0s 167ms/step - loss: 0.0387 - acc: 0.9214 - val_loss: 0.1711 - val_ac
                    c: 0.7620
                    Epoch 56/800
                    1/1 [==============================] - 0s 164ms/step - loss: 0.0404 - acc: 0.9214 - val_loss: 0.1717 - val_ac
                    c: 0.7580
                    Epoch 57/800
                    1/1 [==============================] - 0s 164ms/step - loss: 0.0376 - acc: 0.9714 - val_loss: 0.1710 - val_ac
                    c: 0.7620
                    Epoch 58/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0400 - acc: 0.9214 - val_loss: 0.1698 - val_ac
                    c: 0.7680
                    Epoch 59/800
                    1/1 [==============================] - 0s 181ms/step - loss: 0.0349 - acc: 0.9571 - val_loss: 0.1690 - val_ac
                    c: 0.7680
                    Epoch 60/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0377 - acc: 0.9786 - val_loss: 0.1683 - val_ac
                    c: 0.7700
                    Epoch 61/800
                    1/1 [==============================] - 0s 170ms/step - loss: 0.0364 - acc: 0.9357 - val_loss: 0.1675 - val_ac
                    c: 0.7640
                    Epoch 62/800
                    1/1 [==============================] - 0s 173ms/step - loss: 0.0379 - acc: 0.9500 - val_loss: 0.1669 - val_ac
                    c: 0.7700
                    Epoch 63/800
                    1/1 [==============================] - 0s 186ms/step - loss: 0.0364 - acc: 0.9571 - val_loss: 0.1655 - val_ac
                    c: 0.7760
                    Epoch 64/800
                    1/1 [==============================] - 0s 179ms/step - loss: 0.0344 - acc: 0.9714 - val_loss: 0.1646 - val_ac
                    c: 0.7800
                    Epoch 65/800
                    1/1 [==============================] - 0s 162ms/step - loss: 0.0377 - acc: 0.9500 - val_loss: 0.1637 - val_ac
                    c: 0.7780
                    Epoch 66/800
                    1/1 [==============================] - 0s 170ms/step - loss: 0.0346 - acc: 0.9571 - val_loss: 0.1635 - val_ac
                    c: 0.7740
                    Epoch 67/800
                    1/1 [==============================] - 0s 183ms/step - loss: 0.0367 - acc: 0.9286 - val_loss: 0.1628 - val_ac
                    c: 0.7660
                    Epoch 68/800
                    1/1 [==============================] - 0s 169ms/step - loss: 0.0354 - acc: 0.9500 - val_loss: 0.1624 - val_ac
                    c: 0.7740
                    Epoch 69/800
                    1/1 [==============================] - 0s 167ms/step - loss: 0.0342 - acc: 0.9714 - val_loss: 0.1623 - val_ac
                    c: 0.7680
                    Epoch 70/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0331 - acc: 0.9714 - val_loss: 0.1628 - val_ac
                    c: 0.7700
                    Epoch 71/800
```

```
1/1 [==============================] - 0s 176ms/step - loss: 0.0364 - acc: 0.9214 - val_loss: 0.1626 - val_ac
c: 0.7680
Epoch 72/800
1/1 [==============================] - 0s 191ms/step - loss: 0.0339 - acc: 0.9500 - val_loss: 0.1617 - val_ac
c: 0.7680
Epoch 73/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0331 - acc: 0.9643 - val_loss: 0.1608 - val_ac
c: 0.7680
Epoch 74/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0330 - acc: 0.9714 - val_loss: 0.1602 - val_ac
c: 0.7720
Epoch 75/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0326 - acc: 0.9714 - val_loss: 0.1605 - val_ac
c: 0.7740
Epoch 76/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0333 - acc: 0.9643 - val_loss: 0.1609 - val_ac
c: 0.7700
Epoch 77/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0335 - acc: 0.9429 - val_loss: 0.1602 - val_ac
c: 0.7740
Epoch 78/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0340 - acc: 0.9357 - val_loss: 0.1598 - val_ac
c: 0.7780
Epoch 79/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0344 - acc: 0.9286 - val_loss: 0.1592 - val_ac
c: 0.7880
Epoch 80/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0325 - acc: 0.9929 - val_loss: 0.1589 - val_ac
c: 0.7940
Epoch 81/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0363 - acc: 0.9357 - val_loss: 0.1578 - val_ac
c: 0.7960
Epoch 82/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0335 - acc: 0.9500 - val_loss: 0.1558 - val_ac
c: 0.8040
Epoch 83/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0357 - acc: 0.9143 - val_loss: 0.1549 - val_ac
c: 0.7960
Epoch 84/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0312 - acc: 0.9714 - val_loss: 0.1547 - val_ac
c: 0.7900
Epoch 85/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0333 - acc: 0.9643 - val_loss: 0.1551 - val_ac
c: 0.7840
Epoch 86/800
1/1 [==============================] - 0s 185ms/step - loss: 0.0348 - acc: 0.9357 - val_loss: 0.1571 - val_ac
c: 0.7760
Epoch 87/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0308 - acc: 0.9643 - val_loss: 0.1593 - val_ac
c: 0.7740
Epoch 88/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0297 - acc: 0.9714 - val_loss: 0.1606 - val_ac
c: 0.7720
Epoch 89/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0323 - acc: 0.9714 - val_loss: 0.1614 - val_ac
c: 0.7680
Epoch 90/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0312 - acc: 0.9643 - val_loss: 0.1619 - val_ac
c: 0.7720
Epoch 91/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0315 - acc: 0.9571 - val_loss: 0.1616 - val_ac
c: 0.7760
Epoch 92/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0326 - acc: 0.9571 - val_loss: 0.1604 - val_ac
c: 0.7840
Epoch 93/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0321 - acc: 0.9286 - val_loss: 0.1580 - val_ac
c: 0.7860
Epoch 94/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0302 - acc: 0.9714 - val_loss: 0.1557 - val_ac
c: 0.7900
```

```
Epoch 95/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0337 - acc: 0.9571 - val_loss: 0.1533 - val_ac
c: 0.7920
Epoch 96/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0290 - acc: 0.9786 - val_loss: 0.1519 - val_ac
c: 0.7900
Epoch 97/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0319 - acc: 0.9571 - val_loss: 0.1510 - val_ac
c: 0.7880
Epoch 98/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0281 - acc: 0.9786 - val_loss: 0.1504 - val_ac
c: 0.7900
Epoch 99/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0325 - acc: 0.9500 - val_loss: 0.1505 - val_ac
c: 0.7820
Epoch 100/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0315 - acc: 0.9500 - val_loss: 0.1515 - val_ac
c: 0.7760
Epoch 101/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0315 - acc: 0.9429 - val_loss: 0.1530 - val_ac
c: 0.7760
Epoch 102/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0291 - acc: 0.9643 - val_loss: 0.1554 - val_ac
c: 0.7760
Epoch 103/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0294 - acc: 0.9643 - val_loss: 0.1575 - val_ac
c: 0.7740
Epoch 104/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0305 - acc: 0.9571 - val_loss: 0.1587 - val_ac
c: 0.7720
Epoch 105/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0299 - acc: 0.9714 - val_loss: 0.1593 - val_ac
c: 0.7680
Epoch 106/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0301 - acc: 0.9643 - val_loss: 0.1593 - val_ac
c: 0.7680
Epoch 107/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0300 - acc: 0.9643 - val_loss: 0.1581 - val_ac
c: 0.7760
Epoch 108/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0293 - acc: 0.9714 - val_loss: 0.1561 - val_ac
c: 0.7800
Epoch 109/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0302 - acc: 0.9357 - val_loss: 0.1534 - val_ac
c: 0.7840
Epoch 110/800
1/1 [==============================] - 0s 201ms/step - loss: 0.0307 - acc: 0.9643 - val_loss: 0.1501 - val_ac
c: 0.7800
Epoch 111/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0289 - acc: 0.9571 - val_loss: 0.1470 - val_ac
c: 0.7780
Epoch 112/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0285 - acc: 0.9857 - val_loss: 0.1454 - val_ac
c: 0.7800
Epoch 113/800
1/1 [==============================] - 0s 193ms/step - loss: 0.0293 - acc: 0.9429 - val_loss: 0.1449 - val_ac
c: 0.7760
Epoch 114/800
1/1 [==============================] - 0s 186ms/step - loss: 0.0305 - acc: 0.9429 - val_loss: 0.1462 - val_ac
c: 0.7820
Epoch 115/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0301 - acc: 0.9571 - val_loss: 0.1493 - val_ac
c: 0.7820
Epoch 116/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0292 - acc: 0.9643 - val_loss: 0.1534 - val_ac
c: 0.7720
Epoch 117/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0299 - acc: 0.9643 - val_loss: 0.1565 - val_ac
c: 0.7660
Epoch 118/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0302 - acc: 0.9714 - val_loss: 0.1569 - val_ac
```

```
c: 0.7680
Epoch 119/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0306 - acc: 0.9429 - val_loss: 0.1553 - val_ac
c: 0.7720
Epoch 120/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0257 - acc: 0.9857 - val_loss: 0.1537 - val_ac
c: 0.7720
Epoch 121/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0289 - acc: 0.9143 - val_loss: 0.1510 - val_ac
c: 0.7780
Epoch 122/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0305 - acc: 0.9571 - val_loss: 0.1495 - val_ac
c: 0.7740
Epoch 123/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0260 - acc: 0.9857 - val_loss: 0.1482 - val_ac
c: 0.7760
Epoch 124/800
1/1 [==============================] - 0s 220ms/step - loss: 0.0270 - acc: 0.9857 - val_loss: 0.1470 - val_ac
c: 0.7800
Epoch 125/800
1/1 [==============================] - 0s 186ms/step - loss: 0.0279 - acc: 0.9571 - val_loss: 0.1464 - val_ac
c: 0.7820
Epoch 126/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0276 - acc: 0.9857 - val_loss: 0.1471 - val_ac
c: 0.7740
Epoch 127/800
1/1 [==============================] - 0s 194ms/step - loss: 0.0256 - acc: 0.9857 - val_loss: 0.1495 - val_ac
c: 0.7720
Epoch 128/800
1/1 [==============================] - 0s 182ms/step - loss: 0.0269 - acc: 0.9786 - val_loss: 0.1504 - val_ac
c: 0.7700
Epoch 129/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0267 - acc: 0.9643 - val_loss: 0.1508 - val_ac
c: 0.7720
Epoch 130/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0273 - acc: 0.9786 - val_loss: 0.1499 - val_ac
c: 0.7780
Epoch 131/800
1/1 [==============================] - 0s 226ms/step - loss: 0.0264 - acc: 0.9714 - val_loss: 0.1485 - val_ac
c: 0.7780
Epoch 132/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0254 - acc: 0.9857 - val_loss: 0.1478 - val_ac
c: 0.7860
Epoch 133/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0271 - acc: 0.9500 - val_loss: 0.1495 - val_ac
c: 0.7760
Epoch 134/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0273 - acc: 0.9500 - val_loss: 0.1496 - val_ac
c: 0.7740
Epoch 135/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0272 - acc: 0.9571 - val_loss: 0.1483 - val_ac
c: 0.7740
Epoch 136/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0274 - acc: 0.9714 - val_loss: 0.1474 - val_ac
c: 0.7780
Epoch 137/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0298 - acc: 0.9500 - val_loss: 0.1482 - val_ac
c: 0.7720
Epoch 138/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0261 - acc: 0.9786 - val_loss: 0.1497 - val_ac
c: 0.7680
Epoch 139/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0244 - acc: 0.9714 - val_loss: 0.1505 - val_ac
c: 0.7720
Epoch 140/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0246 - acc: 0.9857 - val_loss: 0.1501 - val_ac
c: 0.7660
Epoch 141/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0267 - acc: 0.9714 - val_loss: 0.1486 - val_ac
c: 0.7640
Epoch 142/800
```

```
1/1 [==============================] - 0s 166ms/step - loss: 0.0256 - acc: 0.9714 - val_loss: 0.1470 - val_ac
c: 0.7720
Epoch 143/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0262 - acc: 0.9714 - val_loss: 0.1460 - val_ac
c: 0.7800
Epoch 144/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0246 - acc: 0.9643 - val_loss: 0.1443 - val_ac
c: 0.7880
Epoch 145/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0287 - acc: 0.9214 - val_loss: 0.1435 - val_ac
c: 0.7900
Epoch 146/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0267 - acc: 0.9429 - val_loss: 0.1433 - val_ac
c: 0.7940
Epoch 147/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0252 - acc: 0.9643 - val_loss: 0.1440 - val_ac
c: 0.7960
Epoch 148/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0272 - acc: 0.9571 - val_loss: 0.1454 - val_ac
c: 0.7900
Epoch 149/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0252 - acc: 0.9929 - val_loss: 0.1481 - val_ac
c: 0.7800
Epoch 150/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0252 - acc: 0.9857 - val_loss: 0.1511 - val_ac
c: 0.7620
Epoch 151/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0251 - acc: 0.9786 - val_loss: 0.1553 - val_ac
c: 0.7600
Epoch 152/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0269 - acc: 0.9714 - val_loss: 0.1594 - val_ac
c: 0.7500
Epoch 153/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0244 - acc: 0.9571 - val_loss: 0.1613 - val_ac
c: 0.7500
Epoch 154/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0243 - acc: 0.9786 - val_loss: 0.1588 - val_ac
c: 0.7560
Epoch 155/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0270 - acc: 0.9643 - val_loss: 0.1525 - val_ac
c: 0.7820
Epoch 156/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0259 - acc: 0.9571 - val_loss: 0.1458 - val_ac
c: 0.7940
Epoch 157/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0246 - acc: 0.9786 - val_loss: 0.1417 - val_ac
c: 0.7960
Epoch 158/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0247 - acc: 0.9857 - val_loss: 0.1398 - val_ac
c: 0.7980
Epoch 159/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0264 - acc: 0.9714 - val_loss: 0.1385 - val_ac
c: 0.8000
Epoch 160/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0277 - acc: 0.9571 - val_loss: 0.1388 - val_ac
c: 0.7980
Epoch 161/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0239 - acc: 0.9857 - val_loss: 0.1402 - val_ac
c: 0.8020
Epoch 162/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0261 - acc: 0.9571 - val_loss: 0.1428 - val_ac
c: 0.7920
Epoch 163/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0273 - acc: 0.9500 - val_loss: 0.1474 - val_ac
c: 0.7660
Epoch 164/800
1/1 [==============================] - 0s 177ms/step - loss: 0.0253 - acc: 0.9643 - val_loss: 0.1522 - val_ac
c: 0.7460
Epoch 165/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0229 - acc: 1.0000 - val_loss: 0.1546 - val_ac
c: 0.7460
```

```
Epoch 166/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0242 - acc: 0.9786 - val_loss: 0.1534 - val_ac
c: 0.7500
Epoch 167/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0238 - acc: 0.9643 - val_loss: 0.1516 - val_ac
c: 0.7560
Epoch 168/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0236 - acc: 0.9714 - val_loss: 0.1488 - val_ac
c: 0.7700
Epoch 169/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0253 - acc: 0.9857 - val_loss: 0.1474 - val_ac
c: 0.7780
Epoch 170/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0239 - acc: 0.9786 - val_loss: 0.1467 - val_ac
c: 0.7820
Epoch 171/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0252 - acc: 0.9714 - val_loss: 0.1447 - val_ac
c: 0.7820
Epoch 172/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0266 - acc: 0.9500 - val_loss: 0.1423 - val_ac
c: 0.7800
Epoch 173/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0246 - acc: 0.9643 - val_loss: 0.1406 - val_ac
c: 0.7880
Epoch 174/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0242 - acc: 0.9643 - val_loss: 0.1402 - val_ac
c: 0.7900
Epoch 175/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0253 - acc: 0.9571 - val_loss: 0.1408 - val_ac
c: 0.7920
Epoch 176/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0227 - acc: 0.9714 - val_loss: 0.1426 - val_ac
c: 0.7860
Epoch 177/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0255 - acc: 0.9643 - val_loss: 0.1447 - val_ac
c: 0.7840
Epoch 178/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0238 - acc: 0.9929 - val_loss: 0.1468 - val_ac
c: 0.7760
Epoch 179/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0251 - acc: 0.9643 - val_loss: 0.1493 - val_ac
c: 0.7640
Epoch 180/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0251 - acc: 0.9643 - val_loss: 0.1509 - val_ac
c: 0.7500
Epoch 181/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0228 - acc: 0.9929 - val_loss: 0.1512 - val_ac
c: 0.7540
Epoch 182/800
1/1 [==============================] - 0s 182ms/step - loss: 0.0233 - acc: 0.9714 - val_loss: 0.1517 - val_ac
c: 0.7620
Epoch 183/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0263 - acc: 0.9571 - val_loss: 0.1499 - val_ac
c: 0.7740
Epoch 184/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0236 - acc: 0.9643 - val_loss: 0.1463 - val_ac
c: 0.7800
Epoch 185/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0250 - acc: 0.9429 - val_loss: 0.1443 - val_ac
c: 0.7800
Epoch 186/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0246 - acc: 0.9857 - val_loss: 0.1433 - val_ac
c: 0.7840
Epoch 187/800
1/1 [==============================] - 0s 177ms/step - loss: 0.0215 - acc: 0.9929 - val_loss: 0.1433 - val_ac
c: 0.7780
Epoch 188/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0229 - acc: 0.9643 - val_loss: 0.1425 - val_ac
c: 0.7740
Epoch 189/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0270 - acc: 0.9143 - val_loss: 0.1434 - val_ac
```

```
c: 0.7800
Epoch 190/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0241 - acc: 0.9571 - val_loss: 0.1452 - val_ac
c: 0.7720
Epoch 191/800
1/1 [==============================] - 0s 182ms/step - loss: 0.0240 - acc: 0.9786 - val_loss: 0.1455 - val_ac
c: 0.7760
Epoch 192/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0214 - acc: 0.9929 - val_loss: 0.1446 - val_ac
c: 0.7840
Epoch 193/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0238 - acc: 0.9857 - val_loss: 0.1422 - val_ac
c: 0.7860
Epoch 194/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0243 - acc: 0.9786 - val_loss: 0.1381 - val_ac
c: 0.7960
Epoch 195/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0244 - acc: 0.9714 - val_loss: 0.1360 - val_ac
c: 0.7900
Epoch 196/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0247 - acc: 0.9643 - val_loss: 0.1386 - val_ac
c: 0.7880
Epoch 197/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0238 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7820
Epoch 198/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0251 - acc: 0.9571 - val_loss: 0.1480 - val_ac
c: 0.7720
Epoch 199/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0264 - acc: 0.9571 - val_loss: 0.1493 - val_ac
c: 0.7740
Epoch 200/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0245 - acc: 0.9643 - val_loss: 0.1504 - val_ac
c: 0.7720
Epoch 201/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0224 - acc: 0.9714 - val_loss: 0.1506 - val_ac
c: 0.7680
Epoch 202/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0235 - acc: 0.9500 - val_loss: 0.1509 - val_ac
c: 0.7660
Epoch 203/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0231 - acc: 0.9643 - val_loss: 0.1488 - val_ac
c: 0.7640
Epoch 204/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0236 - acc: 0.9500 - val_loss: 0.1444 - val_ac
c: 0.7620
Epoch 205/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0226 - acc: 0.9714 - val_loss: 0.1420 - val_ac
c: 0.7680
Epoch 206/800
1/1 [==============================] - 0s 177ms/step - loss: 0.0245 - acc: 0.9571 - val_loss: 0.1407 - val_ac
c: 0.7780
Epoch 207/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0225 - acc: 0.9714 - val_loss: 0.1404 - val_ac
c: 0.7740
Epoch 208/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0228 - acc: 0.9857 - val_loss: 0.1401 - val_ac
c: 0.7820
Epoch 209/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0264 - acc: 0.9357 - val_loss: 0.1413 - val_ac
c: 0.7780
Epoch 210/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0229 - acc: 0.9714 - val_loss: 0.1430 - val_ac
c: 0.7740
Epoch 211/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0248 - acc: 0.9500 - val_loss: 0.1453 - val_ac
c: 0.7580
Epoch 212/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0217 - acc: 0.9714 - val_loss: 0.1476 - val_ac
c: 0.7540
Epoch 213/800
```

```
1/1 [==============================] - 0s 173ms/step - loss: 0.0210 - acc: 0.9714 - val_loss: 0.1486 - val_ac
c: 0.7560
Epoch 214/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0218 - acc: 0.9786 - val_loss: 0.1499 - val_ac
c: 0.7480
Epoch 215/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0239 - acc: 0.9429 - val_loss: 0.1486 - val_ac
c: 0.7600
Epoch 216/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0233 - acc: 0.9500 - val_loss: 0.1491 - val_ac
c: 0.7620
Epoch 217/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0234 - acc: 0.9857 - val_loss: 0.1492 - val_ac
c: 0.7640
Epoch 218/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0226 - acc: 0.9857 - val_loss: 0.1499 - val_ac
c: 0.7600
Epoch 219/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0222 - acc: 0.9786 - val_loss: 0.1488 - val_ac
c: 0.7620
Epoch 220/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0231 - acc: 0.9786 - val_loss: 0.1470 - val_ac
c: 0.7600
Epoch 221/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0234 - acc: 0.9786 - val_loss: 0.1451 - val_ac
c: 0.7580
Epoch 222/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0218 - acc: 0.9714 - val_loss: 0.1440 - val_ac
c: 0.7620
Epoch 223/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0192 - acc: 0.9929 - val_loss: 0.1434 - val_ac
c: 0.7640
Epoch 224/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0235 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7720
Epoch 225/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0249 - acc: 0.9643 - val_loss: 0.1459 - val_ac
c: 0.7640
Epoch 226/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0207 - acc: 0.9857 - val_loss: 0.1483 - val_ac
c: 0.7560
Epoch 227/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0218 - acc: 0.9786 - val_loss: 0.1508 - val_ac
c: 0.7620
Epoch 228/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0213 - acc: 0.9714 - val_loss: 0.1530 - val_ac
c: 0.7440
Epoch 229/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0206 - acc: 0.9786 - val_loss: 0.1531 - val_ac
c: 0.7400
Epoch 230/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0207 - acc: 0.9786 - val_loss: 0.1513 - val_ac
c: 0.7440
Epoch 231/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0225 - acc: 0.9786 - val_loss: 0.1476 - val_ac
c: 0.7520
Epoch 232/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0217 - acc: 0.9714 - val_loss: 0.1447 - val_ac
c: 0.7640
Epoch 233/800
1/1 [==============================] - 0s 197ms/step - loss: 0.0223 - acc: 0.9571 - val_loss: 0.1425 - val_ac
c: 0.7600
Epoch 234/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0228 - acc: 0.9643 - val_loss: 0.1417 - val_ac
c: 0.7600
Epoch 235/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0223 - acc: 0.9571 - val_loss: 0.1410 - val_ac
c: 0.7700
Epoch 236/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0224 - acc: 0.9857 - val_loss: 0.1397 - val_ac
c: 0.7800
```

```
Epoch 237/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0201 - acc: 0.9857 - val_loss: 0.1387 - val_ac
c: 0.7780
Epoch 238/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0186 - acc: 0.9857 - val_loss: 0.1381 - val_ac
c: 0.7780
Epoch 239/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0227 - acc: 0.9786 - val_loss: 0.1381 - val_ac
c: 0.7820
Epoch 240/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0206 - acc: 0.9786 - val_loss: 0.1386 - val_ac
c: 0.7800
Epoch 241/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0198 - acc: 1.0000 - val_loss: 0.1402 - val_ac
c: 0.7700
Epoch 242/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0227 - acc: 0.9643 - val_loss: 0.1421 - val_ac
c: 0.7760
Epoch 243/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0226 - acc: 0.9714 - val_loss: 0.1447 - val_ac
c: 0.7700
Epoch 244/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0216 - acc: 0.9643 - val_loss: 0.1467 - val_ac
c: 0.7700
Epoch 245/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0213 - acc: 0.9929 - val_loss: 0.1479 - val_ac
c: 0.7760
Epoch 246/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0207 - acc: 0.9714 - val_loss: 0.1457 - val_ac
c: 0.7740
Epoch 247/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0204 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7820
Epoch 248/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0217 - acc: 0.9714 - val_loss: 0.1391 - val_ac
c: 0.7860
Epoch 249/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0209 - acc: 0.9714 - val_loss: 0.1367 - val_ac
c: 0.7800
Epoch 250/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0211 - acc: 0.9714 - val_loss: 0.1385 - val_ac
c: 0.7760
Epoch 251/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0226 - acc: 0.9857 - val_loss: 0.1404 - val_ac
c: 0.7720
Epoch 252/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0210 - acc: 0.9786 - val_loss: 0.1428 - val_ac
c: 0.7580
Epoch 253/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0242 - acc: 0.9643 - val_loss: 0.1430 - val_ac
c: 0.7640
Epoch 254/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0229 - acc: 0.9714 - val_loss: 0.1411 - val_ac
c: 0.7740
Epoch 255/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0213 - acc: 0.9643 - val_loss: 0.1409 - val_ac
c: 0.7760
Epoch 256/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0205 - acc: 0.9714 - val_loss: 0.1409 - val_ac
c: 0.7940
Epoch 257/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0228 - acc: 0.9500 - val_loss: 0.1411 - val_ac
c: 0.7940
Epoch 258/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0204 - acc: 0.9786 - val_loss: 0.1396 - val_ac
c: 0.7960
Epoch 259/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0209 - acc: 0.9786 - val_loss: 0.1375 - val_ac
c: 0.7920
Epoch 260/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0197 - acc: 0.9929 - val_loss: 0.1370 - val_ac
```

```
c: 0.7820
Epoch 261/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0204 - acc: 0.9857 - val_loss: 0.1390 - val_ac
c: 0.7720
Epoch 262/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0201 - acc: 0.9571 - val_loss: 0.1421 - val_ac
c: 0.7560
Epoch 263/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0214 - acc: 0.9857 - val_loss: 0.1458 - val_ac
c: 0.7540
Epoch 264/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0226 - acc: 0.9786 - val_loss: 0.1473 - val_ac
c: 0.7500
Epoch 265/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0208 - acc: 0.9786 - val_loss: 0.1459 - val_ac
c: 0.7640
Epoch 266/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.1462 - val_ac
c: 0.7720
Epoch 267/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0198 - acc: 0.9786 - val_loss: 0.1474 - val_ac
c: 0.7720
Epoch 268/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0212 - acc: 0.9857 - val_loss: 0.1472 - val_ac
c: 0.7720
Epoch 269/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0202 - acc: 0.9786 - val_loss: 0.1477 - val_ac
c: 0.7740
Epoch 270/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0214 - acc: 0.9786 - val_loss: 0.1480 - val_ac
c: 0.7700
Epoch 271/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0223 - acc: 0.9571 - val_loss: 0.1471 - val_ac
c: 0.7660
Epoch 272/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0214 - acc: 0.9714 - val_loss: 0.1442 - val_ac
c: 0.7680
Epoch 273/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0204 - acc: 0.9786 - val_loss: 0.1435 - val_ac
c: 0.7680
Epoch 274/800
1/1 [==============================] - 0s 185ms/step - loss: 0.0209 - acc: 0.9929 - val_loss: 0.1432 - val_ac
c: 0.7700
Epoch 275/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0182 - acc: 1.0000 - val_loss: 0.1410 - val_ac
c: 0.7740
Epoch 276/800
1/1 [==============================] - 0s 177ms/step - loss: 0.0198 - acc: 0.9786 - val_loss: 0.1402 - val_ac
c: 0.7760
Epoch 277/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0205 - acc: 0.9714 - val_loss: 0.1392 - val_ac
c: 0.7760
Epoch 278/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0200 - acc: 0.9929 - val_loss: 0.1394 - val_ac
c: 0.7760
Epoch 279/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0204 - acc: 0.9786 - val_loss: 0.1400 - val_ac
c: 0.7780
Epoch 280/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0196 - acc: 0.9857 - val_loss: 0.1402 - val_ac
c: 0.7840
Epoch 281/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0197 - acc: 0.9857 - val_loss: 0.1415 - val_ac
c: 0.7840
Epoch 282/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0209 - acc: 0.9643 - val_loss: 0.1424 - val_ac
c: 0.7840
Epoch 283/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.1435 - val_ac
c: 0.7800
Epoch 284/800
```

```
1/1 [==============================] - 0s 171ms/step - loss: 0.0231 - acc: 0.9643 - val_loss: 0.1406 - val_ac
c: 0.7820
Epoch 285/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0206 - acc: 0.9857 - val_loss: 0.1389 - val_ac
c: 0.7860
Epoch 286/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0235 - acc: 0.9357 - val_loss: 0.1380 - val_ac
c: 0.7820
Epoch 287/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0203 - acc: 0.9857 - val_loss: 0.1385 - val_ac
c: 0.7740
Epoch 288/800
1/1 [==============================] - 0s 177ms/step - loss: 0.0200 - acc: 0.9857 - val_loss: 0.1393 - val_ac
c: 0.7760
Epoch 289/800
1/1 [==============================] - 0s 182ms/step - loss: 0.0210 - acc: 0.9786 - val_loss: 0.1401 - val_ac
c: 0.7820
Epoch 290/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.1416 - val_ac
c: 0.7800
Epoch 291/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0219 - acc: 0.9786 - val_loss: 0.1422 - val_ac
c: 0.7740
Epoch 292/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0197 - acc: 0.9643 - val_loss: 0.1424 - val_ac
c: 0.7800
Epoch 293/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0193 - acc: 0.9786 - val_loss: 0.1426 - val_ac
c: 0.7760
Epoch 294/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0215 - acc: 0.9571 - val_loss: 0.1434 - val_ac
c: 0.7760
Epoch 295/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0203 - acc: 0.9714 - val_loss: 0.1420 - val_ac
c: 0.7700
Epoch 296/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0189 - acc: 0.9714 - val_loss: 0.1409 - val_ac
c: 0.7700
Epoch 297/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0202 - acc: 0.9714 - val_loss: 0.1403 - val_ac
c: 0.7720
Epoch 298/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0198 - acc: 0.9714 - val_loss: 0.1375 - val_ac
c: 0.7780
Epoch 299/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0214 - acc: 0.9571 - val_loss: 0.1368 - val_ac
c: 0.7780
Epoch 300/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0194 - acc: 0.9929 - val_loss: 0.1384 - val_ac
c: 0.7820
Epoch 301/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0210 - acc: 0.9571 - val_loss: 0.1438 - val_ac
c: 0.7740
Epoch 302/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0203 - acc: 0.9714 - val_loss: 0.1502 - val_ac
c: 0.7600
Epoch 303/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0209 - acc: 0.9571 - val_loss: 0.1555 - val_ac
c: 0.7620
Epoch 304/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0194 - acc: 0.9786 - val_loss: 0.1561 - val_ac
c: 0.7560
Epoch 305/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0212 - acc: 0.9643 - val_loss: 0.1505 - val_ac
c: 0.7660
Epoch 306/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0193 - acc: 0.9857 - val_loss: 0.1460 - val_ac
c: 0.7700
Epoch 307/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.1411 - val_ac
c: 0.7840
```

```
Epoch 308/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.1374 - val_ac
c: 0.7780
Epoch 309/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0201 - acc: 0.9786 - val_loss: 0.1352 - val_ac
c: 0.7780
Epoch 310/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0194 - acc: 0.9857 - val_loss: 0.1341 - val_ac
c: 0.7840
Epoch 311/800
1/1 [==============================] - 0s 197ms/step - loss: 0.0189 - acc: 0.9786 - val_loss: 0.1345 - val_ac
c: 0.7840
Epoch 312/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0180 - acc: 0.9929 - val_loss: 0.1349 - val_ac
c: 0.7740
Epoch 313/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0196 - acc: 0.9929 - val_loss: 0.1378 - val_ac
c: 0.7740
Epoch 314/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0212 - acc: 0.9643 - val_loss: 0.1403 - val_ac
c: 0.7680
Epoch 315/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0187 - acc: 0.9857 - val_loss: 0.1420 - val_ac
c: 0.7660
Epoch 316/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0200 - acc: 0.9643 - val_loss: 0.1408 - val_ac
c: 0.7640
Epoch 317/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0201 - acc: 0.9786 - val_loss: 0.1399 - val_ac
c: 0.7760
Epoch 318/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0201 - acc: 0.9786 - val_loss: 0.1400 - val_ac
c: 0.7780
Epoch 319/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1394 - val_ac
c: 0.7800
Epoch 320/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0194 - acc: 0.9643 - val_loss: 0.1374 - val_ac
c: 0.7820
Epoch 321/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0196 - acc: 0.9714 - val_loss: 0.1376 - val_ac
c: 0.7840
Epoch 322/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0178 - acc: 0.9929 - val_loss: 0.1403 - val_ac
c: 0.7860
Epoch 323/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0182 - acc: 0.9929 - val_loss: 0.1435 - val_ac
c: 0.7760
Epoch 324/800
1/1 [==============================] - 0s 187ms/step - loss: 0.0222 - acc: 0.9643 - val_loss: 0.1437 - val_ac
c: 0.7780
Epoch 325/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0187 - acc: 0.9929 - val_loss: 0.1408 - val_ac
c: 0.7700
Epoch 326/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0197 - acc: 0.9714 - val_loss: 0.1383 - val_ac
c: 0.7760
Epoch 327/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0225 - acc: 0.9500 - val_loss: 0.1392 - val_ac
c: 0.7740
Epoch 328/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0207 - acc: 0.9786 - val_loss: 0.1402 - val_ac
c: 0.7700
Epoch 329/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0201 - acc: 0.9786 - val_loss: 0.1401 - val_ac
c: 0.7740
Epoch 330/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0214 - acc: 0.9429 - val_loss: 0.1384 - val_ac
c: 0.7740
Epoch 331/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0216 - acc: 0.9643 - val_loss: 0.1373 - val_ac
```

```
c: 0.7720
Epoch 332/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0211 - acc: 0.9571 - val_loss: 0.1399 - val_ac
c: 0.7700
Epoch 333/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0197 - acc: 0.9857 - val_loss: 0.1438 - val_ac
c: 0.7680
Epoch 334/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0201 - acc: 0.9714 - val_loss: 0.1475 - val_ac
c: 0.7660
Epoch 335/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0201 - acc: 0.9786 - val_loss: 0.1478 - val_ac
c: 0.7660
Epoch 336/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0179 - acc: 0.9929 - val_loss: 0.1465 - val_ac
c: 0.7720
Epoch 337/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0190 - acc: 0.9786 - val_loss: 0.1466 - val_ac
c: 0.7740
Epoch 338/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0224 - acc: 0.9643 - val_loss: 0.1472 - val_ac
c: 0.7740
Epoch 339/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0185 - acc: 0.9857 - val_loss: 0.1465 - val_ac
c: 0.7740
Epoch 340/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0188 - acc: 0.9857 - val_loss: 0.1443 - val_ac
c: 0.7760
Epoch 341/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0200 - acc: 0.9714 - val_loss: 0.1417 - val_ac
c: 0.7780
Epoch 342/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0217 - acc: 0.9571 - val_loss: 0.1406 - val_ac
c: 0.7700
Epoch 343/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0199 - acc: 0.9786 - val_loss: 0.1388 - val_ac
c: 0.7700
Epoch 344/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0212 - acc: 0.9714 - val_loss: 0.1388 - val_ac
c: 0.7740
Epoch 345/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0214 - acc: 0.9500 - val_loss: 0.1369 - val_ac
c: 0.7820
Epoch 346/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0195 - acc: 0.9714 - val_loss: 0.1356 - val_ac
c: 0.7840
Epoch 347/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0188 - acc: 0.9786 - val_loss: 0.1360 - val_ac
c: 0.7840
Epoch 348/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0194 - acc: 0.9857 - val_loss: 0.1348 - val_ac
c: 0.7900
Epoch 349/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0190 - acc: 0.9571 - val_loss: 0.1352 - val_ac
c: 0.7880
Epoch 350/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0203 - acc: 0.9786 - val_loss: 0.1382 - val_ac
c: 0.7840
Epoch 351/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.1420 - val_ac
c: 0.7840
Epoch 352/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0184 - acc: 0.9929 - val_loss: 0.1449 - val_ac
c: 0.7780
Epoch 353/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0204 - acc: 0.9643 - val_loss: 0.1479 - val_ac
c: 0.7780
Epoch 354/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0202 - acc: 0.9643 - val_loss: 0.1494 - val_ac
c: 0.7700
Epoch 355/800
```

```
1/1 [==============================] - 0s 173ms/step - loss: 0.0203 - acc: 0.9643 - val_loss: 0.1453 - val_ac
c: 0.7780
Epoch 356/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0210 - acc: 0.9500 - val_loss: 0.1421 - val_ac
c: 0.7860
Epoch 357/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0204 - acc: 0.9786 - val_loss: 0.1389 - val_ac
c: 0.7840
Epoch 358/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0199 - acc: 0.9786 - val_loss: 0.1370 - val_ac
c: 0.7900
Epoch 359/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0211 - acc: 0.9500 - val_loss: 0.1351 - val_ac
c: 0.7940
Epoch 360/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0200 - acc: 0.9714 - val_loss: 0.1334 - val_ac
c: 0.7880
Epoch 361/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1333 - val_ac
c: 0.7900
Epoch 362/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0212 - acc: 0.9643 - val_loss: 0.1375 - val_ac
c: 0.7780
Epoch 363/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0204 - acc: 0.9571 - val_loss: 0.1436 - val_ac
c: 0.7660
Epoch 364/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0189 - acc: 0.9786 - val_loss: 0.1485 - val_ac
c: 0.7600
Epoch 365/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0188 - acc: 0.9857 - val_loss: 0.1484 - val_ac
c: 0.7660
Epoch 366/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0211 - acc: 0.9786 - val_loss: 0.1479 - val_ac
c: 0.7720
Epoch 367/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0190 - acc: 0.9714 - val_loss: 0.1480 - val_ac
c: 0.7660
Epoch 368/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0173 - acc: 0.9929 - val_loss: 0.1495 - val_ac
c: 0.7600
Epoch 369/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0187 - acc: 0.9714 - val_loss: 0.1495 - val_ac
c: 0.7580
Epoch 370/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0198 - acc: 0.9714 - val_loss: 0.1464 - val_ac
c: 0.7600
Epoch 371/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0195 - acc: 0.9643 - val_loss: 0.1424 - val_ac
c: 0.7700
Epoch 372/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0192 - acc: 0.9643 - val_loss: 0.1382 - val_ac
c: 0.7880
Epoch 373/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0165 - acc: 1.0000 - val_loss: 0.1343 - val_ac
c: 0.7980
Epoch 374/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0170 - acc: 0.9857 - val_loss: 0.1323 - val_ac
c: 0.7960
Epoch 375/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0169 - acc: 0.9786 - val_loss: 0.1333 - val_ac
c: 0.7820
Epoch 376/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0188 - acc: 0.9857 - val_loss: 0.1340 - val_ac
c: 0.7860
Epoch 377/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0194 - acc: 0.9571 - val_loss: 0.1385 - val_ac
c: 0.7800
Epoch 378/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0199 - acc: 0.9429 - val_loss: 0.1406 - val_ac
c: 0.7780
```

```
Epoch 379/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0175 - acc: 0.9857 - val_loss: 0.1423 - val_ac
c: 0.7700
Epoch 380/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0191 - acc: 0.9643 - val_loss: 0.1440 - val_ac
c: 0.7640
Epoch 381/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0186 - acc: 0.9786 - val_loss: 0.1424 - val_ac
c: 0.7740
Epoch 382/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1398 - val_ac
c: 0.7860
Epoch 383/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0185 - acc: 0.9857 - val_loss: 0.1358 - val_ac
c: 0.7880
Epoch 384/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1345 - val_ac
c: 0.7740
Epoch 385/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0190 - acc: 0.9571 - val_loss: 0.1354 - val_ac
c: 0.7680
Epoch 386/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0188 - acc: 0.9786 - val_loss: 0.1375 - val_ac
c: 0.7660
Epoch 387/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0189 - acc: 0.9857 - val_loss: 0.1386 - val_ac
c: 0.7740
Epoch 388/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0198 - acc: 0.9786 - val_loss: 0.1393 - val_ac
c: 0.7760
Epoch 389/800
1/1 [==============================] - 0s 186ms/step - loss: 0.0199 - acc: 0.9357 - val_loss: 0.1416 - val_ac
c: 0.7800
Epoch 390/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0183 - acc: 0.9714 - val_loss: 0.1440 - val_ac
c: 0.7760
Epoch 391/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1463 - val_ac
c: 0.7700
Epoch 392/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0184 - acc: 0.9714 - val_loss: 0.1469 - val_ac
c: 0.7680
Epoch 393/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1443 - val_ac
c: 0.7740
Epoch 394/800
1/1 [==============================] - 0s 182ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1414 - val_ac
c: 0.7820
Epoch 395/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0185 - acc: 0.9857 - val_loss: 0.1409 - val_ac
c: 0.7740
Epoch 396/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0188 - acc: 0.9643 - val_loss: 0.1421 - val_ac
c: 0.7620
Epoch 397/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0180 - acc: 0.9857 - val_loss: 0.1428 - val_ac
c: 0.7580
Epoch 398/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0190 - acc: 0.9714 - val_loss: 0.1436 - val_ac
c: 0.7560
Epoch 399/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0197 - acc: 0.9857 - val_loss: 0.1436 - val_ac
c: 0.7660
Epoch 400/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0221 - acc: 0.9429 - val_loss: 0.1403 - val_ac
c: 0.7780
Epoch 401/800
1/1 [==============================] - 0s 187ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1406 - val_ac
c: 0.7740
Epoch 402/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0199 - acc: 0.9571 - val_loss: 0.1416 - val_ac
```

```
                    c: 0.7660
                    Epoch 403/800
                    1/1 [==============================] - 0s 183ms/step - loss: 0.0197 - acc: 0.9571 - val_loss: 0.1416 - val_ac
                    c: 0.7700
                    Epoch 404/800
                    1/1 [==============================] - 0s 161ms/step - loss: 0.0210 - acc: 0.9571 - val_loss: 0.1397 - val_ac
                    c: 0.7760
                    Epoch 405/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0199 - acc: 0.9643 - val_loss: 0.1372 - val_ac
                    c: 0.7780
                    Epoch 406/800
                    1/1 [==============================] - 0s 166ms/step - loss: 0.0196 - acc: 0.9643 - val_loss: 0.1351 - val_ac
                    c: 0.7720
                    Epoch 407/800
                    1/1 [==============================] - 0s 182ms/step - loss: 0.0196 - acc: 0.9643 - val_loss: 0.1353 - val_ac
                    c: 0.7680
                    Epoch 408/800
                    1/1 [==============================] - 0s 171ms/step - loss: 0.0192 - acc: 0.9857 - val_loss: 0.1371 - val_ac
                    c: 0.7640
                    Epoch 409/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0182 - acc: 0.9786 - val_loss: 0.1396 - val_ac
                    c: 0.7680
                    Epoch 410/800
                    1/1 [==============================] - 0s 166ms/step - loss: 0.0189 - acc: 0.9714 - val_loss: 0.1439 - val_ac
                    c: 0.7480
                    Epoch 411/800
                    1/1 [==============================] - 0s 162ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1482 - val_ac
                    c: 0.7340
                    Epoch 412/800
                    1/1 [==============================] - 0s 171ms/step - loss: 0.0187 - acc: 0.9714 - val_loss: 0.1511 - val_ac
                    c: 0.7440
                    Epoch 413/800
                    1/1 [==============================] - 0s 163ms/step - loss: 0.0193 - acc: 0.9643 - val_loss: 0.1515 - val_ac
                    c: 0.7420
                    Epoch 414/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0181 - acc: 0.9857 - val_loss: 0.1502 - val_ac
                    c: 0.7540
                    Epoch 415/800
                    1/1 [==============================] - 0s 190ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1481 - val_ac
                    c: 0.7680
                    Epoch 416/800
                    1/1 [==============================] - 0s 168ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1462 - val_ac
                    c: 0.7740
                    Epoch 417/800
                    1/1 [==============================] - 0s 172ms/step - loss: 0.0172 - acc: 0.9929 - val_loss: 0.1428 - val_ac
                    c: 0.7800
                    Epoch 418/800
                    1/1 [==============================] - 0s 175ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1393 - val_ac
                    c: 0.7760
                    Epoch 419/800
                    1/1 [==============================] - 0s 164ms/step - loss: 0.0189 - acc: 0.9643 - val_loss: 0.1387 - val_ac
                    c: 0.7760
                    Epoch 420/800
                    1/1 [==============================] - 0s 159ms/step - loss: 0.0182 - acc: 0.9857 - val_loss: 0.1420 - val_ac
                    c: 0.7660
                    Epoch 421/800
                    1/1 [==============================] - 0s 163ms/step - loss: 0.0190 - acc: 0.9929 - val_loss: 0.1450 - val_ac
                    c: 0.7540
                    Epoch 422/800
                    1/1 [==============================] - 0s 167ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1449 - val_ac
                    c: 0.7580
                    Epoch 423/800
                    1/1 [==============================] - 0s 163ms/step - loss: 0.0192 - acc: 0.9714 - val_loss: 0.1424 - val_ac
                    c: 0.7660
                    Epoch 424/800
                    1/1 [==============================] - 0s 175ms/step - loss: 0.0165 - acc: 0.9929 - val_loss: 0.1407 - val_ac
                    c: 0.7660
                    Epoch 425/800
                    1/1 [==============================] - 0s 169ms/step - loss: 0.0206 - acc: 0.9714 - val_loss: 0.1392 - val_ac
                    c: 0.7720
                    Epoch 426/800
```

```
1/1 [==============================] - 0s 171ms/step - loss: 0.0190 - acc: 0.9571 - val_loss: 0.1404 - val_ac
c: 0.7740
Epoch 427/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0180 - acc: 0.9857 - val_loss: 0.1405 - val_ac
c: 0.7740
Epoch 428/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1396 - val_ac
c: 0.7780
Epoch 429/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1384 - val_ac
c: 0.7820
Epoch 430/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1362 - val_ac
c: 0.7860
Epoch 431/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1351 - val_ac
c: 0.7840
Epoch 432/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0166 - acc: 0.9929 - val_loss: 0.1344 - val_ac
c: 0.7760
Epoch 433/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0182 - acc: 0.9786 - val_loss: 0.1366 - val_ac
c: 0.7720
Epoch 434/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0195 - acc: 0.9786 - val_loss: 0.1389 - val_ac
c: 0.7720
Epoch 435/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0168 - acc: 0.9857 - val_loss: 0.1412 - val_ac
c: 0.7700
Epoch 436/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0179 - acc: 0.9643 - val_loss: 0.1421 - val_ac
c: 0.7740
Epoch 437/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1453 - val_ac
c: 0.7700
Epoch 438/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0190 - acc: 0.9714 - val_loss: 0.1462 - val_ac
c: 0.7740
Epoch 439/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0169 - acc: 0.9786 - val_loss: 0.1449 - val_ac
c: 0.7780
Epoch 440/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0172 - acc: 0.9714 - val_loss: 0.1413 - val_ac
c: 0.7780
Epoch 441/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0178 - acc: 0.9714 - val_loss: 0.1377 - val_ac
c: 0.7820
Epoch 442/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0159 - acc: 0.9929 - val_loss: 0.1363 - val_ac
c: 0.7860
Epoch 443/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1370 - val_ac
c: 0.7740
Epoch 444/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0170 - acc: 0.9929 - val_loss: 0.1364 - val_ac
c: 0.7740
Epoch 445/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1355 - val_ac
c: 0.7700
Epoch 446/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0189 - acc: 0.9786 - val_loss: 0.1365 - val_ac
c: 0.7740
Epoch 447/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1371 - val_ac
c: 0.7780
Epoch 448/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0190 - acc: 0.9643 - val_loss: 0.1380 - val_ac
c: 0.7840
Epoch 449/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0201 - acc: 0.9571 - val_loss: 0.1411 - val_ac
c: 0.7780
```

```
Epoch 450/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0181 - acc: 0.9857 - val_loss: 0.1420 - val_ac
c: 0.7800
Epoch 451/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0164 - acc: 0.9929 - val_loss: 0.1432 - val_ac
c: 0.7840
Epoch 452/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0173 - acc: 0.9714 - val_loss: 0.1435 - val_ac
c: 0.7800
Epoch 453/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1445 - val_ac
c: 0.7780
Epoch 454/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1465 - val_ac
c: 0.7640
Epoch 455/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0166 - acc: 0.9786 - val_loss: 0.1468 - val_ac
c: 0.7600
Epoch 456/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0192 - acc: 0.9643 - val_loss: 0.1431 - val_ac
c: 0.7680
Epoch 457/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1392 - val_ac
c: 0.7760
Epoch 458/800
1/1 [==============================] - 0s 184ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1369 - val_ac
c: 0.7720
Epoch 459/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0179 - acc: 0.9929 - val_loss: 0.1357 - val_ac
c: 0.7740
Epoch 460/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1350 - val_ac
c: 0.7740
Epoch 461/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0165 - acc: 0.9929 - val_loss: 0.1368 - val_ac
c: 0.7700
Epoch 462/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0156 - acc: 0.9929 - val_loss: 0.1380 - val_ac
c: 0.7700
Epoch 463/800
1/1 [==============================] - 0s 190ms/step - loss: 0.0189 - acc: 0.9643 - val_loss: 0.1391 - val_ac
c: 0.7740
Epoch 464/800
1/1 [==============================] - 0s 181ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1414 - val_ac
c: 0.7780
Epoch 465/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1438 - val_ac
c: 0.7780
Epoch 466/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0180 - acc: 0.9714 - val_loss: 0.1430 - val_ac
c: 0.7720
Epoch 467/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0196 - acc: 0.9500 - val_loss: 0.1426 - val_ac
c: 0.7640
Epoch 468/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0189 - acc: 0.9714 - val_loss: 0.1429 - val_ac
c: 0.7660
Epoch 469/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0182 - acc: 0.9500 - val_loss: 0.1424 - val_ac
c: 0.7700
Epoch 470/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0188 - acc: 0.9571 - val_loss: 0.1435 - val_ac
c: 0.7560
Epoch 471/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0177 - acc: 0.9929 - val_loss: 0.1413 - val_ac
c: 0.7620
Epoch 472/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0187 - acc: 0.9857 - val_loss: 0.1405 - val_ac
c: 0.7640
Epoch 473/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1404 - val_ac
```

```
                    c: 0.7660
                    Epoch 474/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1417 - val_ac
                    c: 0.7640
                    Epoch 475/800
                    1/1 [==============================] - 0s 170ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1418 - val_ac
                    c: 0.7640
                    Epoch 476/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0195 - acc: 0.9571 - val_loss: 0.1430 - val_ac
                    c: 0.7620
                    Epoch 477/800
                    1/1 [==============================] - 0s 175ms/step - loss: 0.0192 - acc: 0.9643 - val_loss: 0.1422 - val_ac
                    c: 0.7680
                    Epoch 478/800
                    1/1 [==============================] - 0s 167ms/step - loss: 0.0179 - acc: 0.9857 - val_loss: 0.1410 - val_ac
                    c: 0.7680
                    Epoch 479/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0167 - acc: 0.9929 - val_loss: 0.1396 - val_ac
                    c: 0.7640
                    Epoch 480/800
                    1/1 [==============================] - 0s 174ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1379 - val_ac
                    c: 0.7640
                    Epoch 481/800
                    1/1 [==============================] - 0s 174ms/step - loss: 0.0162 - acc: 0.9857 - val_loss: 0.1358 - val_ac
                    c: 0.7700
                    Epoch 482/800
                    1/1 [==============================] - 0s 176ms/step - loss: 0.0179 - acc: 0.9714 - val_loss: 0.1348 - val_ac
                    c: 0.7700
                    Epoch 483/800
                    1/1 [==============================] - 0s 164ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1386 - val_ac
                    c: 0.7700
                    Epoch 484/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0170 - acc: 0.9857 - val_loss: 0.1454 - val_ac
                    c: 0.7680
                    Epoch 485/800
                    1/1 [==============================] - 0s 163ms/step - loss: 0.0178 - acc: 0.9643 - val_loss: 0.1534 - val_ac
                    c: 0.7620
                    Epoch 486/800
                    1/1 [==============================] - 0s 186ms/step - loss: 0.0205 - acc: 0.9714 - val_loss: 0.1594 - val_ac
                    c: 0.7520
                    Epoch 487/800
                    1/1 [==============================] - 0s 176ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1598 - val_ac
                    c: 0.7520
                    Epoch 488/800
                    1/1 [==============================] - 0s 168ms/step - loss: 0.0195 - acc: 0.9500 - val_loss: 0.1512 - val_ac
                    c: 0.7580
                    Epoch 489/800
                    1/1 [==============================] - 0s 163ms/step - loss: 0.0177 - acc: 0.9643 - val_loss: 0.1461 - val_ac
                    c: 0.7640
                    Epoch 490/800
                    1/1 [==============================] - 0s 172ms/step - loss: 0.0195 - acc: 0.9786 - val_loss: 0.1420 - val_ac
                    c: 0.7680
                    Epoch 491/800
                    1/1 [==============================] - 0s 165ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1394 - val_ac
                    c: 0.7780
                    Epoch 492/800
                    1/1 [==============================] - 0s 168ms/step - loss: 0.0176 - acc: 0.9714 - val_loss: 0.1388 - val_ac
                    c: 0.7740
                    Epoch 493/800
                    1/1 [==============================] - 0s 176ms/step - loss: 0.0175 - acc: 0.9857 - val_loss: 0.1413 - val_ac
                    c: 0.7600
                    Epoch 494/800
                    1/1 [==============================] - 0s 180ms/step - loss: 0.0196 - acc: 0.9643 - val_loss: 0.1434 - val_ac
                    c: 0.7480
                    Epoch 495/800
                    1/1 [==============================] - 0s 169ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1447 - val_ac
                    c: 0.7460
                    Epoch 496/800
                    1/1 [==============================] - 0s 167ms/step - loss: 0.0182 - acc: 0.9643 - val_loss: 0.1448 - val_ac
                    c: 0.7580
                    Epoch 497/800
```

```
1/1 [==============================] - 0s 175ms/step - loss: 0.0170 - acc: 0.9857 - val_loss: 0.1474 - val_ac
c: 0.7600
Epoch 498/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1483 - val_ac
c: 0.7660
Epoch 499/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1477 - val_ac
c: 0.7580
Epoch 500/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1476 - val_ac
c: 0.7620
Epoch 501/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1460 - val_ac
c: 0.7600
Epoch 502/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0161 - acc: 1.0000 - val_loss: 0.1448 - val_ac
c: 0.7540
Epoch 503/800
1/1 [==============================] - 0s 183ms/step - loss: 0.0193 - acc: 0.9714 - val_loss: 0.1432 - val_ac
c: 0.7600
Epoch 504/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0173 - acc: 0.9857 - val_loss: 0.1425 - val_ac
c: 0.7640
Epoch 505/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0192 - acc: 0.9429 - val_loss: 0.1429 - val_ac
c: 0.7740
Epoch 506/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0168 - acc: 0.9786 - val_loss: 0.1413 - val_ac
c: 0.7700
Epoch 507/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0161 - acc: 1.0000 - val_loss: 0.1390 - val_ac
c: 0.7720
Epoch 508/800
1/1 [==============================] - 0s 185ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1379 - val_ac
c: 0.7740
Epoch 509/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0173 - acc: 1.0000 - val_loss: 0.1382 - val_ac
c: 0.7740
Epoch 510/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1396 - val_ac
c: 0.7660
Epoch 511/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1430 - val_ac
c: 0.7640
Epoch 512/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1457 - val_ac
c: 0.7600
Epoch 513/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0181 - acc: 0.9929 - val_loss: 0.1475 - val_ac
c: 0.7580
Epoch 514/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0165 - acc: 0.9929 - val_loss: 0.1460 - val_ac
c: 0.7640
Epoch 515/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1443 - val_ac
c: 0.7640
Epoch 516/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1402 - val_ac
c: 0.7660
Epoch 517/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0142 - acc: 0.9929 - val_loss: 0.1369 - val_ac
c: 0.7680
Epoch 518/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0184 - acc: 0.9714 - val_loss: 0.1331 - val_ac
c: 0.7700
Epoch 519/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0180 - acc: 0.9714 - val_loss: 0.1302 - val_ac
c: 0.7820
Epoch 520/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0157 - acc: 0.9929 - val_loss: 0.1293 - val_ac
c: 0.7820
```

```
Epoch 521/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0187 - acc: 0.9571 - val_loss: 0.1293 - val_ac
c: 0.7840
Epoch 522/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0172 - acc: 0.9714 - val_loss: 0.1304 - val_ac
c: 0.7800
Epoch 523/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1364 - val_ac
c: 0.7760
Epoch 524/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0152 - acc: 0.9714 - val_loss: 0.1424 - val_ac
c: 0.7720
Epoch 525/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0158 - acc: 0.9929 - val_loss: 0.1472 - val_ac
c: 0.7640
Epoch 526/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1475 - val_ac
c: 0.7640
Epoch 527/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0183 - acc: 0.9643 - val_loss: 0.1432 - val_ac
c: 0.7720
Epoch 528/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0185 - acc: 0.9714 - val_loss: 0.1387 - val_ac
c: 0.7640
Epoch 529/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1380 - val_ac
c: 0.7660
Epoch 530/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1386 - val_ac
c: 0.7700
Epoch 531/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1377 - val_ac
c: 0.7760
Epoch 532/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1381 - val_ac
c: 0.7760
Epoch 533/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1407 - val_ac
c: 0.7620
Epoch 534/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0184 - acc: 0.9786 - val_loss: 0.1428 - val_ac
c: 0.7660
Epoch 535/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0174 - acc: 0.9643 - val_loss: 0.1449 - val_ac
c: 0.7740
Epoch 536/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0191 - acc: 0.9714 - val_loss: 0.1431 - val_ac
c: 0.7740
Epoch 537/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1380 - val_ac
c: 0.7700
Epoch 538/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1362 - val_ac
c: 0.7740
Epoch 539/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1371 - val_ac
c: 0.7660
Epoch 540/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0160 - acc: 0.9643 - val_loss: 0.1421 - val_ac
c: 0.7580
Epoch 541/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0161 - acc: 1.0000 - val_loss: 0.1469 - val_ac
c: 0.7440
Epoch 542/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1516 - val_ac
c: 0.7500
Epoch 543/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0151 - acc: 1.0000 - val_loss: 0.1553 - val_ac
c: 0.7480
Epoch 544/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0153 - acc: 0.9857 - val_loss: 0.1550 - val_ac
```

```
c: 0.7480
Epoch 545/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0172 - acc: 0.9714 - val_loss: 0.1510 - val_ac
c: 0.7520
Epoch 546/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1462 - val_ac
c: 0.7660
Epoch 547/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0174 - acc: 0.9643 - val_loss: 0.1387 - val_ac
c: 0.7660
Epoch 548/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0157 - acc: 1.0000 - val_loss: 0.1341 - val_ac
c: 0.7780
Epoch 549/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1308 - val_ac
c: 0.7920
Epoch 550/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0151 - acc: 0.9714 - val_loss: 0.1291 - val_ac
c: 0.7980
Epoch 551/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0158 - acc: 0.9929 - val_loss: 0.1299 - val_ac
c: 0.7960
Epoch 552/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0179 - acc: 0.9643 - val_loss: 0.1337 - val_ac
c: 0.7840
Epoch 553/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0142 - acc: 1.0000 - val_loss: 0.1412 - val_ac
c: 0.7660
Epoch 554/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0175 - acc: 0.9643 - val_loss: 0.1473 - val_ac
c: 0.7520
Epoch 555/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1499 - val_ac
c: 0.7440
Epoch 556/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1474 - val_ac
c: 0.7500
Epoch 557/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1462 - val_ac
c: 0.7680
Epoch 558/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1414 - val_ac
c: 0.7760
Epoch 559/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1338 - val_ac
c: 0.7940
Epoch 560/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0164 - acc: 0.9643 - val_loss: 0.1282 - val_ac
c: 0.8020
Epoch 561/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0162 - acc: 0.9857 - val_loss: 0.1271 - val_ac
c: 0.8000
Epoch 562/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0187 - acc: 0.9571 - val_loss: 0.1283 - val_ac
c: 0.8060
Epoch 563/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1333 - val_ac
c: 0.7840
Epoch 564/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1374 - val_ac
c: 0.7940
Epoch 565/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1413 - val_ac
c: 0.7800
Epoch 566/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0166 - acc: 0.9857 - val_loss: 0.1444 - val_ac
c: 0.7660
Epoch 567/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1456 - val_ac
c: 0.7660
Epoch 568/800
```

```
1/1 [==============================] - 0s 163ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1435 - val_ac
c: 0.7700
Epoch 569/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1414 - val_ac
c: 0.7720
Epoch 570/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1403 - val_ac
c: 0.7600
Epoch 571/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0170 - acc: 0.9643 - val_loss: 0.1394 - val_ac
c: 0.7640
Epoch 572/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1380 - val_ac
c: 0.7640
Epoch 573/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0171 - acc: 0.9714 - val_loss: 0.1360 - val_ac
c: 0.7660
Epoch 574/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0182 - acc: 0.9571 - val_loss: 0.1374 - val_ac
c: 0.7660
Epoch 575/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0173 - acc: 0.9786 - val_loss: 0.1423 - val_ac
c: 0.7720
Epoch 576/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0151 - acc: 1.0000 - val_loss: 0.1468 - val_ac
c: 0.7600
Epoch 577/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0166 - acc: 0.9786 - val_loss: 0.1458 - val_ac
c: 0.7620
Epoch 578/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1453 - val_ac
c: 0.7580
Epoch 579/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0167 - acc: 0.9714 - val_loss: 0.1452 - val_ac
c: 0.7500
Epoch 580/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0182 - acc: 0.9786 - val_loss: 0.1433 - val_ac
c: 0.7640
Epoch 581/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1424 - val_ac
c: 0.7640
Epoch 582/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0183 - acc: 0.9643 - val_loss: 0.1395 - val_ac
c: 0.7700
Epoch 583/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0153 - acc: 0.9786 - val_loss: 0.1360 - val_ac
c: 0.7740
Epoch 584/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0166 - acc: 0.9714 - val_loss: 0.1323 - val_ac
c: 0.7700
Epoch 585/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0168 - acc: 0.9786 - val_loss: 0.1328 - val_ac
c: 0.7760
Epoch 586/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1354 - val_ac
c: 0.7740
Epoch 587/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0157 - acc: 1.0000 - val_loss: 0.1411 - val_ac
c: 0.7600
Epoch 588/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1454 - val_ac
c: 0.7460
Epoch 589/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0135 - acc: 1.0000 - val_loss: 0.1480 - val_ac
c: 0.7360
Epoch 590/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0182 - acc: 0.9643 - val_loss: 0.1493 - val_ac
c: 0.7480
Epoch 591/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0153 - acc: 0.9857 - val_loss: 0.1518 - val_ac
c: 0.7460
```

```
Epoch 592/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1527 - val_ac
c: 0.7480
Epoch 593/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0201 - acc: 0.9357 - val_loss: 0.1534 - val_ac
c: 0.7460
Epoch 594/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0142 - acc: 0.9929 - val_loss: 0.1509 - val_ac
c: 0.7400
Epoch 595/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0173 - acc: 0.9929 - val_loss: 0.1480 - val_ac
c: 0.7520
Epoch 596/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1472 - val_ac
c: 0.7520
Epoch 597/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0154 - acc: 0.9786 - val_loss: 0.1456 - val_ac
c: 0.7580
Epoch 598/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1447 - val_ac
c: 0.7560
Epoch 599/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0152 - acc: 0.9929 - val_loss: 0.1415 - val_ac
c: 0.7660
Epoch 600/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0190 - acc: 0.9571 - val_loss: 0.1398 - val_ac
c: 0.7760
Epoch 601/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0166 - acc: 0.9643 - val_loss: 0.1373 - val_ac
c: 0.7780
Epoch 602/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0164 - acc: 0.9643 - val_loss: 0.1358 - val_ac
c: 0.7780
Epoch 603/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1368 - val_ac
c: 0.7740
Epoch 604/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1386 - val_ac
c: 0.7660
Epoch 605/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1397 - val_ac
c: 0.7580
Epoch 606/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0166 - acc: 0.9857 - val_loss: 0.1367 - val_ac
c: 0.7700
Epoch 607/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1349 - val_ac
c: 0.7700
Epoch 608/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1339 - val_ac
c: 0.7660
Epoch 609/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0173 - acc: 0.9714 - val_loss: 0.1350 - val_ac
c: 0.7640
Epoch 610/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0180 - acc: 0.9643 - val_loss: 0.1386 - val_ac
c: 0.7580
Epoch 611/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0157 - acc: 0.9929 - val_loss: 0.1423 - val_ac
c: 0.7460
Epoch 612/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0179 - acc: 0.9643 - val_loss: 0.1444 - val_ac
c: 0.7580
Epoch 613/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0170 - acc: 0.9643 - val_loss: 0.1466 - val_ac
c: 0.7600
Epoch 614/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1521 - val_ac
c: 0.7500
Epoch 615/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0163 - acc: 0.9786 - val_loss: 0.1574 - val_ac
```

```
c: 0.7440
Epoch 616/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0191 - acc: 0.9500 - val_loss: 0.1521 - val_ac
c: 0.7440
Epoch 617/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0176 - acc: 0.9714 - val_loss: 0.1420 - val_ac
c: 0.7540
Epoch 618/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1376 - val_ac
c: 0.7660
Epoch 619/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1390 - val_ac
c: 0.7560
Epoch 620/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0178 - acc: 0.9643 - val_loss: 0.1417 - val_ac
c: 0.7560
Epoch 621/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0182 - acc: 0.9500 - val_loss: 0.1451 - val_ac
c: 0.7520
Epoch 622/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0216 - acc: 0.9500 - val_loss: 0.1465 - val_ac
c: 0.7540
Epoch 623/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1495 - val_ac
c: 0.7520
Epoch 624/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0176 - acc: 0.9786 - val_loss: 0.1521 - val_ac
c: 0.7480
Epoch 625/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1569 - val_ac
c: 0.7400
Epoch 626/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0171 - acc: 0.9929 - val_loss: 0.1610 - val_ac
c: 0.7240
Epoch 627/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0186 - acc: 0.9643 - val_loss: 0.1582 - val_ac
c: 0.7300
Epoch 628/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0185 - acc: 0.9643 - val_loss: 0.1534 - val_ac
c: 0.7340
Epoch 629/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0165 - acc: 0.9857 - val_loss: 0.1458 - val_ac
c: 0.7440
Epoch 630/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0175 - acc: 0.9643 - val_loss: 0.1384 - val_ac
c: 0.7560
Epoch 631/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0172 - acc: 0.9643 - val_loss: 0.1371 - val_ac
c: 0.7540
Epoch 632/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1382 - val_ac
c: 0.7680
Epoch 633/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1417 - val_ac
c: 0.7600
Epoch 634/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0167 - acc: 0.9643 - val_loss: 0.1415 - val_ac
c: 0.7560
Epoch 635/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0161 - acc: 0.9857 - val_loss: 0.1440 - val_ac
c: 0.7560
Epoch 636/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0156 - acc: 0.9929 - val_loss: 0.1481 - val_ac
c: 0.7500
Epoch 637/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0157 - acc: 0.9714 - val_loss: 0.1548 - val_ac
c: 0.7460
Epoch 638/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1572 - val_ac
c: 0.7460
Epoch 639/800
```

```
1/1 [==============================] - 0s 168ms/step - loss: 0.0176 - acc: 0.9643 - val_loss: 0.1585 - val_ac
c: 0.7400
Epoch 640/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1549 - val_ac
c: 0.7480
Epoch 641/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0167 - acc: 0.9571 - val_loss: 0.1491 - val_ac
c: 0.7560
Epoch 642/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1432 - val_ac
c: 0.7600
Epoch 643/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0163 - acc: 0.9929 - val_loss: 0.1372 - val_ac
c: 0.7740
Epoch 644/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0153 - acc: 0.9786 - val_loss: 0.1340 - val_ac
c: 0.7740
Epoch 645/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1343 - val_ac
c: 0.7740
Epoch 646/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0162 - acc: 1.0000 - val_loss: 0.1371 - val_ac
c: 0.7700
Epoch 647/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0166 - acc: 0.9929 - val_loss: 0.1382 - val_ac
c: 0.7740
Epoch 648/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0166 - acc: 0.9786 - val_loss: 0.1391 - val_ac
c: 0.7780
Epoch 649/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0161 - acc: 0.9857 - val_loss: 0.1402 - val_ac
c: 0.7700
Epoch 650/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1438 - val_ac
c: 0.7640
Epoch 651/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1447 - val_ac
c: 0.7520
Epoch 652/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0173 - acc: 0.9714 - val_loss: 0.1433 - val_ac
c: 0.7600
Epoch 653/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1420 - val_ac
c: 0.7640
Epoch 654/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1439 - val_ac
c: 0.7660
Epoch 655/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0152 - acc: 0.9857 - val_loss: 0.1447 - val_ac
c: 0.7720
Epoch 656/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0146 - acc: 0.9929 - val_loss: 0.1440 - val_ac
c: 0.7760
Epoch 657/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0177 - acc: 0.9643 - val_loss: 0.1429 - val_ac
c: 0.7840
Epoch 658/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0162 - acc: 0.9929 - val_loss: 0.1419 - val_ac
c: 0.7840
Epoch 659/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1412 - val_ac
c: 0.7720
Epoch 660/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7620
Epoch 661/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1488 - val_ac
c: 0.7520
Epoch 662/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0168 - acc: 0.9786 - val_loss: 0.1501 - val_ac
c: 0.7500
```

```
Epoch 663/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0179 - acc: 0.9714 - val_loss: 0.1469 - val_ac
c: 0.7580
Epoch 664/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0156 - acc: 0.9786 - val_loss: 0.1455 - val_ac
c: 0.7560
Epoch 665/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1458 - val_ac
c: 0.7640
Epoch 666/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1464 - val_ac
c: 0.7600
Epoch 667/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0165 - acc: 0.9643 - val_loss: 0.1441 - val_ac
c: 0.7640
Epoch 668/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1421 - val_ac
c: 0.7780
Epoch 669/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1384 - val_ac
c: 0.7800
Epoch 670/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0144 - acc: 0.9929 - val_loss: 0.1354 - val_ac
c: 0.7780
Epoch 671/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0165 - acc: 0.9857 - val_loss: 0.1353 - val_ac
c: 0.7720
Epoch 672/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1409 - val_ac
c: 0.7520
Epoch 673/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0166 - acc: 0.9786 - val_loss: 0.1467 - val_ac
c: 0.7480
Epoch 674/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0141 - acc: 0.9857 - val_loss: 0.1523 - val_ac
c: 0.7420
Epoch 675/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1554 - val_ac
c: 0.7520
Epoch 676/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0151 - acc: 0.9929 - val_loss: 0.1558 - val_ac
c: 0.7500
Epoch 677/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0156 - acc: 0.9786 - val_loss: 0.1538 - val_ac
c: 0.7560
Epoch 678/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0156 - acc: 0.9714 - val_loss: 0.1510 - val_ac
c: 0.7560
Epoch 679/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0158 - acc: 0.9929 - val_loss: 0.1467 - val_ac
c: 0.7620
Epoch 680/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1415 - val_ac
c: 0.7600
Epoch 681/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0167 - acc: 0.9714 - val_loss: 0.1366 - val_ac
c: 0.7740
Epoch 682/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0158 - acc: 0.9714 - val_loss: 0.1315 - val_ac
c: 0.7740
Epoch 683/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1298 - val_ac
c: 0.7780
Epoch 684/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0167 - acc: 0.9643 - val_loss: 0.1315 - val_ac
c: 0.7680
Epoch 685/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0170 - acc: 0.9643 - val_loss: 0.1349 - val_ac
c: 0.7660
Epoch 686/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0140 - acc: 0.9929 - val_loss: 0.1385 - val_ac
```

```
c: 0.7540
Epoch 687/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7560
Epoch 688/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0151 - acc: 0.9857 - val_loss: 0.1495 - val_ac
c: 0.7500
Epoch 689/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0176 - acc: 0.9571 - val_loss: 0.1536 - val_ac
c: 0.7460
Epoch 690/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0173 - acc: 0.9571 - val_loss: 0.1517 - val_ac
c: 0.7540
Epoch 691/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1483 - val_ac
c: 0.7560
Epoch 692/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0175 - acc: 0.9643 - val_loss: 0.1439 - val_ac
c: 0.7620
Epoch 693/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0179 - acc: 0.9786 - val_loss: 0.1386 - val_ac
c: 0.7640
Epoch 694/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0157 - acc: 1.0000 - val_loss: 0.1367 - val_ac
c: 0.7740
Epoch 695/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1349 - val_ac
c: 0.7760
Epoch 696/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0163 - acc: 0.9929 - val_loss: 0.1337 - val_ac
c: 0.7840
Epoch 697/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1319 - val_ac
c: 0.7820
Epoch 698/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0165 - acc: 0.9714 - val_loss: 0.1327 - val_ac
c: 0.7800
Epoch 699/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1346 - val_ac
c: 0.7800
Epoch 700/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0186 - acc: 0.9643 - val_loss: 0.1384 - val_ac
c: 0.7640
Epoch 701/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0165 - acc: 0.9714 - val_loss: 0.1452 - val_ac
c: 0.7660
Epoch 702/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0156 - acc: 0.9786 - val_loss: 0.1492 - val_ac
c: 0.7580
Epoch 703/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0154 - acc: 0.9929 - val_loss: 0.1493 - val_ac
c: 0.7540
Epoch 704/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0149 - acc: 1.0000 - val_loss: 0.1476 - val_ac
c: 0.7500
Epoch 705/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1470 - val_ac
c: 0.7540
Epoch 706/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1485 - val_ac
c: 0.7460
Epoch 707/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1493 - val_ac
c: 0.7440
Epoch 708/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0172 - acc: 0.9643 - val_loss: 0.1516 - val_ac
c: 0.7420
Epoch 709/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1518 - val_ac
c: 0.7420
Epoch 710/800
```

```
1/1 [==============================] - 0s 166ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1499 - val_ac
c: 0.7460
Epoch 711/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0173 - acc: 0.9714 - val_loss: 0.1463 - val_ac
c: 0.7540
Epoch 712/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0150 - acc: 0.9857 - val_loss: 0.1471 - val_ac
c: 0.7560
Epoch 713/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0164 - acc: 0.9643 - val_loss: 0.1473 - val_ac
c: 0.7500
Epoch 714/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0189 - acc: 0.9643 - val_loss: 0.1486 - val_ac
c: 0.7460
Epoch 715/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0172 - acc: 0.9643 - val_loss: 0.1449 - val_ac
c: 0.7580
Epoch 716/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0168 - acc: 0.9714 - val_loss: 0.1437 - val_ac
c: 0.7480
Epoch 717/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0160 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7660
Epoch 718/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1483 - val_ac
c: 0.7540
Epoch 719/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0185 - acc: 0.9643 - val_loss: 0.1496 - val_ac
c: 0.7600
Epoch 720/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0161 - acc: 0.9857 - val_loss: 0.1515 - val_ac
c: 0.7540
Epoch 721/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0176 - acc: 0.9857 - val_loss: 0.1540 - val_ac
c: 0.7520
Epoch 722/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0184 - acc: 0.9714 - val_loss: 0.1553 - val_ac
c: 0.7560
Epoch 723/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1573 - val_ac
c: 0.7640
Epoch 724/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0182 - acc: 0.9429 - val_loss: 0.1538 - val_ac
c: 0.7680
Epoch 725/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0169 - acc: 0.9571 - val_loss: 0.1483 - val_ac
c: 0.7680
Epoch 726/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0168 - acc: 0.9643 - val_loss: 0.1461 - val_ac
c: 0.7620
Epoch 727/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1435 - val_ac
c: 0.7700
Epoch 728/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0159 - acc: 0.9643 - val_loss: 0.1419 - val_ac
c: 0.7760
Epoch 729/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0163 - acc: 0.9786 - val_loss: 0.1412 - val_ac
c: 0.7640
Epoch 730/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0156 - acc: 0.9929 - val_loss: 0.1417 - val_ac
c: 0.7600
Epoch 731/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0153 - acc: 0.9929 - val_loss: 0.1455 - val_ac
c: 0.7560
Epoch 732/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0148 - acc: 0.9929 - val_loss: 0.1494 - val_ac
c: 0.7520
Epoch 733/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0157 - acc: 0.9857 - val_loss: 0.1548 - val_ac
c: 0.7420
```

```
Epoch 734/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0153 - acc: 0.9857 - val_loss: 0.1600 - val_ac
c: 0.7440
Epoch 735/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0177 - acc: 0.9643 - val_loss: 0.1616 - val_ac
c: 0.7520
Epoch 736/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1581 - val_ac
c: 0.7600
Epoch 737/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0152 - acc: 0.9786 - val_loss: 0.1504 - val_ac
c: 0.7600
Epoch 738/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0160 - acc: 0.9786 - val_loss: 0.1401 - val_ac
c: 0.7800
Epoch 739/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0147 - acc: 1.0000 - val_loss: 0.1346 - val_ac
c: 0.7820
Epoch 740/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1307 - val_ac
c: 0.7840
Epoch 741/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0149 - acc: 0.9857 - val_loss: 0.1293 - val_ac
c: 0.7820
Epoch 742/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0178 - acc: 0.9643 - val_loss: 0.1267 - val_ac
c: 0.7920
Epoch 743/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0142 - acc: 1.0000 - val_loss: 0.1271 - val_ac
c: 0.7860
Epoch 744/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1298 - val_ac
c: 0.7840
Epoch 745/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0140 - acc: 0.9786 - val_loss: 0.1361 - val_ac
c: 0.7720
Epoch 746/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0142 - acc: 0.9857 - val_loss: 0.1425 - val_ac
c: 0.7700
Epoch 747/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0175 - acc: 0.9643 - val_loss: 0.1499 - val_ac
c: 0.7680
Epoch 748/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0153 - acc: 0.9929 - val_loss: 0.1569 - val_ac
c: 0.7580
Epoch 749/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0173 - acc: 0.9571 - val_loss: 0.1534 - val_ac
c: 0.7620
Epoch 750/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0144 - acc: 0.9929 - val_loss: 0.1485 - val_ac
c: 0.7620
Epoch 751/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0156 - acc: 0.9714 - val_loss: 0.1460 - val_ac
c: 0.7680
Epoch 752/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0144 - acc: 1.0000 - val_loss: 0.1434 - val_ac
c: 0.7640
Epoch 753/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0147 - acc: 0.9857 - val_loss: 0.1434 - val_ac
c: 0.7700
Epoch 754/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1418 - val_ac
c: 0.7620
Epoch 755/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1426 - val_ac
c: 0.7620
Epoch 756/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1476 - val_ac
c: 0.7580
Epoch 757/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1500 - val_ac
```

```
c: 0.7620
Epoch 758/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1481 - val_ac
c: 0.7740
Epoch 759/800
1/1 [==============================] - 0s 190ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1436 - val_ac
c: 0.7780
Epoch 760/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1430 - val_ac
c: 0.7880
Epoch 761/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1458 - val_ac
c: 0.7840
Epoch 762/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0151 - acc: 0.9929 - val_loss: 0.1505 - val_ac
c: 0.7820
Epoch 763/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0153 - acc: 0.9857 - val_loss: 0.1533 - val_ac
c: 0.7700
Epoch 764/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0168 - acc: 0.9714 - val_loss: 0.1592 - val_ac
c: 0.7600
Epoch 765/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0168 - acc: 0.9714 - val_loss: 0.1596 - val_ac
c: 0.7660
Epoch 766/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0173 - acc: 0.9571 - val_loss: 0.1607 - val_ac
c: 0.7620
Epoch 767/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1596 - val_ac
c: 0.7580
Epoch 768/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0163 - acc: 0.9643 - val_loss: 0.1530 - val_ac
c: 0.7580
Epoch 769/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0150 - acc: 0.9786 - val_loss: 0.1460 - val_ac
c: 0.7680
Epoch 770/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1374 - val_ac
c: 0.7820
Epoch 771/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0142 - acc: 0.9929 - val_loss: 0.1321 - val_ac
c: 0.7880
Epoch 772/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0163 - acc: 0.9786 - val_loss: 0.1311 - val_ac
c: 0.7880
Epoch 773/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0156 - acc: 0.9929 - val_loss: 0.1325 - val_ac
c: 0.7940
Epoch 774/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0143 - acc: 0.9929 - val_loss: 0.1341 - val_ac
c: 0.7880
Epoch 775/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0194 - acc: 0.9500 - val_loss: 0.1357 - val_ac
c: 0.7860
Epoch 776/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1391 - val_ac
c: 0.7900
Epoch 777/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0163 - acc: 0.9714 - val_loss: 0.1392 - val_ac
c: 0.7880
Epoch 778/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1431 - val_ac
c: 0.7840
Epoch 779/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0155 - acc: 0.9786 - val_loss: 0.1439 - val_ac
c: 0.7760
Epoch 780/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0168 - acc: 0.9786 - val_loss: 0.1404 - val_ac
c: 0.7800
Epoch 781/800
```

```
1/1 [==============================] - 0s 163ms/step - loss: 0.0169 - acc: 0.9714 - val_loss: 0.1358 - val_ac
c: 0.7900
Epoch 782/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0157 - acc: 0.9786 - val_loss: 0.1311 - val_ac
c: 0.7960
Epoch 783/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0157 - acc: 0.9929 - val_loss: 0.1298 - val_ac
c: 0.7960
Epoch 784/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0196 - acc: 0.9429 - val_loss: 0.1335 - val_ac
c: 0.7820
Epoch 785/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1389 - val_ac
c: 0.7720
Epoch 786/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1457 - val_ac
c: 0.7660
Epoch 787/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1502 - val_ac
c: 0.7600
Epoch 788/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0166 - acc: 0.9714 - val_loss: 0.1533 - val_ac
c: 0.7620
Epoch 789/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1541 - val_ac
c: 0.7600
Epoch 790/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1518 - val_ac
c: 0.7640
Epoch 791/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0181 - acc: 0.9643 - val_loss: 0.1440 - val_ac
c: 0.7740
Epoch 792/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0157 - acc: 0.9786 - val_loss: 0.1380 - val_ac
c: 0.7800
Epoch 793/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1362 - val_ac
c: 0.7780
Epoch 794/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0172 - acc: 0.9643 - val_loss: 0.1387 - val_ac
c: 0.7740
Epoch 795/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0166 - acc: 0.9929 - val_loss: 0.1448 - val_ac
c: 0.7760
Epoch 796/800
1/1 [==============================] - 0s 187ms/step - loss: 0.0145 - acc: 0.9857 - val_loss: 0.1510 - val_ac
c: 0.7720
Epoch 797/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1539 - val_ac
c: 0.7700
Epoch 798/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0163 - acc: 0.9786 - val_loss: 0.1551 - val_ac
c: 0.7680
Epoch 799/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1515 - val_ac
c: 0.7720
Epoch 800/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0165 - acc: 0.9714 - val_loss: 0.1462 - val_ac
c: 0.7800
```

Out[ ]: <tensorflow.python.keras.callbacks.History at 0x19f1d9afdc8>

```python
In [ ]:  # Evaluate model
         X_te = X[test_mask]
         A_te = A[test_mask,:][:,test_mask]
         y_te = labels_encoded[test_mask]

         y_pred = model.predict([X_te, A_te], batch_size=N)
         report = classification_report(np.argmax(y_te,axis=1), np.argmax(y_pred,axis=1), target_names=classes)
         print('GCN Classification Report: \n {}'.format(report))
```

```
GCN Classification Report:
                        precision    recall  f1-score   support

         Case_Based         0.66      0.86      0.75       114
   Genetic_Algorithms       0.84      0.88      0.86       156
      Neural_Networks       0.84      0.63      0.72       290
 Probabilistic_Methods      0.80      0.74      0.77       172
Reinforcement_Learning      0.71      0.76      0.74        85
        Rule_Learning       0.62      0.72      0.67        60
              Theory        0.56      0.68      0.62       123

            accuracy                            0.74      1000
           macro avg        0.72      0.75      0.73      1000
        weighted avg        0.75      0.74      0.74      1000
```

Get hidden layer representation for GCN

In [ ]:
```python
layer_outputs = [layer.output for layer in model.layers]
activation_model = Model(inputs=model.input, outputs=layer_outputs)
activations = activation_model.predict([X,A],batch_size=N)

#Get t-SNE Representation
#get the hidden layer representation after the first GCN layer
x_tsne = TSNE(n_components=2).fit_transform(activations[3])
```

In [ ]:
```python
def plot_tSNE(labels_encoded,x_tsne):
    color_map = np.argmax(labels_encoded, axis=1)
    plt.figure(figsize=(10,10))
    for cl in range(num_classes):
        indices = np.where(color_map==cl)
        indices = indices[0]
        plt.scatter(x_tsne[indices,0], x_tsne[indices, 1], label=cl)
    plt.legend()
    plt.show()

plot_tSNE(labels_encoded,x_tsne)
```
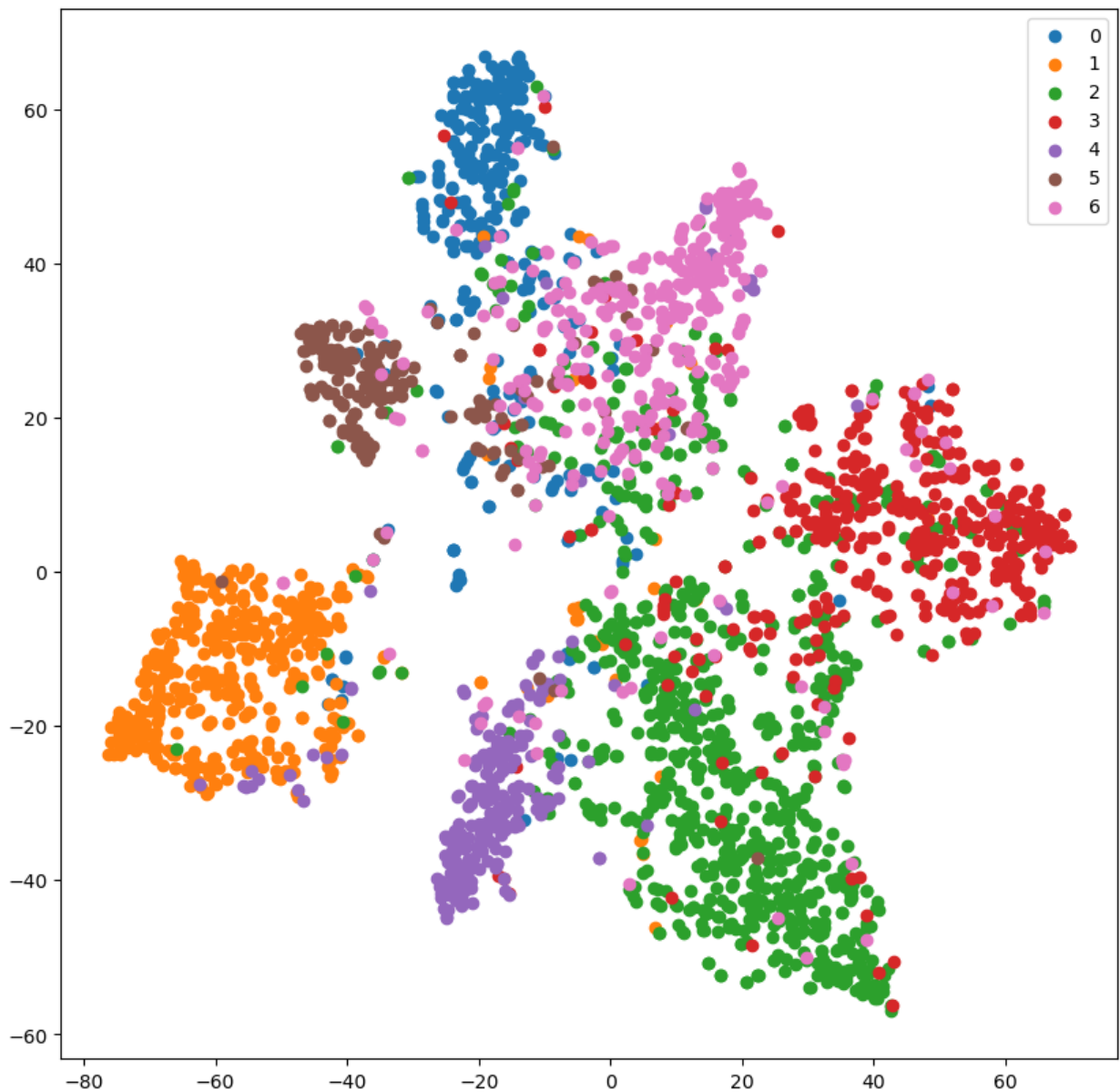
Comparison to Fully-Connected Neural Networks

Building and Training FNN

```
In [ ]:   es_patience = 400
          optimizer = Adam(lr=1e-2)
          l2_reg = 5e-4
          epochs = 800

          #Compare with FNN
          #Construct the model
          model_fnn = Sequential()
          model_fnn.add(Dense(
                          128,
                          input_dim=X.shape[1],
                          activation=tf.nn.relu,
                          kernel_regularizer=tf.keras.regularizers.l2(l2_reg))
                      )
          model_fnn.add(Dropout(0.5))
          model_fnn.add(Dense(256, activation=tf.nn.relu))
          model_fnn.add(Dropout(0.5))
          model_fnn.add(Dense(num_classes, activation=tf.keras.activations.softmax))
```

```python
model_fnn.compile(optimizer=optimizer,
                  loss='categorical_crossentropy',
                  weighted_metrics=['acc'])


#define TensorBoard
tbCallBack_FNN = TensorBoard(
    log_dir='./Tensorboard_FNN_cora',
)

#Train model
validation_data_fnn = (X, labels_encoded, val_mask)
model_fnn.fit(
              X,labels_encoded,
              sample_weight=train_mask,
              epochs=epochs,
              batch_size=N,
              validation_data=validation_data_fnn,
              shuffle=False,
              callbacks=[
                EarlyStopping(patience=es_patience,  restore_best_weights=True),
                tbCallBack_FNN
          ])
```

```
Epoch 1/800
1/1 [==============================] - 0s 242ms/step - loss: 0.2202 - acc: 0.0786 - val_loss: 0.4328 - val_ac
c: 0.3120
Epoch 2/800
1/1 [==============================] - ETA: 0s - loss: 0.1762 - acc: 0.3429WARNING:tensorflow:Method (on_trai
n_batch_end) is slow compared to the batch update (0.143841). Check your callbacks.
1/1 [==============================] - 0s 167ms/step - loss: 0.1762 - acc: 0.3429 - val_loss: 0.3976 - val_ac
c: 0.4500
Epoch 3/800
1/1 [==============================] - 0s 176ms/step - loss: 0.1423 - acc: 0.5571 - val_loss: 0.3695 - val_ac
c: 0.5080
Epoch 4/800
1/1 [==============================] - 0s 171ms/step - loss: 0.1147 - acc: 0.6857 - val_loss: 0.3419 - val_ac
c: 0.5380
Epoch 5/800
1/1 [==============================] - 0s 176ms/step - loss: 0.0905 - acc: 0.7714 - val_loss: 0.3131 - val_ac
c: 0.5660
Epoch 6/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0692 - acc: 0.8714 - val_loss: 0.2848 - val_ac
c: 0.5920
Epoch 7/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0547 - acc: 0.9286 - val_loss: 0.2620 - val_ac
c: 0.5980
Epoch 8/800
1/1 [==============================] - 0s 190ms/step - loss: 0.0468 - acc: 0.9500 - val_loss: 0.2574 - val_ac
c: 0.6000
Epoch 9/800
1/1 [==============================] - 0s 206ms/step - loss: 0.0428 - acc: 0.9714 - val_loss: 0.2619 - val_ac
c: 0.6020
Epoch 10/800
1/1 [==============================] - 0s 249ms/step - loss: 0.0423 - acc: 0.9500 - val_loss: 0.2810 - val_ac
c: 0.5920
Epoch 11/800
1/1 [==============================] - 0s 225ms/step - loss: 0.0413 - acc: 0.9786 - val_loss: 0.3093 - val_ac
c: 0.5800
Epoch 12/800
1/1 [==============================] - 0s 222ms/step - loss: 0.0428 - acc: 0.9786 - val_loss: 0.3312 - val_ac
c: 0.5720
Epoch 13/800
1/1 [==============================] - 0s 273ms/step - loss: 0.0413 - acc: 0.9786 - val_loss: 0.3439 - val_ac
c: 0.5760
Epoch 14/800
1/1 [==============================] - 0s 277ms/step - loss: 0.0381 - acc: 0.9929 - val_loss: 0.3493 - val_ac
c: 0.5840
Epoch 15/800
1/1 [==============================] - 0s 224ms/step - loss: 0.0374 - acc: 0.9786 - val_loss: 0.3551 - val_ac
c: 0.5880
Epoch 16/800
1/1 [==============================] - 0s 224ms/step - loss: 0.0330 - acc: 1.0000 - val_loss: 0.3624 - val_ac
c: 0.5920
Epoch 17/800
1/1 [==============================] - 0s 227ms/step - loss: 0.0311 - acc: 0.9929 - val_loss: 0.3764 - val_ac
c: 0.5860
Epoch 18/800
1/1 [==============================] - 0s 225ms/step - loss: 0.0288 - acc: 0.9857 - val_loss: 0.3984 - val_ac
c: 0.5720
Epoch 19/800
1/1 [==============================] - 0s 216ms/step - loss: 0.0269 - acc: 0.9786 - val_loss: 0.4359 - val_ac
c: 0.5320
Epoch 20/800
1/1 [==============================] - 0s 238ms/step - loss: 0.0293 - acc: 0.9643 - val_loss: 0.4651 - val_ac
c: 0.5060
Epoch 21/800
1/1 [==============================] - 0s 281ms/step - loss: 0.0233 - acc: 0.9929 - val_loss: 0.4827 - val_ac
c: 0.4880
Epoch 22/800
1/1 [==============================] - 0s 220ms/step - loss: 0.0238 - acc: 0.9857 - val_loss: 0.5147 - val_ac
c: 0.4680
Epoch 23/800
1/1 [==============================] - 0s 213ms/step - loss: 0.0224 - acc: 0.9786 - val_loss: 0.5116 - val_ac
c: 0.4700
```

```
Epoch 24/800
1/1 [==============================] - 0s 292ms/step - loss: 0.0231 - acc: 0.9714 - val_loss: 0.4787 - val_ac
c: 0.4680
Epoch 25/800
1/1 [==============================] - 0s 240ms/step - loss: 0.0205 - acc: 0.9786 - val_loss: 0.4467 - val_ac
c: 0.4680
Epoch 26/800
1/1 [==============================] - 0s 213ms/step - loss: 0.0193 - acc: 0.9929 - val_loss: 0.4197 - val_ac
c: 0.4740
Epoch 27/800
1/1 [==============================] - 0s 234ms/step - loss: 0.0183 - acc: 0.9929 - val_loss: 0.4029 - val_ac
c: 0.4600
Epoch 28/800
1/1 [==============================] - 0s 258ms/step - loss: 0.0196 - acc: 0.9786 - val_loss: 0.3881 - val_ac
c: 0.4660
Epoch 29/800
1/1 [==============================] - 0s 242ms/step - loss: 0.0180 - acc: 1.0000 - val_loss: 0.3738 - val_ac
c: 0.4720
Epoch 30/800
1/1 [==============================] - 0s 230ms/step - loss: 0.0210 - acc: 0.9714 - val_loss: 0.3658 - val_ac
c: 0.4820
Epoch 31/800
1/1 [==============================] - 0s 242ms/step - loss: 0.0221 - acc: 0.9786 - val_loss: 0.3475 - val_ac
c: 0.5020
Epoch 32/800
1/1 [==============================] - 0s 214ms/step - loss: 0.0202 - acc: 0.9857 - val_loss: 0.3369 - val_ac
c: 0.5220
Epoch 33/800
1/1 [==============================] - 0s 220ms/step - loss: 0.0193 - acc: 1.0000 - val_loss: 0.3349 - val_ac
c: 0.5340
Epoch 34/800
1/1 [==============================] - 0s 232ms/step - loss: 0.0196 - acc: 0.9929 - val_loss: 0.3396 - val_ac
c: 0.5360
Epoch 35/800
1/1 [==============================] - 0s 265ms/step - loss: 0.0190 - acc: 1.0000 - val_loss: 0.3480 - val_ac
c: 0.5300
Epoch 36/800
1/1 [==============================] - 0s 226ms/step - loss: 0.0202 - acc: 1.0000 - val_loss: 0.3561 - val_ac
c: 0.5160
Epoch 37/800
1/1 [==============================] - 0s 217ms/step - loss: 0.0204 - acc: 0.9929 - val_loss: 0.3602 - val_ac
c: 0.5060
Epoch 38/800
1/1 [==============================] - 0s 211ms/step - loss: 0.0204 - acc: 0.9929 - val_loss: 0.3695 - val_ac
c: 0.5040
Epoch 39/800
1/1 [==============================] - 0s 216ms/step - loss: 0.0207 - acc: 0.9929 - val_loss: 0.3731 - val_ac
c: 0.4980
Epoch 40/800
1/1 [==============================] - 0s 207ms/step - loss: 0.0212 - acc: 0.9857 - val_loss: 0.3773 - val_ac
c: 0.4920
Epoch 41/800
1/1 [==============================] - 0s 201ms/step - loss: 0.0204 - acc: 0.9929 - val_loss: 0.3762 - val_ac
c: 0.4960
Epoch 42/800
1/1 [==============================] - 0s 189ms/step - loss: 0.0206 - acc: 0.9929 - val_loss: 0.3693 - val_ac
c: 0.5000
Epoch 43/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0206 - acc: 0.9929 - val_loss: 0.3644 - val_ac
c: 0.4920
Epoch 44/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0217 - acc: 0.9714 - val_loss: 0.3599 - val_ac
c: 0.5060
Epoch 45/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0214 - acc: 0.9857 - val_loss: 0.3601 - val_ac
c: 0.5040
Epoch 46/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0191 - acc: 0.9929 - val_loss: 0.3534 - val_ac
c: 0.5120
Epoch 47/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0179 - acc: 1.0000 - val_loss: 0.3465 - val_ac
```

```
c: 0.5180
Epoch 48/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0218 - acc: 0.9786 - val_loss: 0.3394 - val_ac
c: 0.5240
Epoch 49/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0183 - acc: 1.0000 - val_loss: 0.3345 - val_ac
c: 0.5320
Epoch 50/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0176 - acc: 1.0000 - val_loss: 0.3354 - val_ac
c: 0.5300
Epoch 51/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0190 - acc: 0.9929 - val_loss: 0.3415 - val_ac
c: 0.5160
Epoch 52/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0176 - acc: 1.0000 - val_loss: 0.3465 - val_ac
c: 0.5180
Epoch 53/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0188 - acc: 0.9929 - val_loss: 0.3483 - val_ac
c: 0.5160
Epoch 54/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0190 - acc: 0.9857 - val_loss: 0.3455 - val_ac
c: 0.5260
Epoch 55/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.3423 - val_ac
c: 0.5340
Epoch 56/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.3384 - val_ac
c: 0.5520
Epoch 57/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0180 - acc: 0.9857 - val_loss: 0.3397 - val_ac
c: 0.5440
Epoch 58/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0178 - acc: 0.9929 - val_loss: 0.3450 - val_ac
c: 0.5380
Epoch 59/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0181 - acc: 0.9929 - val_loss: 0.3561 - val_ac
c: 0.5300
Epoch 60/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0229 - acc: 0.9643 - val_loss: 0.3583 - val_ac
c: 0.5260
Epoch 61/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0215 - acc: 0.9786 - val_loss: 0.3503 - val_ac
c: 0.5320
Epoch 62/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0181 - acc: 0.9929 - val_loss: 0.3507 - val_ac
c: 0.5300
Epoch 63/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.3534 - val_ac
c: 0.5040
Epoch 64/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0181 - acc: 1.0000 - val_loss: 0.3597 - val_ac
c: 0.5000
Epoch 65/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0192 - acc: 0.9857 - val_loss: 0.3671 - val_ac
c: 0.4940
Epoch 66/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0194 - acc: 0.9786 - val_loss: 0.3670 - val_ac
c: 0.4960
Epoch 67/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0202 - acc: 0.9714 - val_loss: 0.3766 - val_ac
c: 0.4800
Epoch 68/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0211 - acc: 0.9857 - val_loss: 0.3930 - val_ac
c: 0.4640
Epoch 69/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0201 - acc: 0.9857 - val_loss: 0.4144 - val_ac
c: 0.4360
Epoch 70/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0209 - acc: 0.9786 - val_loss: 0.4098 - val_ac
c: 0.4580
Epoch 71/800
```

```
1/1 [==============================] - 0s 165ms/step - loss: 0.0216 - acc: 0.9857 - val_loss: 0.3810 - val_ac
c: 0.4800
Epoch 72/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0215 - acc: 0.9857 - val_loss: 0.3609 - val_ac
c: 0.5020
Epoch 73/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0213 - acc: 1.0000 - val_loss: 0.3500 - val_ac
c: 0.5100
Epoch 74/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0233 - acc: 0.9786 - val_loss: 0.3480 - val_ac
c: 0.5300
Epoch 75/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0248 - acc: 0.9643 - val_loss: 0.3547 - val_ac
c: 0.5140
Epoch 76/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0242 - acc: 0.9857 - val_loss: 0.3649 - val_ac
c: 0.5060
Epoch 77/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0225 - acc: 1.0000 - val_loss: 0.3806 - val_ac
c: 0.5020
Epoch 78/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0250 - acc: 0.9714 - val_loss: 0.3934 - val_ac
c: 0.4940
Epoch 79/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0232 - acc: 0.9929 - val_loss: 0.4048 - val_ac
c: 0.4840
Epoch 80/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0249 - acc: 0.9786 - val_loss: 0.4080 - val_ac
c: 0.4900
Epoch 81/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0244 - acc: 0.9786 - val_loss: 0.4146 - val_ac
c: 0.4920
Epoch 82/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0240 - acc: 0.9857 - val_loss: 0.4259 - val_ac
c: 0.4800
Epoch 83/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0284 - acc: 0.9857 - val_loss: 0.4226 - val_ac
c: 0.4740
Epoch 84/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0246 - acc: 0.9857 - val_loss: 0.4170 - val_ac
c: 0.4840
Epoch 85/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0240 - acc: 1.0000 - val_loss: 0.4134 - val_ac
c: 0.4880
Epoch 86/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0282 - acc: 0.9714 - val_loss: 0.4055 - val_ac
c: 0.4760
Epoch 87/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0294 - acc: 0.9714 - val_loss: 0.4031 - val_ac
c: 0.4780
Epoch 88/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0261 - acc: 0.9857 - val_loss: 0.3998 - val_ac
c: 0.4860
Epoch 89/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0265 - acc: 0.9857 - val_loss: 0.3963 - val_ac
c: 0.5040
Epoch 90/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0273 - acc: 0.9857 - val_loss: 0.3835 - val_ac
c: 0.5180
Epoch 91/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0281 - acc: 0.9857 - val_loss: 0.3761 - val_ac
c: 0.5220
Epoch 92/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0273 - acc: 0.9929 - val_loss: 0.3780 - val_ac
c: 0.5240
Epoch 93/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0303 - acc: 0.9643 - val_loss: 0.3824 - val_ac
c: 0.5140
Epoch 94/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0332 - acc: 0.9571 - val_loss: 0.3825 - val_ac
c: 0.5200
```

```
Epoch 95/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0279 - acc: 0.9929 - val_loss: 0.3863 - val_ac
c: 0.5320
Epoch 96/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0302 - acc: 0.9714 - val_loss: 0.3945 - val_ac
c: 0.5220
Epoch 97/800
1/1 [==============================] - 0s 179ms/step - loss: 0.0320 - acc: 0.9786 - val_loss: 0.4016 - val_ac
c: 0.5220
Epoch 98/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0298 - acc: 0.9857 - val_loss: 0.4032 - val_ac
c: 0.5160
Epoch 99/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0294 - acc: 0.9857 - val_loss: 0.4074 - val_ac
c: 0.5140
Epoch 100/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0307 - acc: 0.9857 - val_loss: 0.4140 - val_ac
c: 0.5120
Epoch 101/800
1/1 [==============================] - 0s 178ms/step - loss: 0.0299 - acc: 0.9929 - val_loss: 0.4134 - val_ac
c: 0.5040
Epoch 102/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0338 - acc: 0.9714 - val_loss: 0.4153 - val_ac
c: 0.5020
Epoch 103/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0319 - acc: 0.9714 - val_loss: 0.4088 - val_ac
c: 0.4980
Epoch 104/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0297 - acc: 0.9857 - val_loss: 0.4157 - val_ac
c: 0.4940
Epoch 105/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0291 - acc: 0.9929 - val_loss: 0.4300 - val_ac
c: 0.4940
Epoch 106/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0303 - acc: 0.9857 - val_loss: 0.4338 - val_ac
c: 0.4820
Epoch 107/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0338 - acc: 0.9571 - val_loss: 0.4363 - val_ac
c: 0.4740
Epoch 108/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0319 - acc: 0.9786 - val_loss: 0.4293 - val_ac
c: 0.4720
Epoch 109/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0300 - acc: 0.9857 - val_loss: 0.4252 - val_ac
c: 0.4680
Epoch 110/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0344 - acc: 0.9643 - val_loss: 0.4036 - val_ac
c: 0.4900
Epoch 111/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0292 - acc: 1.0000 - val_loss: 0.3854 - val_ac
c: 0.5080
Epoch 112/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0318 - acc: 0.9714 - val_loss: 0.3896 - val_ac
c: 0.5160
Epoch 113/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0328 - acc: 0.9714 - val_loss: 0.3925 - val_ac
c: 0.5240
Epoch 114/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0352 - acc: 0.9643 - val_loss: 0.3924 - val_ac
c: 0.5140
Epoch 115/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0306 - acc: 0.9929 - val_loss: 0.3915 - val_ac
c: 0.5060
Epoch 116/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0312 - acc: 0.9929 - val_loss: 0.3886 - val_ac
c: 0.5020
Epoch 117/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0309 - acc: 0.9929 - val_loss: 0.3954 - val_ac
c: 0.4960
Epoch 118/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0323 - acc: 0.9857 - val_loss: 0.3985 - val_ac
```

```
c: 0.4920
Epoch 119/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0401 - acc: 0.9643 - val_loss: 0.4018 - val_ac
c: 0.4840
Epoch 120/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0316 - acc: 0.9857 - val_loss: 0.4066 - val_ac
c: 0.4740
Epoch 121/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0325 - acc: 0.9643 - val_loss: 0.4043 - val_ac
c: 0.4900
Epoch 122/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0338 - acc: 0.9714 - val_loss: 0.4076 - val_ac
c: 0.5020
Epoch 123/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0298 - acc: 1.0000 - val_loss: 0.4114 - val_ac
c: 0.4960
Epoch 124/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0309 - acc: 0.9857 - val_loss: 0.4035 - val_ac
c: 0.5000
Epoch 125/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0334 - acc: 0.9786 - val_loss: 0.4050 - val_ac
c: 0.4900
Epoch 126/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0306 - acc: 0.9857 - val_loss: 0.4093 - val_ac
c: 0.4780
Epoch 127/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0351 - acc: 0.9643 - val_loss: 0.4157 - val_ac
c: 0.4700
Epoch 128/800
1/1 [==============================] - 0s 208ms/step - loss: 0.0292 - acc: 0.9857 - val_loss: 0.4247 - val_ac
c: 0.4560
Epoch 129/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0316 - acc: 0.9643 - val_loss: 0.4246 - val_ac
c: 0.4600
Epoch 130/800
1/1 [==============================] - 0s 175ms/step - loss: 0.0310 - acc: 0.9714 - val_loss: 0.4306 - val_ac
c: 0.4620
Epoch 131/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0289 - acc: 0.9857 - val_loss: 0.4390 - val_ac
c: 0.4680
Epoch 132/800
1/1 [==============================] - 0s 215ms/step - loss: 0.0299 - acc: 0.9929 - val_loss: 0.4385 - val_ac
c: 0.4680
Epoch 133/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0294 - acc: 0.9929 - val_loss: 0.4283 - val_ac
c: 0.4740
Epoch 134/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0282 - acc: 1.0000 - val_loss: 0.4216 - val_ac
c: 0.4820
Epoch 135/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0294 - acc: 0.9857 - val_loss: 0.4174 - val_ac
c: 0.4840
Epoch 136/800
1/1 [==============================] - 0s 248ms/step - loss: 0.0291 - acc: 0.9929 - val_loss: 0.4072 - val_ac
c: 0.4760
Epoch 137/800
1/1 [==============================] - 0s 204ms/step - loss: 0.0305 - acc: 0.9643 - val_loss: 0.3917 - val_ac
c: 0.4800
Epoch 138/800
1/1 [==============================] - 0s 188ms/step - loss: 0.0299 - acc: 0.9786 - val_loss: 0.3829 - val_ac
c: 0.4960
Epoch 139/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0283 - acc: 0.9857 - val_loss: 0.3796 - val_ac
c: 0.4980
Epoch 140/800
1/1 [==============================] - 0s 200ms/step - loss: 0.0277 - acc: 0.9929 - val_loss: 0.3764 - val_ac
c: 0.5100
Epoch 141/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0297 - acc: 0.9714 - val_loss: 0.3768 - val_ac
c: 0.5240
Epoch 142/800
```

```
1/1 [==============================] - 0s 167ms/step - loss: 0.0278 - acc: 0.9786 - val_loss: 0.3837 - val_ac
c: 0.5100
Epoch 143/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0283 - acc: 0.9857 - val_loss: 0.3926 - val_ac
c: 0.5120
Epoch 144/800
1/1 [==============================] - 0s 203ms/step - loss: 0.0305 - acc: 0.9786 - val_loss: 0.4070 - val_ac
c: 0.5100
Epoch 145/800
1/1 [==============================] - 0s 180ms/step - loss: 0.0322 - acc: 0.9643 - val_loss: 0.4048 - val_ac
c: 0.5060
Epoch 146/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0292 - acc: 0.9786 - val_loss: 0.3978 - val_ac
c: 0.4980
Epoch 147/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0319 - acc: 0.9571 - val_loss: 0.3841 - val_ac
c: 0.5160
Epoch 148/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0321 - acc: 0.9786 - val_loss: 0.3760 - val_ac
c: 0.5200
Epoch 149/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0300 - acc: 0.9714 - val_loss: 0.3668 - val_ac
c: 0.5480
Epoch 150/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0293 - acc: 0.9857 - val_loss: 0.3665 - val_ac
c: 0.5560
Epoch 151/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0371 - acc: 0.9714 - val_loss: 0.3733 - val_ac
c: 0.5600
Epoch 152/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0320 - acc: 0.9786 - val_loss: 0.3811 - val_ac
c: 0.5420
Epoch 153/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0303 - acc: 0.9786 - val_loss: 0.3876 - val_ac
c: 0.5420
Epoch 154/800
1/1 [==============================] - 0s 185ms/step - loss: 0.0310 - acc: 0.9786 - val_loss: 0.3949 - val_ac
c: 0.5360
Epoch 155/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0310 - acc: 0.9857 - val_loss: 0.4024 - val_ac
c: 0.5240
Epoch 156/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0347 - acc: 0.9571 - val_loss: 0.4103 - val_ac
c: 0.5140
Epoch 157/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0315 - acc: 0.9786 - val_loss: 0.4296 - val_ac
c: 0.5000
Epoch 158/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0326 - acc: 0.9643 - val_loss: 0.4572 - val_ac
c: 0.4940
Epoch 159/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0359 - acc: 0.9500 - val_loss: 0.4787 - val_ac
c: 0.4840
Epoch 160/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0368 - acc: 0.9571 - val_loss: 0.4856 - val_ac
c: 0.4780
Epoch 161/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0330 - acc: 0.9786 - val_loss: 0.4816 - val_ac
c: 0.4820
Epoch 162/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0325 - acc: 0.9929 - val_loss: 0.4741 - val_ac
c: 0.4880
Epoch 163/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0340 - acc: 0.9643 - val_loss: 0.4551 - val_ac
c: 0.4960
Epoch 164/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0351 - acc: 0.9643 - val_loss: 0.4363 - val_ac
c: 0.4980
Epoch 165/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0350 - acc: 0.9857 - val_loss: 0.4305 - val_ac
c: 0.5080
```

```
Epoch 166/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0389 - acc: 0.9643 - val_loss: 0.4336 - val_ac
c: 0.5100
Epoch 167/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0374 - acc: 0.9714 - val_loss: 0.4430 - val_ac
c: 0.5080
Epoch 168/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0358 - acc: 0.9786 - val_loss: 0.4578 - val_ac
c: 0.4980
Epoch 169/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0412 - acc: 0.9571 - val_loss: 0.4671 - val_ac
c: 0.4960
Epoch 170/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0391 - acc: 0.9714 - val_loss: 0.4799 - val_ac
c: 0.4880
Epoch 171/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0438 - acc: 0.9500 - val_loss: 0.4822 - val_ac
c: 0.4960
Epoch 172/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0347 - acc: 1.0000 - val_loss: 0.4859 - val_ac
c: 0.4880
Epoch 173/800
1/1 [==============================] - 0s 186ms/step - loss: 0.0443 - acc: 0.9643 - val_loss: 0.4785 - val_ac
c: 0.4980
Epoch 174/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0362 - acc: 0.9857 - val_loss: 0.4720 - val_ac
c: 0.4960
Epoch 175/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0427 - acc: 0.9714 - val_loss: 0.4648 - val_ac
c: 0.4960
Epoch 176/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0412 - acc: 0.9571 - val_loss: 0.4534 - val_ac
c: 0.4960
Epoch 177/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0392 - acc: 0.9786 - val_loss: 0.4493 - val_ac
c: 0.4920
Epoch 178/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0380 - acc: 0.9786 - val_loss: 0.4504 - val_ac
c: 0.4980
Epoch 179/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0414 - acc: 0.9571 - val_loss: 0.4412 - val_ac
c: 0.5100
Epoch 180/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0413 - acc: 0.9571 - val_loss: 0.4378 - val_ac
c: 0.5200
Epoch 181/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0457 - acc: 0.9571 - val_loss: 0.4541 - val_ac
c: 0.5100
Epoch 182/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0400 - acc: 0.9786 - val_loss: 0.4761 - val_ac
c: 0.4780
Epoch 183/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0462 - acc: 0.9571 - val_loss: 0.4800 - val_ac
c: 0.4680
Epoch 184/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0403 - acc: 0.9929 - val_loss: 0.4775 - val_ac
c: 0.4580
Epoch 185/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0426 - acc: 0.9571 - val_loss: 0.4811 - val_ac
c: 0.4700
Epoch 186/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0384 - acc: 0.9857 - val_loss: 0.4900 - val_ac
c: 0.4740
Epoch 187/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0417 - acc: 0.9786 - val_loss: 0.4984 - val_ac
c: 0.4760
Epoch 188/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0410 - acc: 0.9643 - val_loss: 0.5042 - val_ac
c: 0.4720
Epoch 189/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0425 - acc: 0.9714 - val_loss: 0.4886 - val_ac
```

```
c: 0.4880
Epoch 190/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0420 - acc: 0.9643 - val_loss: 0.4724 - val_ac
c: 0.4960
Epoch 191/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0433 - acc: 0.9786 - val_loss: 0.4593 - val_ac
c: 0.4940
Epoch 192/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0441 - acc: 0.9571 - val_loss: 0.4540 - val_ac
c: 0.4860
Epoch 193/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0400 - acc: 0.9786 - val_loss: 0.4478 - val_ac
c: 0.4840
Epoch 194/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0396 - acc: 0.9929 - val_loss: 0.4498 - val_ac
c: 0.4840
Epoch 195/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0407 - acc: 0.9786 - val_loss: 0.4579 - val_ac
c: 0.4900
Epoch 196/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0427 - acc: 0.9786 - val_loss: 0.4566 - val_ac
c: 0.4920
Epoch 197/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0440 - acc: 0.9714 - val_loss: 0.4585 - val_ac
c: 0.4920
Epoch 198/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0414 - acc: 0.9857 - val_loss: 0.4652 - val_ac
c: 0.4920
Epoch 199/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0432 - acc: 0.9786 - val_loss: 0.4633 - val_ac
c: 0.4920
Epoch 200/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0451 - acc: 0.9643 - val_loss: 0.4510 - val_ac
c: 0.4840
Epoch 201/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0387 - acc: 0.9857 - val_loss: 0.4412 - val_ac
c: 0.4840
Epoch 202/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0420 - acc: 0.9857 - val_loss: 0.4300 - val_ac
c: 0.4880
Epoch 203/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0394 - acc: 0.9857 - val_loss: 0.4191 - val_ac
c: 0.4940
Epoch 204/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0425 - acc: 0.9786 - val_loss: 0.4095 - val_ac
c: 0.4940
Epoch 205/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0390 - acc: 0.9857 - val_loss: 0.4057 - val_ac
c: 0.4880
Epoch 206/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0418 - acc: 0.9643 - val_loss: 0.4059 - val_ac
c: 0.4980
Epoch 207/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0416 - acc: 0.9714 - val_loss: 0.4110 - val_ac
c: 0.4920
Epoch 208/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0365 - acc: 0.9929 - val_loss: 0.4153 - val_ac
c: 0.4900
Epoch 209/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0383 - acc: 0.9643 - val_loss: 0.4202 - val_ac
c: 0.4920
Epoch 210/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0375 - acc: 0.9786 - val_loss: 0.4299 - val_ac
c: 0.4880
Epoch 211/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0437 - acc: 0.9571 - val_loss: 0.4290 - val_ac
c: 0.4840
Epoch 212/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0381 - acc: 0.9714 - val_loss: 0.4205 - val_ac
c: 0.4920
Epoch 213/800
```

```
1/1 [==============================] - 0s 163ms/step - loss: 0.0396 - acc: 0.9571 - val_loss: 0.4105 - val_ac
c: 0.4940
Epoch 214/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0356 - acc: 0.9929 - val_loss: 0.4024 - val_ac
c: 0.5040
Epoch 215/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0401 - acc: 0.9643 - val_loss: 0.3967 - val_ac
c: 0.5120
Epoch 216/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0364 - acc: 0.9786 - val_loss: 0.3931 - val_ac
c: 0.5240
Epoch 217/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0366 - acc: 0.9857 - val_loss: 0.3864 - val_ac
c: 0.5340
Epoch 218/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0378 - acc: 0.9786 - val_loss: 0.3769 - val_ac
c: 0.5440
Epoch 219/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0359 - acc: 0.9857 - val_loss: 0.3727 - val_ac
c: 0.5520
Epoch 220/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0370 - acc: 0.9786 - val_loss: 0.3753 - val_ac
c: 0.5400
Epoch 221/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0378 - acc: 0.9714 - val_loss: 0.3802 - val_ac
c: 0.5280
Epoch 222/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0384 - acc: 0.9714 - val_loss: 0.3834 - val_ac
c: 0.5220
Epoch 223/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0414 - acc: 0.9571 - val_loss: 0.3898 - val_ac
c: 0.5100
Epoch 224/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0366 - acc: 0.9857 - val_loss: 0.4001 - val_ac
c: 0.5140
Epoch 225/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0405 - acc: 0.9643 - val_loss: 0.4054 - val_ac
c: 0.5080
Epoch 226/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0400 - acc: 0.9643 - val_loss: 0.4107 - val_ac
c: 0.5080
Epoch 227/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0446 - acc: 0.9571 - val_loss: 0.4100 - val_ac
c: 0.5000
Epoch 228/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0400 - acc: 0.9643 - val_loss: 0.4060 - val_ac
c: 0.4940
Epoch 229/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0352 - acc: 0.9857 - val_loss: 0.4016 - val_ac
c: 0.5040
Epoch 230/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0356 - acc: 0.9929 - val_loss: 0.3988 - val_ac
c: 0.5060
Epoch 231/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0377 - acc: 0.9714 - val_loss: 0.3950 - val_ac
c: 0.5220
Epoch 232/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0364 - acc: 0.9857 - val_loss: 0.3873 - val_ac
c: 0.5200
Epoch 233/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0410 - acc: 0.9571 - val_loss: 0.3838 - val_ac
c: 0.5300
Epoch 234/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0368 - acc: 0.9714 - val_loss: 0.3861 - val_ac
c: 0.5140
Epoch 235/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0370 - acc: 0.9786 - val_loss: 0.4013 - val_ac
c: 0.4820
Epoch 236/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0371 - acc: 0.9786 - val_loss: 0.4236 - val_ac
c: 0.4660
```

```
Epoch 237/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0360 - acc: 0.9786 - val_loss: 0.4395 - val_ac
c: 0.4620
Epoch 238/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0339 - acc: 0.9929 - val_loss: 0.4525 - val_ac
c: 0.4560
Epoch 239/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0393 - acc: 0.9429 - val_loss: 0.4448 - val_ac
c: 0.4560
Epoch 240/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0431 - acc: 0.9571 - val_loss: 0.4272 - val_ac
c: 0.4640
Epoch 241/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0401 - acc: 0.9643 - val_loss: 0.4177 - val_ac
c: 0.4780
Epoch 242/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0361 - acc: 0.9786 - val_loss: 0.4248 - val_ac
c: 0.4820
Epoch 243/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0373 - acc: 0.9571 - val_loss: 0.4441 - val_ac
c: 0.4740
Epoch 244/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0373 - acc: 0.9786 - val_loss: 0.4560 - val_ac
c: 0.4700
Epoch 245/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0358 - acc: 0.9786 - val_loss: 0.4484 - val_ac
c: 0.4800
Epoch 246/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0389 - acc: 0.9571 - val_loss: 0.4391 - val_ac
c: 0.5020
Epoch 247/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0391 - acc: 0.9500 - val_loss: 0.4407 - val_ac
c: 0.4980
Epoch 248/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0373 - acc: 0.9714 - val_loss: 0.4435 - val_ac
c: 0.4920
Epoch 249/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0392 - acc: 0.9571 - val_loss: 0.4322 - val_ac
c: 0.5120
Epoch 250/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0372 - acc: 0.9786 - val_loss: 0.4242 - val_ac
c: 0.5180
Epoch 251/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0396 - acc: 0.9857 - val_loss: 0.4241 - val_ac
c: 0.5180
Epoch 252/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0429 - acc: 0.9714 - val_loss: 0.4225 - val_ac
c: 0.5060
Epoch 253/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0395 - acc: 0.9643 - val_loss: 0.4230 - val_ac
c: 0.5020
Epoch 254/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0459 - acc: 0.9571 - val_loss: 0.4192 - val_ac
c: 0.4980
Epoch 255/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0386 - acc: 0.9857 - val_loss: 0.4194 - val_ac
c: 0.5080
Epoch 256/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0477 - acc: 0.9714 - val_loss: 0.4147 - val_ac
c: 0.5200
Epoch 257/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0395 - acc: 0.9857 - val_loss: 0.4095 - val_ac
c: 0.5180
Epoch 258/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0431 - acc: 0.9786 - val_loss: 0.4011 - val_ac
c: 0.5220
Epoch 259/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0409 - acc: 0.9786 - val_loss: 0.3886 - val_ac
c: 0.5300
Epoch 260/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0382 - acc: 0.9857 - val_loss: 0.3779 - val_ac
```

```
c: 0.5440
Epoch 261/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0431 - acc: 0.9714 - val_loss: 0.3741 - val_ac
c: 0.5580
Epoch 262/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0394 - acc: 0.9786 - val_loss: 0.3737 - val_ac
c: 0.5640
Epoch 263/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0464 - acc: 0.9429 - val_loss: 0.3689 - val_ac
c: 0.5640
Epoch 264/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0409 - acc: 0.9929 - val_loss: 0.3667 - val_ac
c: 0.5540
Epoch 265/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0414 - acc: 0.9786 - val_loss: 0.3650 - val_ac
c: 0.5500
Epoch 266/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0436 - acc: 0.9714 - val_loss: 0.3605 - val_ac
c: 0.5540
Epoch 267/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0426 - acc: 0.9929 - val_loss: 0.3630 - val_ac
c: 0.5440
Epoch 268/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0434 - acc: 0.9643 - val_loss: 0.3649 - val_ac
c: 0.5520
Epoch 269/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0387 - acc: 0.9857 - val_loss: 0.3709 - val_ac
c: 0.5500
Epoch 270/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0380 - acc: 0.9929 - val_loss: 0.3772 - val_ac
c: 0.5440
Epoch 271/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0439 - acc: 0.9571 - val_loss: 0.3737 - val_ac
c: 0.5380
Epoch 272/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0394 - acc: 0.9857 - val_loss: 0.3768 - val_ac
c: 0.5360
Epoch 273/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0395 - acc: 0.9714 - val_loss: 0.3882 - val_ac
c: 0.5280
Epoch 274/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0412 - acc: 0.9714 - val_loss: 0.4049 - val_ac
c: 0.5100
Epoch 275/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0397 - acc: 0.9786 - val_loss: 0.4243 - val_ac
c: 0.5020
Epoch 276/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0356 - acc: 1.0000 - val_loss: 0.4446 - val_ac
c: 0.4900
Epoch 277/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0404 - acc: 0.9571 - val_loss: 0.4513 - val_ac
c: 0.4800
Epoch 278/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0369 - acc: 0.9857 - val_loss: 0.4429 - val_ac
c: 0.4840
Epoch 279/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0441 - acc: 0.9429 - val_loss: 0.4254 - val_ac
c: 0.5100
Epoch 280/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0379 - acc: 0.9714 - val_loss: 0.4148 - val_ac
c: 0.5200
Epoch 281/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0352 - acc: 0.9929 - val_loss: 0.4088 - val_ac
c: 0.5160
Epoch 282/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0383 - acc: 0.9857 - val_loss: 0.4050 - val_ac
c: 0.5300
Epoch 283/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0364 - acc: 0.9786 - val_loss: 0.4036 - val_ac
c: 0.5440
Epoch 284/800
```

```
1/1 [==============================] - 0s 166ms/step - loss: 0.0353 - acc: 0.9929 - val_loss: 0.4035 - val_ac
c: 0.5320
Epoch 285/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0400 - acc: 0.9714 - val_loss: 0.4044 - val_ac
c: 0.5240
Epoch 286/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0372 - acc: 0.9643 - val_loss: 0.4063 - val_ac
c: 0.5300
Epoch 287/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0404 - acc: 0.9500 - val_loss: 0.4011 - val_ac
c: 0.5300
Epoch 288/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0339 - acc: 1.0000 - val_loss: 0.4001 - val_ac
c: 0.5340
Epoch 289/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0385 - acc: 0.9714 - val_loss: 0.4060 - val_ac
c: 0.5180
Epoch 290/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0346 - acc: 0.9929 - val_loss: 0.4149 - val_ac
c: 0.5140
Epoch 291/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0377 - acc: 0.9786 - val_loss: 0.4221 - val_ac
c: 0.4960
Epoch 292/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0392 - acc: 0.9571 - val_loss: 0.4273 - val_ac
c: 0.4940
Epoch 293/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0356 - acc: 0.9857 - val_loss: 0.4349 - val_ac
c: 0.4980
Epoch 294/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0438 - acc: 0.9571 - val_loss: 0.4420 - val_ac
c: 0.5000
Epoch 295/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0454 - acc: 0.9500 - val_loss: 0.4434 - val_ac
c: 0.4980
Epoch 296/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0433 - acc: 0.9571 - val_loss: 0.4464 - val_ac
c: 0.4920
Epoch 297/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0381 - acc: 0.9857 - val_loss: 0.4509 - val_ac
c: 0.4960
Epoch 298/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0387 - acc: 0.9857 - val_loss: 0.4526 - val_ac
c: 0.4860
Epoch 299/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0371 - acc: 0.9571 - val_loss: 0.4431 - val_ac
c: 0.4840
Epoch 300/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0389 - acc: 0.9643 - val_loss: 0.4379 - val_ac
c: 0.4720
Epoch 301/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0389 - acc: 0.9643 - val_loss: 0.4302 - val_ac
c: 0.4900
Epoch 302/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0419 - acc: 0.9714 - val_loss: 0.4250 - val_ac
c: 0.5000
Epoch 303/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0402 - acc: 0.9571 - val_loss: 0.4289 - val_ac
c: 0.5020
Epoch 304/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0433 - acc: 0.9786 - val_loss: 0.4403 - val_ac
c: 0.4940
Epoch 305/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0449 - acc: 0.9643 - val_loss: 0.4430 - val_ac
c: 0.4840
Epoch 306/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0388 - acc: 0.9714 - val_loss: 0.4526 - val_ac
c: 0.4860
Epoch 307/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0420 - acc: 0.9714 - val_loss: 0.4623 - val_ac
c: 0.4860
```

```
Epoch 308/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0551 - acc: 0.9500 - val_loss: 0.4624 - val_ac
c: 0.4740
Epoch 309/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0430 - acc: 0.9786 - val_loss: 0.4632 - val_ac
c: 0.4820
Epoch 310/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0456 - acc: 0.9714 - val_loss: 0.4563 - val_ac
c: 0.4900
Epoch 311/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0425 - acc: 0.9929 - val_loss: 0.4540 - val_ac
c: 0.4960
Epoch 312/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0437 - acc: 0.9857 - val_loss: 0.4578 - val_ac
c: 0.4840
Epoch 313/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0498 - acc: 0.9643 - val_loss: 0.4673 - val_ac
c: 0.4780
Epoch 314/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0458 - acc: 0.9857 - val_loss: 0.4818 - val_ac
c: 0.4720
Epoch 315/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0571 - acc: 0.9429 - val_loss: 0.4773 - val_ac
c: 0.4840
Epoch 316/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0448 - acc: 0.9786 - val_loss: 0.4691 - val_ac
c: 0.4900
Epoch 317/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0445 - acc: 0.9857 - val_loss: 0.4588 - val_ac
c: 0.5020
Epoch 318/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0442 - acc: 0.9786 - val_loss: 0.4455 - val_ac
c: 0.5300
Epoch 319/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0457 - acc: 0.9714 - val_loss: 0.4378 - val_ac
c: 0.5420
Epoch 320/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0445 - acc: 0.9714 - val_loss: 0.4374 - val_ac
c: 0.5480
Epoch 321/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0479 - acc: 0.9786 - val_loss: 0.4416 - val_ac
c: 0.5440
Epoch 322/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0476 - acc: 0.9357 - val_loss: 0.4432 - val_ac
c: 0.5520
Epoch 323/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0463 - acc: 0.9786 - val_loss: 0.4415 - val_ac
c: 0.5500
Epoch 324/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0455 - acc: 0.9786 - val_loss: 0.4391 - val_ac
c: 0.5580
Epoch 325/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0449 - acc: 0.9500 - val_loss: 0.4378 - val_ac
c: 0.5560
Epoch 326/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0427 - acc: 0.9929 - val_loss: 0.4414 - val_ac
c: 0.5500
Epoch 327/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0456 - acc: 0.9786 - val_loss: 0.4470 - val_ac
c: 0.5500
Epoch 328/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0468 - acc: 0.9500 - val_loss: 0.4573 - val_ac
c: 0.5320
Epoch 329/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0587 - acc: 0.9357 - val_loss: 0.4631 - val_ac
c: 0.5140
Epoch 330/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0433 - acc: 0.9857 - val_loss: 0.4716 - val_ac
c: 0.5000
Epoch 331/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0437 - acc: 0.9714 - val_loss: 0.4755 - val_ac
```

```
c: 0.5020
Epoch 332/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0480 - acc: 0.9571 - val_loss: 0.4675 - val_ac
c: 0.4960
Epoch 333/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0423 - acc: 0.9929 - val_loss: 0.4613 - val_ac
c: 0.4920
Epoch 334/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0446 - acc: 0.9786 - val_loss: 0.4552 - val_ac
c: 0.4960
Epoch 335/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0451 - acc: 0.9643 - val_loss: 0.4397 - val_ac
c: 0.5160
Epoch 336/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0450 - acc: 0.9714 - val_loss: 0.4302 - val_ac
c: 0.5260
Epoch 337/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0445 - acc: 0.9643 - val_loss: 0.4279 - val_ac
c: 0.5300
Epoch 338/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0490 - acc: 0.9714 - val_loss: 0.4275 - val_ac
c: 0.5240
Epoch 339/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0454 - acc: 0.9857 - val_loss: 0.4355 - val_ac
c: 0.5100
Epoch 340/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0569 - acc: 0.9429 - val_loss: 0.4289 - val_ac
c: 0.5000
Epoch 341/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0463 - acc: 0.9643 - val_loss: 0.4246 - val_ac
c: 0.4940
Epoch 342/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0458 - acc: 0.9786 - val_loss: 0.4233 - val_ac
c: 0.4900
Epoch 343/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0444 - acc: 0.9786 - val_loss: 0.4215 - val_ac
c: 0.4920
Epoch 344/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0445 - acc: 0.9643 - val_loss: 0.4207 - val_ac
c: 0.5080
Epoch 345/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0434 - acc: 0.9929 - val_loss: 0.4212 - val_ac
c: 0.5080
Epoch 346/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0419 - acc: 0.9929 - val_loss: 0.4234 - val_ac
c: 0.5020
Epoch 347/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0476 - acc: 0.9714 - val_loss: 0.4212 - val_ac
c: 0.5080
Epoch 348/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0495 - acc: 0.9857 - val_loss: 0.4142 - val_ac
c: 0.5020
Epoch 349/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0453 - acc: 0.9714 - val_loss: 0.4103 - val_ac
c: 0.5000
Epoch 350/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0458 - acc: 0.9714 - val_loss: 0.4068 - val_ac
c: 0.4960
Epoch 351/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0409 - acc: 0.9857 - val_loss: 0.3998 - val_ac
c: 0.5040
Epoch 352/800
1/1 [==============================] - 0s 172ms/step - loss: 0.0431 - acc: 0.9714 - val_loss: 0.3925 - val_ac
c: 0.5180
Epoch 353/800
1/1 [==============================] - 0s 173ms/step - loss: 0.0419 - acc: 0.9786 - val_loss: 0.3883 - val_ac
c: 0.5160
Epoch 354/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0408 - acc: 0.9786 - val_loss: 0.3898 - val_ac
c: 0.5120
Epoch 355/800
```

```
1/1 [==============================] - 0s 162ms/step - loss: 0.0410 - acc: 0.9714 - val_loss: 0.3941 - val_ac
c: 0.4940
Epoch 356/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0421 - acc: 0.9714 - val_loss: 0.3977 - val_ac
c: 0.5060
Epoch 357/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0393 - acc: 0.9786 - val_loss: 0.3973 - val_ac
c: 0.5000
Epoch 358/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0403 - acc: 0.9929 - val_loss: 0.4042 - val_ac
c: 0.4880
Epoch 359/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0388 - acc: 0.9571 - val_loss: 0.4109 - val_ac
c: 0.4820
Epoch 360/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0381 - acc: 0.9786 - val_loss: 0.4182 - val_ac
c: 0.4680
Epoch 361/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0406 - acc: 0.9714 - val_loss: 0.4152 - val_ac
c: 0.4620
Epoch 362/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0399 - acc: 0.9643 - val_loss: 0.4060 - val_ac
c: 0.4760
Epoch 363/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0371 - acc: 0.9786 - val_loss: 0.3985 - val_ac
c: 0.4720
Epoch 364/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0339 - acc: 1.0000 - val_loss: 0.3944 - val_ac
c: 0.4960
Epoch 365/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0360 - acc: 0.9714 - val_loss: 0.3893 - val_ac
c: 0.4980
Epoch 366/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0356 - acc: 0.9786 - val_loss: 0.3897 - val_ac
c: 0.4980
Epoch 367/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0329 - acc: 1.0000 - val_loss: 0.3925 - val_ac
c: 0.4860
Epoch 368/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0359 - acc: 0.9786 - val_loss: 0.3958 - val_ac
c: 0.4800
Epoch 369/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0373 - acc: 0.9786 - val_loss: 0.4011 - val_ac
c: 0.4680
Epoch 370/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0321 - acc: 0.9929 - val_loss: 0.4056 - val_ac
c: 0.4640
Epoch 371/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0324 - acc: 0.9857 - val_loss: 0.4100 - val_ac
c: 0.4600
Epoch 372/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0329 - acc: 0.9857 - val_loss: 0.4214 - val_ac
c: 0.4560
Epoch 373/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0320 - acc: 0.9929 - val_loss: 0.4302 - val_ac
c: 0.4560
Epoch 374/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0312 - acc: 0.9929 - val_loss: 0.4322 - val_ac
c: 0.4560
Epoch 375/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0314 - acc: 0.9857 - val_loss: 0.4332 - val_ac
c: 0.4580
Epoch 376/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0324 - acc: 0.9643 - val_loss: 0.4301 - val_ac
c: 0.4660
Epoch 377/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0315 - acc: 0.9643 - val_loss: 0.4285 - val_ac
c: 0.4680
Epoch 378/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0321 - acc: 0.9571 - val_loss: 0.4243 - val_ac
c: 0.4600
```

```
Epoch 379/800
1/1 [==============================] - 0s 170ms/step - loss: 0.0294 - acc: 0.9786 - val_loss: 0.4234 - val_ac
c: 0.4540
Epoch 380/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0317 - acc: 0.9714 - val_loss: 0.4316 - val_ac
c: 0.4440
Epoch 381/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0307 - acc: 0.9857 - val_loss: 0.4394 - val_ac
c: 0.4380
Epoch 382/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0326 - acc: 0.9643 - val_loss: 0.4406 - val_ac
c: 0.4320
Epoch 383/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0280 - acc: 0.9929 - val_loss: 0.4411 - val_ac
c: 0.4340
Epoch 384/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0295 - acc: 0.9786 - val_loss: 0.4342 - val_ac
c: 0.4340
Epoch 385/800
1/1 [==============================] - 0s 168ms/step - loss: 0.0342 - acc: 0.9571 - val_loss: 0.4225 - val_ac
c: 0.4480
Epoch 386/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0283 - acc: 0.9786 - val_loss: 0.4129 - val_ac
c: 0.4580
Epoch 387/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0323 - acc: 0.9714 - val_loss: 0.4084 - val_ac
c: 0.4660
Epoch 388/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0280 - acc: 0.9857 - val_loss: 0.4097 - val_ac
c: 0.4880
Epoch 389/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0302 - acc: 0.9786 - val_loss: 0.4155 - val_ac
c: 0.5020
Epoch 390/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0300 - acc: 0.9786 - val_loss: 0.4194 - val_ac
c: 0.5080
Epoch 391/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0297 - acc: 0.9786 - val_loss: 0.4231 - val_ac
c: 0.5080
Epoch 392/800
1/1 [==============================] - 0s 157ms/step - loss: 0.0308 - acc: 0.9714 - val_loss: 0.4277 - val_ac
c: 0.5140
Epoch 393/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0293 - acc: 0.9857 - val_loss: 0.4265 - val_ac
c: 0.5020
Epoch 394/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0298 - acc: 0.9929 - val_loss: 0.4256 - val_ac
c: 0.5100
Epoch 395/800
1/1 [==============================] - 0s 174ms/step - loss: 0.0289 - acc: 0.9929 - val_loss: 0.4243 - val_ac
c: 0.5060
Epoch 396/800
1/1 [==============================] - 0s 169ms/step - loss: 0.0320 - acc: 0.9643 - val_loss: 0.4232 - val_ac
c: 0.5080
Epoch 397/800
1/1 [==============================] - 0s 158ms/step - loss: 0.0322 - acc: 0.9786 - val_loss: 0.4208 - val_ac
c: 0.5100
Epoch 398/800
1/1 [==============================] - 0s 162ms/step - loss: 0.0323 - acc: 0.9643 - val_loss: 0.4106 - val_ac
c: 0.5080
Epoch 399/800
1/1 [==============================] - 0s 171ms/step - loss: 0.0286 - acc: 0.9929 - val_loss: 0.4061 - val_ac
c: 0.5240
Epoch 400/800
1/1 [==============================] - 0s 161ms/step - loss: 0.0286 - acc: 0.9929 - val_loss: 0.4041 - val_ac
c: 0.5180
Epoch 401/800
1/1 [==============================] - 0s 167ms/step - loss: 0.0301 - acc: 0.9857 - val_loss: 0.4038 - val_ac
c: 0.5140
Epoch 402/800
1/1 [==============================] - 0s 163ms/step - loss: 0.0320 - acc: 0.9643 - val_loss: 0.4049 - val_ac
```

```
                                                             c: 0.5180
Epoch 403/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0317 - acc: 0.9714 - val_loss: 0.4107 - val_ac
c: 0.5180
Epoch 404/800
1/1 [==============================] - 0s 165ms/step - loss: 0.0324 - acc: 0.9857 - val_loss: 0.4237 - val_ac
c: 0.4940
Epoch 405/800
1/1 [==============================] - 0s 160ms/step - loss: 0.0359 - acc: 0.9357 - val_loss: 0.4300 - val_ac
c: 0.4920
Epoch 406/800
1/1 [==============================] - 0s 164ms/step - loss: 0.0324 - acc: 0.9786 - val_loss: 0.4365 - val_ac
c: 0.5040
Epoch 407/800
1/1 [==============================] - 0s 159ms/step - loss: 0.0291 - acc: 0.9929 - val_loss: 0.4437 - val_ac
c: 0.4940
Epoch 408/800
1/1 [==============================] - 0s 166ms/step - loss: 0.0335 - acc: 0.9571 - val_loss: 0.4315 - val_ac
c: 0.5160
```

Out[ ]: `<tensorflow.python.keras.callbacks.History at 0x19f545be608>`

In [ ]:
```python
# Evaluate model
y_pred = model_fnn.predict(X_te)
report = classification_report(np.argmax(y_te,axis=1), np.argmax(y_pred,axis=1), target_names=classes)
print('FCNN Classification Report: \n {}'.format(report))
```

```
FCNN Classification Report:
                        precision    recall  f1-score   support

           Case_Based       0.57      0.54      0.56       114
   Genetic_Algorithms       0.68      0.82      0.75       156
      Neural_Networks       0.67      0.56      0.61       290
 Probabilistic_Methods      0.69      0.50      0.58       172
Reinforcement_Learning      0.45      0.53      0.49        85
        Rule_Learning       0.52      0.53      0.53        60
               Theory       0.40      0.58      0.47       123

             accuracy                           0.59      1000
            macro avg       0.57      0.58      0.57      1000
         weighted avg       0.60      0.59      0.59      1000
```
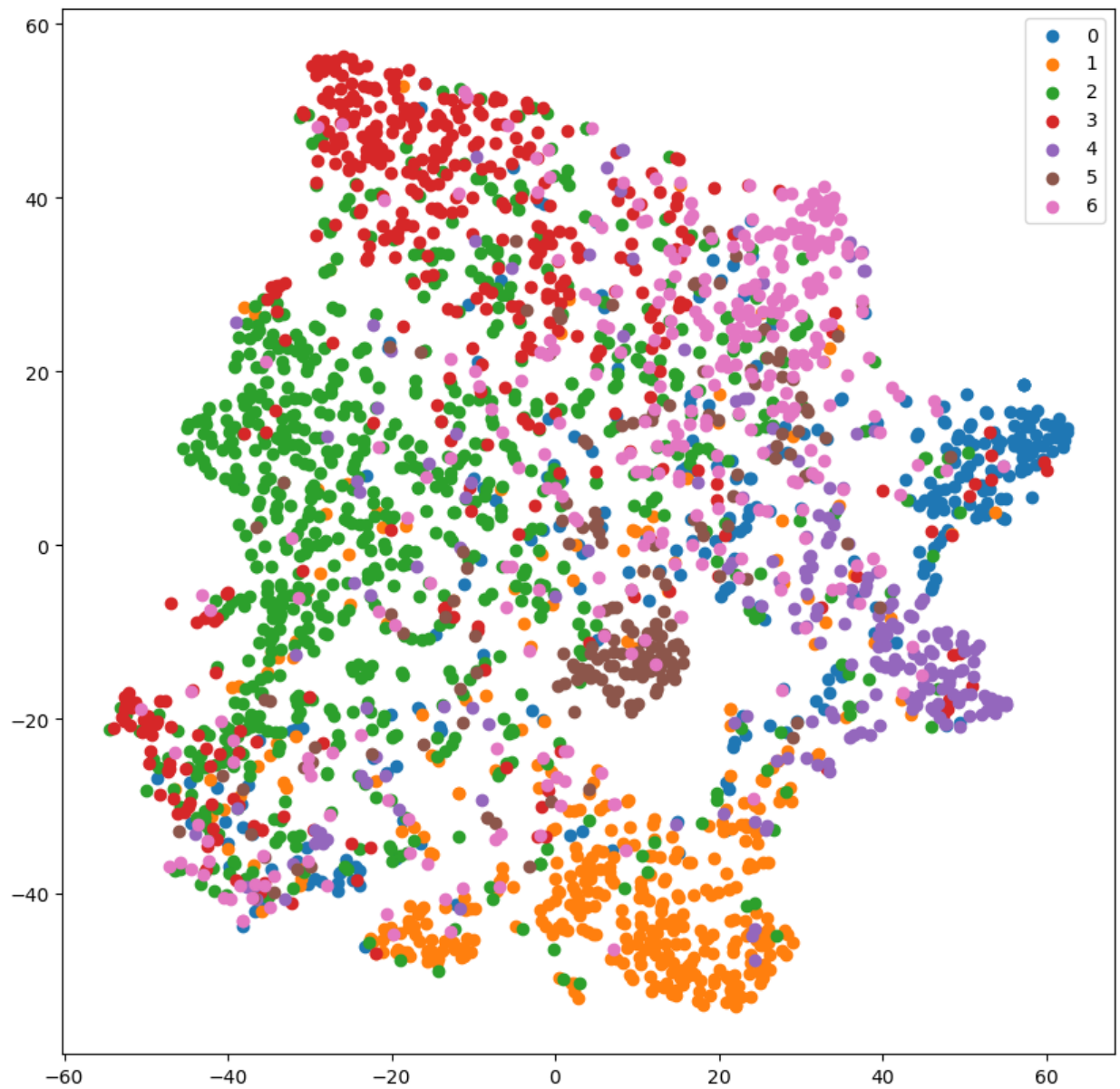
Get hidden layer representation for FNN

In [ ]:
```python
layer_outputs = [layer.output for layer in model_fnn.layers]
activation_model = Model(inputs=model_fnn.input, outputs=layer_outputs)
activations = activation_model.predict([X])
```

In [ ]:
```python
x_tsne = TSNE(n_components=2).fit_transform(activations[3])
plot_tSNE(labels_encoded,x_tsne)
```

```
In [ ]: ### END OF NOTEBOOK ###
```