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

In [ ]:
```
#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**.

In [ ]:
```
#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:  {'Case_Based', 'Theory', 'Probabilistic_Methods', 'Rule_Learning', 'Neural_Networks', 'Reinforce
ment_Learning', 'Genetic_Algorithms'}

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

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 = 900            # Number of training epochs
es_patience = 450        # 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
__________________________________________________________________________________________________
```

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 1/900
1/1 [==============================] - 0s 365ms/step - loss: 0.1172 - acc: 0.1429 - val_loss: 0.3657 - val_ac
c: 0.2960
Epoch 2/900
1/1 [==============================] - ETA: 0s - loss: 0.1094 - acc: 0.3429WARNING:tensorflow:Method (on_trai
n_batch_end) is slow compared to the batch update (0.180944). Check your callbacks.
1/1 [==============================] - 0s 180ms/step - loss: 0.1094 - acc: 0.3429 - val_loss: 0.3567 - val_ac
c: 0.4160
Epoch 3/900
1/1 [==============================] - 0s 179ms/step - loss: 0.1041 - acc: 0.5143 - val_loss: 0.3457 - val_ac
c: 0.5440
Epoch 4/900
1/1 [==============================] - 0s 181ms/step - loss: 0.0975 - acc: 0.6000 - val_loss: 0.3324 - val_ac
c: 0.6620
Epoch 5/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0923 - acc: 0.7143 - val_loss: 0.3194 - val_ac
c: 0.6920
Epoch 6/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0877 - acc: 0.6786 - val_loss: 0.3080 - val_ac
c: 0.7100
Epoch 7/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0814 - acc: 0.8286 - val_loss: 0.2977 - val_ac
c: 0.7240
Epoch 8/900
1/1 [==============================] - 0s 219ms/step - loss: 0.0805 - acc: 0.7786 - val_loss: 0.2887 - val_ac
c: 0.7300
Epoch 9/900
1/1 [==============================] - 0s 236ms/step - loss: 0.0779 - acc: 0.8071 - val_loss: 0.2807 - val_ac
c: 0.7340
Epoch 10/900
1/1 [==============================] - 0s 236ms/step - loss: 0.0752 - acc: 0.8286 - val_loss: 0.2730 - val_ac
c: 0.7500
Epoch 11/900
1/1 [==============================] - 0s 235ms/step - loss: 0.0727 - acc: 0.8429 - val_loss: 0.2659 - val_ac
c: 0.7540
Epoch 12/900
1/1 [==============================] - 0s 234ms/step - loss: 0.0691 - acc: 0.8857 - val_loss: 0.2590 - val_ac
c: 0.7620
Epoch 13/900
1/1 [==============================] - 0s 233ms/step - loss: 0.0697 - acc: 0.8286 - val_loss: 0.2521 - val_ac
c: 0.7740
Epoch 14/900
1/1 [==============================] - 0s 226ms/step - loss: 0.0675 - acc: 0.8786 - val_loss: 0.2452 - val_ac
c: 0.7800
Epoch 15/900
1/1 [==============================] - 0s 226ms/step - loss: 0.0642 - acc: 0.8929 - val_loss: 0.2387 - val_ac
c: 0.7800
Epoch 16/900
1/1 [==============================] - 0s 258ms/step - loss: 0.0634 - acc: 0.8857 - val_loss: 0.2327 - val_ac
c: 0.7820
Epoch 17/900
1/1 [==============================] - 0s 264ms/step - loss: 0.0627 - acc: 0.9000 - val_loss: 0.2275 - val_ac
c: 0.7740
Epoch 18/900
1/1 [==============================] - 0s 215ms/step - loss: 0.0611 - acc: 0.9143 - val_loss: 0.2229 - val_ac
c: 0.7760
Epoch 19/900
1/1 [==============================] - 0s 231ms/step - loss: 0.0544 - acc: 0.9500 - val_loss: 0.2194 - val_ac
c: 0.7720
Epoch 20/900
1/1 [==============================] - 0s 227ms/step - loss: 0.0566 - acc: 0.9071 - val_loss: 0.2164 - val_ac
c: 0.7720
Epoch 21/900
1/1 [==============================] - 0s 212ms/step - loss: 0.0571 - acc: 0.9214 - val_loss: 0.2136 - val_ac
c: 0.7680
Epoch 22/900
1/1 [==============================] - 0s 227ms/step - loss: 0.0554 - acc: 0.9286 - val_loss: 0.2110 - val_ac
c: 0.7640
Epoch 23/900
1/1 [==============================] - 0s 270ms/step - loss: 0.0546 - acc: 0.9143 - val_loss: 0.2087 - val_ac
c: 0.7600
```

```
Epoch 24/900
1/1 [==============================] - 0s 286ms/step - loss: 0.0539 - acc: 0.9143 - val_loss: 0.2060 - val_ac
c: 0.7620
Epoch 25/900
1/1 [==============================] - 0s 233ms/step - loss: 0.0532 - acc: 0.9286 - val_loss: 0.2041 - val_ac
c: 0.7600
Epoch 26/900
1/1 [==============================] - 0s 218ms/step - loss: 0.0510 - acc: 0.9214 - val_loss: 0.2018 - val_ac
c: 0.7600
Epoch 27/900
1/1 [==============================] - 0s 216ms/step - loss: 0.0559 - acc: 0.8929 - val_loss: 0.1994 - val_ac
c: 0.7660
Epoch 28/900
1/1 [==============================] - 0s 205ms/step - loss: 0.0497 - acc: 0.9357 - val_loss: 0.1969 - val_ac
c: 0.7740
Epoch 29/900
1/1 [==============================] - 0s 206ms/step - loss: 0.0484 - acc: 0.9643 - val_loss: 0.1954 - val_ac
c: 0.7680
Epoch 30/900
1/1 [==============================] - 0s 217ms/step - loss: 0.0478 - acc: 0.9429 - val_loss: 0.1941 - val_ac
c: 0.7680
Epoch 31/900
1/1 [==============================] - 0s 218ms/step - loss: 0.0477 - acc: 0.9429 - val_loss: 0.1932 - val_ac
c: 0.7620
Epoch 32/900
1/1 [==============================] - 0s 230ms/step - loss: 0.0456 - acc: 0.9357 - val_loss: 0.1919 - val_ac
c: 0.7640
Epoch 33/900
1/1 [==============================] - 0s 200ms/step - loss: 0.0472 - acc: 0.9286 - val_loss: 0.1900 - val_ac
c: 0.7700
Epoch 34/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0455 - acc: 0.9643 - val_loss: 0.1883 - val_ac
c: 0.7700
Epoch 35/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0474 - acc: 0.9071 - val_loss: 0.1869 - val_ac
c: 0.7680
Epoch 36/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0447 - acc: 0.9357 - val_loss: 0.1856 - val_ac
c: 0.7740
Epoch 37/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0425 - acc: 0.9714 - val_loss: 0.1846 - val_ac
c: 0.7680
Epoch 38/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0433 - acc: 0.9643 - val_loss: 0.1834 - val_ac
c: 0.7660
Epoch 39/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0456 - acc: 0.9214 - val_loss: 0.1817 - val_ac
c: 0.7720
Epoch 40/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0441 - acc: 0.9143 - val_loss: 0.1790 - val_ac
c: 0.7760
Epoch 41/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0409 - acc: 0.9429 - val_loss: 0.1762 - val_ac
c: 0.7840
Epoch 42/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0431 - acc: 0.9286 - val_loss: 0.1738 - val_ac
c: 0.7840
Epoch 43/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0424 - acc: 0.9571 - val_loss: 0.1721 - val_ac
c: 0.7860
Epoch 44/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0395 - acc: 0.9786 - val_loss: 0.1714 - val_ac
c: 0.7860
Epoch 45/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0414 - acc: 0.9500 - val_loss: 0.1709 - val_ac
c: 0.7860
Epoch 46/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0412 - acc: 0.9357 - val_loss: 0.1708 - val_ac
c: 0.7860
Epoch 47/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0395 - acc: 0.9357 - val_loss: 0.1711 - val_ac
```

```
c: 0.7860
Epoch 48/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0437 - acc: 0.9286 - val_loss: 0.1722 - val_ac
c: 0.7740
Epoch 49/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0376 - acc: 0.9714 - val_loss: 0.1732 - val_ac
c: 0.7740
Epoch 50/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0392 - acc: 0.9357 - val_loss: 0.1728 - val_ac
c: 0.7700
Epoch 51/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0393 - acc: 0.9500 - val_loss: 0.1725 - val_ac
c: 0.7700
Epoch 52/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0371 - acc: 0.9571 - val_loss: 0.1718 - val_ac
c: 0.7700
Epoch 53/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0360 - acc: 0.9571 - val_loss: 0.1697 - val_ac
c: 0.7680
Epoch 54/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0383 - acc: 0.9143 - val_loss: 0.1673 - val_ac
c: 0.7720
Epoch 55/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0342 - acc: 0.9714 - val_loss: 0.1658 - val_ac
c: 0.7720
Epoch 56/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0374 - acc: 0.9643 - val_loss: 0.1647 - val_ac
c: 0.7640
Epoch 57/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0367 - acc: 0.9571 - val_loss: 0.1639 - val_ac
c: 0.7660
Epoch 58/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0365 - acc: 0.9500 - val_loss: 0.1639 - val_ac
c: 0.7680
Epoch 59/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0373 - acc: 0.9500 - val_loss: 0.1646 - val_ac
c: 0.7680
Epoch 60/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0372 - acc: 0.9500 - val_loss: 0.1657 - val_ac
c: 0.7680
Epoch 61/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0347 - acc: 0.9643 - val_loss: 0.1665 - val_ac
c: 0.7620
Epoch 62/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0341 - acc: 0.9714 - val_loss: 0.1659 - val_ac
c: 0.7620
Epoch 63/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0362 - acc: 0.9571 - val_loss: 0.1663 - val_ac
c: 0.7640
Epoch 64/900
1/1 [==============================] - 0s 184ms/step - loss: 0.0364 - acc: 0.9357 - val_loss: 0.1659 - val_ac
c: 0.7700
Epoch 65/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0365 - acc: 0.9429 - val_loss: 0.1640 - val_ac
c: 0.7680
Epoch 66/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0364 - acc: 0.9286 - val_loss: 0.1623 - val_ac
c: 0.7680
Epoch 67/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0347 - acc: 0.9357 - val_loss: 0.1605 - val_ac
c: 0.7740
Epoch 68/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0344 - acc: 1.0000 - val_loss: 0.1585 - val_ac
c: 0.7800
Epoch 69/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0373 - acc: 0.9357 - val_loss: 0.1579 - val_ac
c: 0.7780
Epoch 70/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0348 - acc: 0.9643 - val_loss: 0.1573 - val_ac
c: 0.7760
Epoch 71/900
```

```
1/1 [==============================] - 0s 181ms/step - loss: 0.0344 - acc: 0.9714 - val_loss: 0.1580 - val_ac
c: 0.7720
Epoch 72/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0347 - acc: 0.9571 - val_loss: 0.1592 - val_ac
c: 0.7720
Epoch 73/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0358 - acc: 0.9714 - val_loss: 0.1615 - val_ac
c: 0.7760
Epoch 74/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0342 - acc: 0.9786 - val_loss: 0.1629 - val_ac
c: 0.7760
Epoch 75/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0320 - acc: 0.9643 - val_loss: 0.1623 - val_ac
c: 0.7780
Epoch 76/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0347 - acc: 0.9429 - val_loss: 0.1615 - val_ac
c: 0.7740
Epoch 77/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0322 - acc: 0.9714 - val_loss: 0.1605 - val_ac
c: 0.7740
Epoch 78/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0315 - acc: 0.9429 - val_loss: 0.1584 - val_ac
c: 0.7800
Epoch 79/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0324 - acc: 0.9643 - val_loss: 0.1567 - val_ac
c: 0.7820
Epoch 80/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0313 - acc: 0.9714 - val_loss: 0.1556 - val_ac
c: 0.7800
Epoch 81/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0310 - acc: 0.9714 - val_loss: 0.1551 - val_ac
c: 0.7820
Epoch 82/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0317 - acc: 0.9714 - val_loss: 0.1564 - val_ac
c: 0.7760
Epoch 83/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0328 - acc: 0.9500 - val_loss: 0.1585 - val_ac
c: 0.7660
Epoch 84/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0322 - acc: 0.9429 - val_loss: 0.1625 - val_ac
c: 0.7620
Epoch 85/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0311 - acc: 0.9786 - val_loss: 0.1666 - val_ac
c: 0.7520
Epoch 86/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0316 - acc: 0.9786 - val_loss: 0.1677 - val_ac
c: 0.7500
Epoch 87/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0327 - acc: 0.9643 - val_loss: 0.1665 - val_ac
c: 0.7560
Epoch 88/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0314 - acc: 0.9571 - val_loss: 0.1629 - val_ac
c: 0.7700
Epoch 89/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0313 - acc: 0.9929 - val_loss: 0.1594 - val_ac
c: 0.7740
Epoch 90/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0289 - acc: 0.9786 - val_loss: 0.1562 - val_ac
c: 0.7780
Epoch 91/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0298 - acc: 0.9857 - val_loss: 0.1543 - val_ac
c: 0.7820
Epoch 92/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0305 - acc: 0.9500 - val_loss: 0.1535 - val_ac
c: 0.7760
Epoch 93/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0288 - acc: 0.9857 - val_loss: 0.1535 - val_ac
c: 0.7720
Epoch 94/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0301 - acc: 0.9429 - val_loss: 0.1531 - val_ac
c: 0.7740
```

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Epoch 95/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0332 - acc: 0.9500 - val_loss: 0.1525 - val_ac
c: 0.7820
Epoch 96/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0309 - acc: 0.9786 - val_loss: 0.1527 - val_ac
c: 0.7900
Epoch 97/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0295 - acc: 0.9786 - val_loss: 0.1541 - val_ac
c: 0.7840
Epoch 98/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0260 - acc: 0.9786 - val_loss: 0.1552 - val_ac
c: 0.7800
Epoch 99/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0293 - acc: 0.9571 - val_loss: 0.1549 - val_ac
c: 0.7820
Epoch 100/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0303 - acc: 0.9429 - val_loss: 0.1533 - val_ac
c: 0.7860
Epoch 101/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0298 - acc: 0.9643 - val_loss: 0.1518 - val_ac
c: 0.7880
Epoch 102/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0314 - acc: 0.9643 - val_loss: 0.1503 - val_ac
c: 0.7840
Epoch 103/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0294 - acc: 0.9571 - val_loss: 0.1501 - val_ac
c: 0.7800
Epoch 104/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0286 - acc: 0.9643 - val_loss: 0.1504 - val_ac
c: 0.7760
Epoch 105/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0288 - acc: 0.9429 - val_loss: 0.1519 - val_ac
c: 0.7720
Epoch 106/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0286 - acc: 0.9786 - val_loss: 0.1527 - val_ac
c: 0.7720
Epoch 107/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0302 - acc: 0.9429 - val_loss: 0.1533 - val_ac
c: 0.7820
Epoch 108/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0311 - acc: 0.9571 - val_loss: 0.1536 - val_ac
c: 0.7820
Epoch 109/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0275 - acc: 0.9857 - val_loss: 0.1544 - val_ac
c: 0.7740
Epoch 110/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0291 - acc: 0.9571 - val_loss: 0.1559 - val_ac
c: 0.7760
Epoch 111/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0278 - acc: 0.9786 - val_loss: 0.1558 - val_ac
c: 0.7720
Epoch 112/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0287 - acc: 0.9786 - val_loss: 0.1531 - val_ac
c: 0.7740
Epoch 113/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0284 - acc: 0.9857 - val_loss: 0.1498 - val_ac
c: 0.7780
Epoch 114/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0287 - acc: 0.9500 - val_loss: 0.1472 - val_ac
c: 0.7760
Epoch 115/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0259 - acc: 0.9857 - val_loss: 0.1450 - val_ac
c: 0.7800
Epoch 116/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0274 - acc: 0.9643 - val_loss: 0.1455 - val_ac
c: 0.7760
Epoch 117/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0274 - acc: 0.9643 - val_loss: 0.1457 - val_ac
c: 0.7760
Epoch 118/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0296 - acc: 0.9643 - val_loss: 0.1479 - val_ac
```

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c: 0.7740
Epoch 119/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0265 - acc: 0.9714 - val_loss: 0.1510 - val_ac
c: 0.7780
Epoch 120/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0290 - acc: 0.9429 - val_loss: 0.1541 - val_ac
c: 0.7740
Epoch 121/900
1/1 [==============================] - 0s 231ms/step - loss: 0.0275 - acc: 0.9643 - val_loss: 0.1579 - val_ac
c: 0.7660
Epoch 122/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0282 - acc: 0.9786 - val_loss: 0.1599 - val_ac
c: 0.7620
Epoch 123/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0270 - acc: 0.9857 - val_loss: 0.1597 - val_ac
c: 0.7600
Epoch 124/900
1/1 [==============================] - 0s 214ms/step - loss: 0.0292 - acc: 0.9429 - val_loss: 0.1562 - val_ac
c: 0.7640
Epoch 125/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0292 - acc: 0.9571 - val_loss: 0.1509 - val_ac
c: 0.7760
Epoch 126/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0274 - acc: 0.9786 - val_loss: 0.1476 - val_ac
c: 0.7780
Epoch 127/900
1/1 [==============================] - 0s 191ms/step - loss: 0.0287 - acc: 0.9500 - val_loss: 0.1466 - val_ac
c: 0.7820
Epoch 128/900
1/1 [==============================] - 0s 186ms/step - loss: 0.0293 - acc: 0.9500 - val_loss: 0.1474 - val_ac
c: 0.7720
Epoch 129/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0276 - acc: 0.9571 - val_loss: 0.1496 - val_ac
c: 0.7660
Epoch 130/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0259 - acc: 0.9786 - val_loss: 0.1522 - val_ac
c: 0.7600
Epoch 131/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0304 - acc: 0.9643 - val_loss: 0.1536 - val_ac
c: 0.7620
Epoch 132/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0253 - acc: 0.9857 - val_loss: 0.1550 - val_ac
c: 0.7580
Epoch 133/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0268 - acc: 0.9786 - val_loss: 0.1550 - val_ac
c: 0.7460
Epoch 134/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0236 - acc: 1.0000 - val_loss: 0.1553 - val_ac
c: 0.7420
Epoch 135/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0250 - acc: 0.9857 - val_loss: 0.1537 - val_ac
c: 0.7480
Epoch 136/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0249 - acc: 0.9929 - val_loss: 0.1521 - val_ac
c: 0.7640
Epoch 137/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0299 - acc: 0.9643 - val_loss: 0.1485 - val_ac
c: 0.7700
Epoch 138/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0243 - acc: 0.9643 - val_loss: 0.1461 - val_ac
c: 0.7800
Epoch 139/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0260 - acc: 0.9786 - val_loss: 0.1450 - val_ac
c: 0.7800
Epoch 140/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0262 - acc: 0.9857 - val_loss: 0.1459 - val_ac
c: 0.7780
Epoch 141/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0260 - acc: 0.9643 - val_loss: 0.1481 - val_ac
c: 0.7720
Epoch 142/900
```

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1/1 [==============================] - 0s 164ms/step - loss: 0.0237 - acc: 0.9857 - val_loss: 0.1498 - val_ac
c: 0.7640
Epoch 143/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0278 - acc: 0.9500 - val_loss: 0.1493 - val_ac
c: 0.7700
Epoch 144/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0265 - acc: 0.9786 - val_loss: 0.1476 - val_ac
c: 0.7660
Epoch 145/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0269 - acc: 0.9571 - val_loss: 0.1463 - val_ac
c: 0.7680
Epoch 146/900
1/1 [==============================] - 0s 191ms/step - loss: 0.0261 - acc: 0.9857 - val_loss: 0.1459 - val_ac
c: 0.7620
Epoch 147/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0278 - acc: 0.9571 - val_loss: 0.1441 - val_ac
c: 0.7720
Epoch 148/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0262 - acc: 0.9500 - val_loss: 0.1429 - val_ac
c: 0.7740
Epoch 149/900
1/1 [==============================] - 0s 199ms/step - loss: 0.0257 - acc: 0.9714 - val_loss: 0.1417 - val_ac
c: 0.7740
Epoch 150/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0233 - acc: 0.9857 - val_loss: 0.1415 - val_ac
c: 0.7780
Epoch 151/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0249 - acc: 0.9786 - val_loss: 0.1438 - val_ac
c: 0.7780
Epoch 152/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0244 - acc: 1.0000 - val_loss: 0.1479 - val_ac
c: 0.7680
Epoch 153/900
1/1 [==============================] - 0s 207ms/step - loss: 0.0252 - acc: 0.9643 - val_loss: 0.1515 - val_ac
c: 0.7680
Epoch 154/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0271 - acc: 0.9786 - val_loss: 0.1532 - val_ac
c: 0.7680
Epoch 155/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0242 - acc: 0.9786 - val_loss: 0.1541 - val_ac
c: 0.7560
Epoch 156/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0256 - acc: 0.9643 - val_loss: 0.1531 - val_ac
c: 0.7700
Epoch 157/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0295 - acc: 0.9500 - val_loss: 0.1535 - val_ac
c: 0.7660
Epoch 158/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0252 - acc: 0.9714 - val_loss: 0.1514 - val_ac
c: 0.7720
Epoch 159/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0251 - acc: 0.9857 - val_loss: 0.1485 - val_ac
c: 0.7700
Epoch 160/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0255 - acc: 0.9643 - val_loss: 0.1454 - val_ac
c: 0.7740
Epoch 161/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0229 - acc: 0.9857 - val_loss: 0.1430 - val_ac
c: 0.7740
Epoch 162/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0271 - acc: 0.9571 - val_loss: 0.1419 - val_ac
c: 0.7720
Epoch 163/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0229 - acc: 0.9929 - val_loss: 0.1420 - val_ac
c: 0.7700
Epoch 164/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0246 - acc: 0.9929 - val_loss: 0.1436 - val_ac
c: 0.7660
Epoch 165/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0235 - acc: 0.9786 - val_loss: 0.1453 - val_ac
c: 0.7600
```

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Epoch 166/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0257 - acc: 0.9714 - val_loss: 0.1468 - val_ac
c: 0.7700
Epoch 167/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0230 - acc: 0.9857 - val_loss: 0.1484 - val_ac
c: 0.7700
Epoch 168/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0245 - acc: 0.9500 - val_loss: 0.1484 - val_ac
c: 0.7700
Epoch 169/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0271 - acc: 0.9357 - val_loss: 0.1476 - val_ac
c: 0.7760
Epoch 170/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0245 - acc: 0.9643 - val_loss: 0.1471 - val_ac
c: 0.7680
Epoch 171/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0243 - acc: 0.9786 - val_loss: 0.1460 - val_ac
c: 0.7700
Epoch 172/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0238 - acc: 0.9714 - val_loss: 0.1448 - val_ac
c: 0.7720
Epoch 173/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0268 - acc: 0.9714 - val_loss: 0.1446 - val_ac
c: 0.7780
Epoch 174/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0249 - acc: 0.9714 - val_loss: 0.1441 - val_ac
c: 0.7760
Epoch 175/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0245 - acc: 0.9571 - val_loss: 0.1449 - val_ac
c: 0.7740
Epoch 176/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0246 - acc: 0.9786 - val_loss: 0.1471 - val_ac
c: 0.7660
Epoch 177/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0260 - acc: 0.9786 - val_loss: 0.1479 - val_ac
c: 0.7660
Epoch 178/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0260 - acc: 0.9571 - val_loss: 0.1472 - val_ac
c: 0.7620
Epoch 179/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0242 - acc: 0.9786 - val_loss: 0.1457 - val_ac
c: 0.7700
Epoch 180/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0236 - acc: 0.9929 - val_loss: 0.1448 - val_ac
c: 0.7760
Epoch 181/900
1/1 [==============================] - 0s 181ms/step - loss: 0.0255 - acc: 0.9571 - val_loss: 0.1446 - val_ac
c: 0.7740
Epoch 182/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0238 - acc: 0.9643 - val_loss: 0.1428 - val_ac
c: 0.7720
Epoch 183/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0233 - acc: 0.9857 - val_loss: 0.1403 - val_ac
c: 0.7760
Epoch 184/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0246 - acc: 0.9714 - val_loss: 0.1379 - val_ac
c: 0.7780
Epoch 185/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0252 - acc: 0.9643 - val_loss: 0.1368 - val_ac
c: 0.7800
Epoch 186/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0228 - acc: 0.9857 - val_loss: 0.1368 - val_ac
c: 0.7800
Epoch 187/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0233 - acc: 0.9929 - val_loss: 0.1382 - val_ac
c: 0.7740
Epoch 188/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0227 - acc: 0.9929 - val_loss: 0.1411 - val_ac
c: 0.7720
Epoch 189/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0243 - acc: 0.9786 - val_loss: 0.1448 - val_ac
```

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c: 0.7720
Epoch 190/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0253 - acc: 0.9571 - val_loss: 0.1470 - val_ac
c: 0.7720
Epoch 191/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0232 - acc: 0.9571 - val_loss: 0.1498 - val_ac
c: 0.7700
Epoch 192/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0229 - acc: 0.9857 - val_loss: 0.1506 - val_ac
c: 0.7720
Epoch 193/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0258 - acc: 0.9571 - val_loss: 0.1486 - val_ac
c: 0.7700
Epoch 194/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0224 - acc: 0.9643 - val_loss: 0.1450 - val_ac
c: 0.7740
Epoch 195/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0232 - acc: 0.9857 - val_loss: 0.1412 - val_ac
c: 0.7800
Epoch 196/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0208 - acc: 0.9929 - val_loss: 0.1396 - val_ac
c: 0.7780
Epoch 197/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0232 - acc: 0.9857 - val_loss: 0.1389 - val_ac
c: 0.7760
Epoch 198/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0224 - acc: 0.9714 - val_loss: 0.1389 - val_ac
c: 0.7760
Epoch 199/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0225 - acc: 0.9929 - val_loss: 0.1397 - val_ac
c: 0.7760
Epoch 200/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0237 - acc: 0.9714 - val_loss: 0.1415 - val_ac
c: 0.7800
Epoch 201/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0239 - acc: 0.9643 - val_loss: 0.1441 - val_ac
c: 0.7780
Epoch 202/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0230 - acc: 0.9714 - val_loss: 0.1477 - val_ac
c: 0.7660
Epoch 203/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0208 - acc: 1.0000 - val_loss: 0.1484 - val_ac
c: 0.7640
Epoch 204/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0226 - acc: 0.9786 - val_loss: 0.1457 - val_ac
c: 0.7720
Epoch 205/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0245 - acc: 0.9643 - val_loss: 0.1416 - val_ac
c: 0.7780
Epoch 206/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0230 - acc: 0.9643 - val_loss: 0.1387 - val_ac
c: 0.7860
Epoch 207/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0211 - acc: 0.9857 - val_loss: 0.1377 - val_ac
c: 0.7900
Epoch 208/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0244 - acc: 0.9714 - val_loss: 0.1395 - val_ac
c: 0.7740
Epoch 209/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0252 - acc: 0.9643 - val_loss: 0.1426 - val_ac
c: 0.7660
Epoch 210/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0251 - acc: 0.9357 - val_loss: 0.1431 - val_ac
c: 0.7780
Epoch 211/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0236 - acc: 0.9786 - val_loss: 0.1431 - val_ac
c: 0.7780
Epoch 212/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0220 - acc: 0.9786 - val_loss: 0.1439 - val_ac
c: 0.7820
Epoch 213/900
```

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1/1 [==============================] - 0s 169ms/step - loss: 0.0231 - acc: 0.9929 - val_loss: 0.1444 - val_ac
c: 0.7820
Epoch 214/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0241 - acc: 0.9714 - val_loss: 0.1431 - val_ac
c: 0.7920
Epoch 215/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0237 - acc: 0.9786 - val_loss: 0.1418 - val_ac
c: 0.7940
Epoch 216/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0238 - acc: 0.9786 - val_loss: 0.1394 - val_ac
c: 0.7900
Epoch 217/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0216 - acc: 0.9786 - val_loss: 0.1372 - val_ac
c: 0.7900
Epoch 218/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0212 - acc: 0.9929 - val_loss: 0.1364 - val_ac
c: 0.7880
Epoch 219/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0220 - acc: 0.9857 - val_loss: 0.1367 - val_ac
c: 0.7820
Epoch 220/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0219 - acc: 0.9786 - val_loss: 0.1373 - val_ac
c: 0.7780
Epoch 221/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0214 - acc: 0.9714 - val_loss: 0.1396 - val_ac
c: 0.7680
Epoch 222/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0236 - acc: 0.9786 - val_loss: 0.1427 - val_ac
c: 0.7720
Epoch 223/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0220 - acc: 0.9786 - val_loss: 0.1440 - val_ac
c: 0.7700
Epoch 224/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0232 - acc: 0.9643 - val_loss: 0.1449 - val_ac
c: 0.7620
Epoch 225/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0221 - acc: 0.9929 - val_loss: 0.1456 - val_ac
c: 0.7600
Epoch 226/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0228 - acc: 0.9643 - val_loss: 0.1474 - val_ac
c: 0.7580
Epoch 227/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0211 - acc: 0.9643 - val_loss: 0.1472 - val_ac
c: 0.7580
Epoch 228/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0223 - acc: 0.9786 - val_loss: 0.1458 - val_ac
c: 0.7620
Epoch 229/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0218 - acc: 0.9786 - val_loss: 0.1436 - val_ac
c: 0.7700
Epoch 230/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0215 - acc: 0.9929 - val_loss: 0.1412 - val_ac
c: 0.7840
Epoch 231/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0199 - acc: 0.9857 - val_loss: 0.1401 - val_ac
c: 0.7920
Epoch 232/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0231 - acc: 0.9857 - val_loss: 0.1388 - val_ac
c: 0.7900
Epoch 233/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0209 - acc: 0.9714 - val_loss: 0.1381 - val_ac
c: 0.7960
Epoch 234/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0217 - acc: 0.9571 - val_loss: 0.1385 - val_ac
c: 0.7920
Epoch 235/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0225 - acc: 0.9929 - val_loss: 0.1388 - val_ac
c: 0.7880
Epoch 236/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0212 - acc: 0.9714 - val_loss: 0.1410 - val_ac
c: 0.7860
```

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Epoch 237/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0228 - acc: 0.9643 - val_loss: 0.1438 - val_ac
c: 0.7780
Epoch 238/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0219 - acc: 0.9786 - val_loss: 0.1454 - val_ac
c: 0.7660
Epoch 239/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0202 - acc: 0.9857 - val_loss: 0.1453 - val_ac
c: 0.7660
Epoch 240/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0221 - acc: 0.9643 - val_loss: 0.1451 - val_ac
c: 0.7640
Epoch 241/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0223 - acc: 0.9857 - val_loss: 0.1425 - val_ac
c: 0.7640
Epoch 242/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0222 - acc: 0.9714 - val_loss: 0.1401 - val_ac
c: 0.7740
Epoch 243/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0216 - acc: 0.9857 - val_loss: 0.1375 - val_ac
c: 0.7840
Epoch 244/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0234 - acc: 0.9571 - val_loss: 0.1362 - val_ac
c: 0.7760
Epoch 245/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0206 - acc: 0.9857 - val_loss: 0.1357 - val_ac
c: 0.7780
Epoch 246/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0224 - acc: 0.9786 - val_loss: 0.1368 - val_ac
c: 0.7780
Epoch 247/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0226 - acc: 0.9643 - val_loss: 0.1374 - val_ac
c: 0.7800
Epoch 248/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0214 - acc: 0.9786 - val_loss: 0.1380 - val_ac
c: 0.7780
Epoch 249/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0207 - acc: 0.9857 - val_loss: 0.1380 - val_ac
c: 0.7800
Epoch 250/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0223 - acc: 0.9786 - val_loss: 0.1408 - val_ac
c: 0.7740
Epoch 251/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0208 - acc: 0.9786 - val_loss: 0.1448 - val_ac
c: 0.7680
Epoch 252/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0218 - acc: 0.9571 - val_loss: 0.1482 - val_ac
c: 0.7520
Epoch 253/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0215 - acc: 0.9786 - val_loss: 0.1492 - val_ac
c: 0.7560
Epoch 254/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0212 - acc: 0.9786 - val_loss: 0.1480 - val_ac
c: 0.7560
Epoch 255/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0207 - acc: 0.9714 - val_loss: 0.1452 - val_ac
c: 0.7700
Epoch 256/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0209 - acc: 0.9857 - val_loss: 0.1415 - val_ac
c: 0.7760
Epoch 257/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0229 - acc: 0.9786 - val_loss: 0.1390 - val_ac
c: 0.7820
Epoch 258/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0219 - acc: 0.9857 - val_loss: 0.1405 - val_ac
c: 0.7760
Epoch 259/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0216 - acc: 0.9571 - val_loss: 0.1429 - val_ac
c: 0.7680
Epoch 260/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.1437 - val_ac
```

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c: 0.7720
Epoch 261/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0201 - acc: 0.9929 - val_loss: 0.1425 - val_ac
c: 0.7740
Epoch 262/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0197 - acc: 0.9857 - val_loss: 0.1402 - val_ac
c: 0.7760
Epoch 263/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0204 - acc: 0.9929 - val_loss: 0.1397 - val_ac
c: 0.7780
Epoch 264/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0211 - acc: 0.9857 - val_loss: 0.1395 - val_ac
c: 0.7800
Epoch 265/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.1400 - val_ac
c: 0.7700
Epoch 266/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0216 - acc: 0.9643 - val_loss: 0.1416 - val_ac
c: 0.7660
Epoch 267/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0203 - acc: 0.9714 - val_loss: 0.1451 - val_ac
c: 0.7460
Epoch 268/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0229 - acc: 0.9714 - val_loss: 0.1480 - val_ac
c: 0.7480
Epoch 269/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0226 - acc: 0.9643 - val_loss: 0.1456 - val_ac
c: 0.7600
Epoch 270/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0216 - acc: 0.9857 - val_loss: 0.1418 - val_ac
c: 0.7720
Epoch 271/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0216 - acc: 0.9714 - val_loss: 0.1390 - val_ac
c: 0.7660
Epoch 272/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0208 - acc: 0.9857 - val_loss: 0.1378 - val_ac
c: 0.7720
Epoch 273/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0216 - acc: 0.9714 - val_loss: 0.1360 - val_ac
c: 0.7720
Epoch 274/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0193 - acc: 0.9929 - val_loss: 0.1357 - val_ac
c: 0.7740
Epoch 275/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0233 - acc: 0.9571 - val_loss: 0.1354 - val_ac
c: 0.7740
Epoch 276/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0213 - acc: 0.9786 - val_loss: 0.1358 - val_ac
c: 0.7740
Epoch 277/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0193 - acc: 0.9714 - val_loss: 0.1391 - val_ac
c: 0.7680
Epoch 278/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0205 - acc: 0.9786 - val_loss: 0.1490 - val_ac
c: 0.7580
Epoch 279/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0196 - acc: 0.9929 - val_loss: 0.1591 - val_ac
c: 0.7420
Epoch 280/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0209 - acc: 0.9571 - val_loss: 0.1633 - val_ac
c: 0.7360
Epoch 281/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0209 - acc: 0.9714 - val_loss: 0.1614 - val_ac
c: 0.7420
Epoch 282/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0206 - acc: 0.9714 - val_loss: 0.1540 - val_ac
c: 0.7600
Epoch 283/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0205 - acc: 0.9786 - val_loss: 0.1492 - val_ac
c: 0.7620
Epoch 284/900
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1/1 [==============================] - 0s 168ms/step - loss: 0.0219 - acc: 0.9714 - val_loss: 0.1449 - val_ac
c: 0.7660
Epoch 285/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0218 - acc: 0.9643 - val_loss: 0.1392 - val_ac
c: 0.7620
Epoch 286/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0208 - acc: 0.9714 - val_loss: 0.1379 - val_ac
c: 0.7600
Epoch 287/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0195 - acc: 1.0000 - val_loss: 0.1379 - val_ac
c: 0.7640
Epoch 288/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1385 - val_ac
c: 0.7700
Epoch 289/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0215 - acc: 0.9571 - val_loss: 0.1418 - val_ac
c: 0.7700
Epoch 290/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0209 - acc: 0.9786 - val_loss: 0.1452 - val_ac
c: 0.7520
Epoch 291/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0194 - acc: 0.9929 - val_loss: 0.1482 - val_ac
c: 0.7500
Epoch 292/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0215 - acc: 0.9786 - val_loss: 0.1482 - val_ac
c: 0.7500
Epoch 293/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0207 - acc: 0.9857 - val_loss: 0.1453 - val_ac
c: 0.7540
Epoch 294/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0210 - acc: 0.9857 - val_loss: 0.1420 - val_ac
c: 0.7600
Epoch 295/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0193 - acc: 0.9714 - val_loss: 0.1407 - val_ac
c: 0.7620
Epoch 296/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0227 - acc: 0.9429 - val_loss: 0.1414 - val_ac
c: 0.7660
Epoch 297/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0199 - acc: 0.9786 - val_loss: 0.1413 - val_ac
c: 0.7700
Epoch 298/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0213 - acc: 0.9714 - val_loss: 0.1405 - val_ac
c: 0.7720
Epoch 299/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0203 - acc: 0.9929 - val_loss: 0.1383 - val_ac
c: 0.7760
Epoch 300/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0207 - acc: 0.9786 - val_loss: 0.1377 - val_ac
c: 0.7780
Epoch 301/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0212 - acc: 0.9571 - val_loss: 0.1369 - val_ac
c: 0.7860
Epoch 302/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0191 - acc: 0.9929 - val_loss: 0.1378 - val_ac
c: 0.7820
Epoch 303/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0199 - acc: 0.9857 - val_loss: 0.1411 - val_ac
c: 0.7720
Epoch 304/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0216 - acc: 0.9571 - val_loss: 0.1452 - val_ac
c: 0.7660
Epoch 305/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0208 - acc: 0.9857 - val_loss: 0.1469 - val_ac
c: 0.7660
Epoch 306/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0190 - acc: 0.9929 - val_loss: 0.1476 - val_ac
c: 0.7740
Epoch 307/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0187 - acc: 0.9857 - val_loss: 0.1466 - val_ac
c: 0.7760
```

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Epoch 308/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0203 - acc: 0.9571 - val_loss: 0.1473 - val_ac
c: 0.7720
Epoch 309/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0210 - acc: 0.9786 - val_loss: 0.1468 - val_ac
c: 0.7720
Epoch 310/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0175 - acc: 0.9929 - val_loss: 0.1457 - val_ac
c: 0.7780
Epoch 311/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0242 - acc: 0.9357 - val_loss: 0.1454 - val_ac
c: 0.7760
Epoch 312/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0213 - acc: 0.9643 - val_loss: 0.1451 - val_ac
c: 0.7800
Epoch 313/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0200 - acc: 0.9571 - val_loss: 0.1438 - val_ac
c: 0.7820
Epoch 314/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0208 - acc: 0.9643 - val_loss: 0.1425 - val_ac
c: 0.7820
Epoch 315/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0191 - acc: 0.9929 - val_loss: 0.1427 - val_ac
c: 0.7760
Epoch 316/900
1/1 [==============================] - 0s 186ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.1430 - val_ac
c: 0.7800
Epoch 317/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0207 - acc: 0.9643 - val_loss: 0.1441 - val_ac
c: 0.7720
Epoch 318/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0220 - acc: 0.9714 - val_loss: 0.1433 - val_ac
c: 0.7700
Epoch 319/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0209 - acc: 0.9786 - val_loss: 0.1437 - val_ac
c: 0.7700
Epoch 320/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0197 - acc: 0.9857 - val_loss: 0.1436 - val_ac
c: 0.7720
Epoch 321/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0196 - acc: 0.9857 - val_loss: 0.1442 - val_ac
c: 0.7660
Epoch 322/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0188 - acc: 0.9714 - val_loss: 0.1449 - val_ac
c: 0.7640
Epoch 323/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0195 - acc: 0.9857 - val_loss: 0.1454 - val_ac
c: 0.7600
Epoch 324/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0183 - acc: 0.9857 - val_loss: 0.1439 - val_ac
c: 0.7580
Epoch 325/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.1428 - val_ac
c: 0.7620
Epoch 326/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0209 - acc: 0.9786 - val_loss: 0.1404 - val_ac
c: 0.7700
Epoch 327/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0211 - acc: 0.9714 - val_loss: 0.1372 - val_ac
c: 0.7700
Epoch 328/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0200 - acc: 0.9643 - val_loss: 0.1361 - val_ac
c: 0.7720
Epoch 329/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0203 - acc: 0.9714 - val_loss: 0.1362 - val_ac
c: 0.7840
Epoch 330/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0197 - acc: 0.9714 - val_loss: 0.1383 - val_ac
c: 0.7740
Epoch 331/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0209 - acc: 0.9714 - val_loss: 0.1416 - val_ac
```

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c: 0.7700
Epoch 332/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0195 - acc: 0.9857 - val_loss: 0.1449 - val_ac
c: 0.7640
Epoch 333/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0190 - acc: 0.9857 - val_loss: 0.1456 - val_ac
c: 0.7620
Epoch 334/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0203 - acc: 0.9714 - val_loss: 0.1431 - val_ac
c: 0.7720
Epoch 335/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0205 - acc: 0.9571 - val_loss: 0.1398 - val_ac
c: 0.7760
Epoch 336/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.1380 - val_ac
c: 0.7700
Epoch 337/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0189 - acc: 0.9929 - val_loss: 0.1390 - val_ac
c: 0.7760
Epoch 338/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0199 - acc: 0.9857 - val_loss: 0.1407 - val_ac
c: 0.7740
Epoch 339/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0187 - acc: 0.9786 - val_loss: 0.1405 - val_ac
c: 0.7660
Epoch 340/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.1401 - val_ac
c: 0.7740
Epoch 341/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.1431 - val_ac
c: 0.7620
Epoch 342/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0192 - acc: 0.9857 - val_loss: 0.1469 - val_ac
c: 0.7540
Epoch 343/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0203 - acc: 0.9714 - val_loss: 0.1478 - val_ac
c: 0.7480
Epoch 344/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1463 - val_ac
c: 0.7560
Epoch 345/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0193 - acc: 0.9643 - val_loss: 0.1440 - val_ac
c: 0.7680
Epoch 346/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0187 - acc: 0.9929 - val_loss: 0.1415 - val_ac
c: 0.7640
Epoch 347/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0177 - acc: 0.9857 - val_loss: 0.1378 - val_ac
c: 0.7660
Epoch 348/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0198 - acc: 0.9643 - val_loss: 0.1370 - val_ac
c: 0.7740
Epoch 349/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0176 - acc: 0.9786 - val_loss: 0.1417 - val_ac
c: 0.7640
Epoch 350/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1447 - val_ac
c: 0.7540
Epoch 351/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0186 - acc: 0.9786 - val_loss: 0.1441 - val_ac
c: 0.7540
Epoch 352/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0199 - acc: 0.9786 - val_loss: 0.1444 - val_ac
c: 0.7720
Epoch 353/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0195 - acc: 0.9714 - val_loss: 0.1462 - val_ac
c: 0.7720
Epoch 354/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0187 - acc: 0.9786 - val_loss: 0.1482 - val_ac
c: 0.7660
Epoch 355/900
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1/1 [==============================] - 0s 166ms/step - loss: 0.0180 - acc: 0.9929 - val_loss: 0.1443 - val_ac
c: 0.7700
Epoch 356/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0204 - acc: 0.9571 - val_loss: 0.1390 - val_ac
c: 0.7700
Epoch 357/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1363 - val_ac
c: 0.7660
Epoch 358/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0181 - acc: 0.9857 - val_loss: 0.1342 - val_ac
c: 0.7800
Epoch 359/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0195 - acc: 0.9643 - val_loss: 0.1345 - val_ac
c: 0.7760
Epoch 360/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0202 - acc: 0.9643 - val_loss: 0.1360 - val_ac
c: 0.7680
Epoch 361/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0184 - acc: 0.9643 - val_loss: 0.1389 - val_ac
c: 0.7660
Epoch 362/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0184 - acc: 0.9857 - val_loss: 0.1420 - val_ac
c: 0.7660
Epoch 363/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0186 - acc: 0.9786 - val_loss: 0.1454 - val_ac
c: 0.7660
Epoch 364/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0183 - acc: 0.9929 - val_loss: 0.1444 - val_ac
c: 0.7640
Epoch 365/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0199 - acc: 0.9714 - val_loss: 0.1409 - val_ac
c: 0.7640
Epoch 366/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0200 - acc: 0.9714 - val_loss: 0.1387 - val_ac
c: 0.7720
Epoch 367/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1371 - val_ac
c: 0.7760
Epoch 368/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0205 - acc: 0.9643 - val_loss: 0.1354 - val_ac
c: 0.7760
Epoch 369/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0175 - acc: 0.9857 - val_loss: 0.1336 - val_ac
c: 0.7900
Epoch 370/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0179 - acc: 0.9857 - val_loss: 0.1319 - val_ac
c: 0.8000
Epoch 371/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.1318 - val_ac
c: 0.7960
Epoch 372/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0205 - acc: 0.9357 - val_loss: 0.1334 - val_ac
c: 0.7840
Epoch 373/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.1365 - val_ac
c: 0.7820
Epoch 374/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0184 - acc: 0.9786 - val_loss: 0.1412 - val_ac
c: 0.7760
Epoch 375/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0187 - acc: 0.9857 - val_loss: 0.1459 - val_ac
c: 0.7560
Epoch 376/900
1/1 [==============================] - 0s 183ms/step - loss: 0.0184 - acc: 0.9857 - val_loss: 0.1463 - val_ac
c: 0.7560
Epoch 377/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0179 - acc: 0.9929 - val_loss: 0.1445 - val_ac
c: 0.7600
Epoch 378/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0206 - acc: 0.9786 - val_loss: 0.1381 - val_ac
c: 0.7700
```

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Epoch 379/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0170 - acc: 0.9857 - val_loss: 0.1357 - val_ac
c: 0.7860
Epoch 380/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0194 - acc: 0.9857 - val_loss: 0.1359 - val_ac
c: 0.7880
Epoch 381/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0193 - acc: 0.9857 - val_loss: 0.1360 - val_ac
c: 0.7840
Epoch 382/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1383 - val_ac
c: 0.7680
Epoch 383/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1415 - val_ac
c: 0.7720
Epoch 384/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0194 - acc: 0.9786 - val_loss: 0.1450 - val_ac
c: 0.7660
Epoch 385/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1484 - val_ac
c: 0.7620
Epoch 386/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0181 - acc: 0.9857 - val_loss: 0.1495 - val_ac
c: 0.7540
Epoch 387/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0180 - acc: 0.9857 - val_loss: 0.1506 - val_ac
c: 0.7540
Epoch 388/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0191 - acc: 0.9786 - val_loss: 0.1462 - val_ac
c: 0.7620
Epoch 389/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1419 - val_ac
c: 0.7660
Epoch 390/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0184 - acc: 0.9786 - val_loss: 0.1396 - val_ac
c: 0.7680
Epoch 391/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0173 - acc: 0.9929 - val_loss: 0.1377 - val_ac
c: 0.7620
Epoch 392/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0189 - acc: 0.9643 - val_loss: 0.1372 - val_ac
c: 0.7560
Epoch 393/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1390 - val_ac
c: 0.7520
Epoch 394/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1393 - val_ac
c: 0.7540
Epoch 395/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0203 - acc: 0.9500 - val_loss: 0.1394 - val_ac
c: 0.7520
Epoch 396/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0190 - acc: 0.9714 - val_loss: 0.1404 - val_ac
c: 0.7620
Epoch 397/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0183 - acc: 0.9786 - val_loss: 0.1418 - val_ac
c: 0.7680
Epoch 398/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0178 - acc: 0.9929 - val_loss: 0.1418 - val_ac
c: 0.7740
Epoch 399/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1413 - val_ac
c: 0.7700
Epoch 400/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0169 - acc: 0.9857 - val_loss: 0.1413 - val_ac
c: 0.7660
Epoch 401/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0186 - acc: 0.9786 - val_loss: 0.1419 - val_ac
c: 0.7680
Epoch 402/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1429 - val_ac
```

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c: 0.7660
Epoch 403/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1435 - val_ac
c: 0.7660
Epoch 404/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0169 - acc: 0.9714 - val_loss: 0.1429 - val_ac
c: 0.7660
Epoch 405/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1431 - val_ac
c: 0.7660
Epoch 406/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0159 - acc: 0.9929 - val_loss: 0.1442 - val_ac
c: 0.7720
Epoch 407/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0169 - acc: 0.9857 - val_loss: 0.1456 - val_ac
c: 0.7760
Epoch 408/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0185 - acc: 0.9714 - val_loss: 0.1448 - val_ac
c: 0.7760
Epoch 409/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1425 - val_ac
c: 0.7800
Epoch 410/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1379 - val_ac
c: 0.7840
Epoch 411/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0181 - acc: 0.9857 - val_loss: 0.1336 - val_ac
c: 0.7860
Epoch 412/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0184 - acc: 0.9643 - val_loss: 0.1323 - val_ac
c: 0.7820
Epoch 413/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1334 - val_ac
c: 0.7860
Epoch 414/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1364 - val_ac
c: 0.7780
Epoch 415/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0175 - acc: 0.9929 - val_loss: 0.1393 - val_ac
c: 0.7780
Epoch 416/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0178 - acc: 0.9929 - val_loss: 0.1412 - val_ac
c: 0.7700
Epoch 417/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.1404 - val_ac
c: 0.7720
Epoch 418/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0167 - acc: 0.9929 - val_loss: 0.1369 - val_ac
c: 0.7740
Epoch 419/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0162 - acc: 0.9929 - val_loss: 0.1344 - val_ac
c: 0.7780
Epoch 420/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0177 - acc: 0.9857 - val_loss: 0.1351 - val_ac
c: 0.7740
Epoch 421/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1351 - val_ac
c: 0.7720
Epoch 422/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0179 - acc: 0.9929 - val_loss: 0.1338 - val_ac
c: 0.7740
Epoch 423/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0209 - acc: 0.9643 - val_loss: 0.1327 - val_ac
c: 0.7760
Epoch 424/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0178 - acc: 0.9929 - val_loss: 0.1321 - val_ac
c: 0.7740
Epoch 425/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0163 - acc: 0.9929 - val_loss: 0.1315 - val_ac
c: 0.7780
Epoch 426/900
```

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1/1 [==============================] - 0s 167ms/step - loss: 0.0192 - acc: 0.9786 - val_loss: 0.1306 - val_ac
c: 0.7760
Epoch 427/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0173 - acc: 0.9857 - val_loss: 0.1315 - val_ac
c: 0.7720
Epoch 428/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0166 - acc: 0.9929 - val_loss: 0.1342 - val_ac
c: 0.7660
Epoch 429/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1388 - val_ac
c: 0.7620
Epoch 430/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0188 - acc: 0.9500 - val_loss: 0.1429 - val_ac
c: 0.7560
Epoch 431/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0175 - acc: 0.9929 - val_loss: 0.1435 - val_ac
c: 0.7580
Epoch 432/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0169 - acc: 0.9929 - val_loss: 0.1436 - val_ac
c: 0.7540
Epoch 433/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0203 - acc: 0.9643 - val_loss: 0.1402 - val_ac
c: 0.7600
Epoch 434/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0185 - acc: 0.9786 - val_loss: 0.1373 - val_ac
c: 0.7660
Epoch 435/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0165 - acc: 0.9929 - val_loss: 0.1366 - val_ac
c: 0.7620
Epoch 436/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0161 - acc: 0.9929 - val_loss: 0.1369 - val_ac
c: 0.7620
Epoch 437/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0197 - acc: 0.9643 - val_loss: 0.1372 - val_ac
c: 0.7600
Epoch 438/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0161 - acc: 0.9929 - val_loss: 0.1388 - val_ac
c: 0.7640
Epoch 439/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0159 - acc: 1.0000 - val_loss: 0.1407 - val_ac
c: 0.7540
Epoch 440/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1416 - val_ac
c: 0.7560
Epoch 441/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0173 - acc: 0.9857 - val_loss: 0.1422 - val_ac
c: 0.7640
Epoch 442/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0168 - acc: 0.9929 - val_loss: 0.1422 - val_ac
c: 0.7660
Epoch 443/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0189 - acc: 0.9786 - val_loss: 0.1405 - val_ac
c: 0.7680
Epoch 444/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0188 - acc: 0.9714 - val_loss: 0.1404 - val_ac
c: 0.7600
Epoch 445/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0175 - acc: 0.9857 - val_loss: 0.1424 - val_ac
c: 0.7540
Epoch 446/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1432 - val_ac
c: 0.7540
Epoch 447/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0150 - acc: 0.9929 - val_loss: 0.1431 - val_ac
c: 0.7560
Epoch 448/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0191 - acc: 0.9571 - val_loss: 0.1396 - val_ac
c: 0.7560
Epoch 449/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0197 - acc: 0.9571 - val_loss: 0.1366 - val_ac
c: 0.7680
```

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Epoch 450/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0171 - acc: 0.9786 - val_loss: 0.1353 - val_ac
c: 0.7720
Epoch 451/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0164 - acc: 0.9929 - val_loss: 0.1360 - val_ac
c: 0.7640
Epoch 452/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0191 - acc: 0.9714 - val_loss: 0.1370 - val_ac
c: 0.7640
Epoch 453/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0179 - acc: 0.9857 - val_loss: 0.1374 - val_ac
c: 0.7760
Epoch 454/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1372 - val_ac
c: 0.7720
Epoch 455/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1359 - val_ac
c: 0.7700
Epoch 456/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1347 - val_ac
c: 0.7720
Epoch 457/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1392 - val_ac
c: 0.7760
Epoch 458/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0177 - acc: 0.9929 - val_loss: 0.1424 - val_ac
c: 0.7700
Epoch 459/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1460 - val_ac
c: 0.7600
Epoch 460/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0198 - acc: 0.9500 - val_loss: 0.1473 - val_ac
c: 0.7680
Epoch 461/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0157 - acc: 0.9857 - val_loss: 0.1486 - val_ac
c: 0.7640
Epoch 462/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0152 - acc: 1.0000 - val_loss: 0.1472 - val_ac
c: 0.7640
Epoch 463/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0185 - acc: 0.9643 - val_loss: 0.1446 - val_ac
c: 0.7800
Epoch 464/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1418 - val_ac
c: 0.7820
Epoch 465/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0180 - acc: 0.9786 - val_loss: 0.1393 - val_ac
c: 0.7860
Epoch 466/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0160 - acc: 0.9929 - val_loss: 0.1377 - val_ac
c: 0.7840
Epoch 467/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1365 - val_ac
c: 0.7860
Epoch 468/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0178 - acc: 0.9786 - val_loss: 0.1380 - val_ac
c: 0.7780
Epoch 469/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1387 - val_ac
c: 0.7760
Epoch 470/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0156 - acc: 0.9929 - val_loss: 0.1395 - val_ac
c: 0.7760
Epoch 471/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0165 - acc: 0.9929 - val_loss: 0.1417 - val_ac
c: 0.7620
Epoch 472/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0163 - acc: 0.9786 - val_loss: 0.1454 - val_ac
c: 0.7540
Epoch 473/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1477 - val_ac
```

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c: 0.7480
Epoch 474/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0185 - acc: 0.9786 - val_loss: 0.1469 - val_ac
c: 0.7520
Epoch 475/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0183 - acc: 0.9786 - val_loss: 0.1476 - val_ac
c: 0.7500
Epoch 476/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1466 - val_ac
c: 0.7540
Epoch 477/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1443 - val_ac
c: 0.7560
Epoch 478/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0152 - acc: 1.0000 - val_loss: 0.1424 - val_ac
c: 0.7540
Epoch 479/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1411 - val_ac
c: 0.7620
Epoch 480/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0186 - acc: 0.9643 - val_loss: 0.1401 - val_ac
c: 0.7620
Epoch 481/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0152 - acc: 1.0000 - val_loss: 0.1394 - val_ac
c: 0.7640
Epoch 482/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0169 - acc: 0.9786 - val_loss: 0.1387 - val_ac
c: 0.7660
Epoch 483/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0176 - acc: 0.9714 - val_loss: 0.1383 - val_ac
c: 0.7660
Epoch 484/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0189 - acc: 0.9643 - val_loss: 0.1397 - val_ac
c: 0.7640
Epoch 485/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0168 - acc: 0.9786 - val_loss: 0.1417 - val_ac
c: 0.7620
Epoch 486/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0167 - acc: 0.9714 - val_loss: 0.1432 - val_ac
c: 0.7620
Epoch 487/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1434 - val_ac
c: 0.7560
Epoch 488/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0186 - acc: 0.9643 - val_loss: 0.1412 - val_ac
c: 0.7660
Epoch 489/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0173 - acc: 0.9857 - val_loss: 0.1406 - val_ac
c: 0.7680
Epoch 490/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0175 - acc: 0.9857 - val_loss: 0.1396 - val_ac
c: 0.7620
Epoch 491/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0172 - acc: 0.9929 - val_loss: 0.1371 - val_ac
c: 0.7720
Epoch 492/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0165 - acc: 0.9929 - val_loss: 0.1345 - val_ac
c: 0.7780
Epoch 493/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0187 - acc: 0.9786 - val_loss: 0.1328 - val_ac
c: 0.7820
Epoch 494/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0168 - acc: 0.9929 - val_loss: 0.1343 - val_ac
c: 0.7800
Epoch 495/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0179 - acc: 0.9643 - val_loss: 0.1390 - val_ac
c: 0.7800
Epoch 496/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0176 - acc: 0.9929 - val_loss: 0.1443 - val_ac
c: 0.7660
Epoch 497/900
```

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1/1 [==============================] - 0s 163ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1500 - val_ac
c: 0.7620
Epoch 498/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1537 - val_ac
c: 0.7640
Epoch 499/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1540 - val_ac
c: 0.7600
Epoch 500/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0187 - acc: 0.9643 - val_loss: 0.1491 - val_ac
c: 0.7560
Epoch 501/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0187 - acc: 0.9500 - val_loss: 0.1458 - val_ac
c: 0.7540
Epoch 502/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0186 - acc: 0.9643 - val_loss: 0.1449 - val_ac
c: 0.7600
Epoch 503/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1410 - val_ac
c: 0.7520
Epoch 504/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1388 - val_ac
c: 0.7640
Epoch 505/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0162 - acc: 0.9929 - val_loss: 0.1398 - val_ac
c: 0.7680
Epoch 506/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1436 - val_ac
c: 0.7640
Epoch 507/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1437 - val_ac
c: 0.7660
Epoch 508/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0158 - acc: 0.9929 - val_loss: 0.1432 - val_ac
c: 0.7680
Epoch 509/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0173 - acc: 0.9786 - val_loss: 0.1443 - val_ac
c: 0.7680
Epoch 510/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0163 - acc: 0.9714 - val_loss: 0.1453 - val_ac
c: 0.7820
Epoch 511/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0173 - acc: 0.9786 - val_loss: 0.1466 - val_ac
c: 0.7680
Epoch 512/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1465 - val_ac
c: 0.7680
Epoch 513/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1449 - val_ac
c: 0.7680
Epoch 514/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1413 - val_ac
c: 0.7760
Epoch 515/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0169 - acc: 0.9786 - val_loss: 0.1385 - val_ac
c: 0.7780
Epoch 516/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0163 - acc: 0.9643 - val_loss: 0.1367 - val_ac
c: 0.7640
Epoch 517/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0187 - acc: 0.9643 - val_loss: 0.1333 - val_ac
c: 0.7640
Epoch 518/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1310 - val_ac
c: 0.7740
Epoch 519/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1310 - val_ac
c: 0.7700
Epoch 520/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0177 - acc: 0.9857 - val_loss: 0.1274 - val_ac
c: 0.7860
```

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Epoch 521/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0176 - acc: 0.9571 - val_loss: 0.1283 - val_ac
c: 0.7800
Epoch 522/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0176 - acc: 0.9714 - val_loss: 0.1313 - val_ac
c: 0.7760
Epoch 523/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1355 - val_ac
c: 0.7720
Epoch 524/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0173 - acc: 0.9857 - val_loss: 0.1388 - val_ac
c: 0.7680
Epoch 525/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0152 - acc: 0.9714 - val_loss: 0.1410 - val_ac
c: 0.7600
Epoch 526/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0175 - acc: 0.9714 - val_loss: 0.1408 - val_ac
c: 0.7640
Epoch 527/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0173 - acc: 0.9786 - val_loss: 0.1396 - val_ac
c: 0.7660
Epoch 528/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1372 - val_ac
c: 0.7660
Epoch 529/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0175 - acc: 0.9643 - val_loss: 0.1355 - val_ac
c: 0.7700
Epoch 530/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1346 - val_ac
c: 0.7760
Epoch 531/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1357 - val_ac
c: 0.7760
Epoch 532/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0175 - acc: 0.9714 - val_loss: 0.1372 - val_ac
c: 0.7740
Epoch 533/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0191 - acc: 0.9571 - val_loss: 0.1350 - val_ac
c: 0.7740
Epoch 534/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0158 - acc: 0.9786 - val_loss: 0.1325 - val_ac
c: 0.7740
Epoch 535/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0176 - acc: 0.9786 - val_loss: 0.1317 - val_ac
c: 0.7780
Epoch 536/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0176 - acc: 0.9571 - val_loss: 0.1324 - val_ac
c: 0.7760
Epoch 537/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0170 - acc: 0.9786 - val_loss: 0.1349 - val_ac
c: 0.7680
Epoch 538/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0192 - acc: 0.9643 - val_loss: 0.1398 - val_ac
c: 0.7720
Epoch 539/900
1/1 [==============================] - 0s 183ms/step - loss: 0.0172 - acc: 1.0000 - val_loss: 0.1438 - val_ac
c: 0.7620
Epoch 540/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1454 - val_ac
c: 0.7600
Epoch 541/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0166 - acc: 0.9929 - val_loss: 0.1474 - val_ac
c: 0.7600
Epoch 542/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0194 - acc: 0.9500 - val_loss: 0.1471 - val_ac
c: 0.7660
Epoch 543/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1469 - val_ac
c: 0.7600
Epoch 544/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0157 - acc: 0.9929 - val_loss: 0.1448 - val_ac
```

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c: 0.7620
Epoch 545/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1437 - val_ac
c: 0.7700
Epoch 546/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1417 - val_ac
c: 0.7600
Epoch 547/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0173 - acc: 0.9714 - val_loss: 0.1360 - val_ac
c: 0.7620
Epoch 548/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0171 - acc: 0.9714 - val_loss: 0.1317 - val_ac
c: 0.7820
Epoch 549/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0170 - acc: 0.9857 - val_loss: 0.1315 - val_ac
c: 0.7800
Epoch 550/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0177 - acc: 0.9786 - val_loss: 0.1350 - val_ac
c: 0.7800
Epoch 551/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0177 - acc: 0.9643 - val_loss: 0.1397 - val_ac
c: 0.7600
Epoch 552/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0176 - acc: 0.9714 - val_loss: 0.1461 - val_ac
c: 0.7660
Epoch 553/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1510 - val_ac
c: 0.7540
Epoch 554/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1521 - val_ac
c: 0.7500
Epoch 555/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0173 - acc: 0.9643 - val_loss: 0.1481 - val_ac
c: 0.7680
Epoch 556/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0180 - acc: 0.9643 - val_loss: 0.1447 - val_ac
c: 0.7840
Epoch 557/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1422 - val_ac
c: 0.7820
Epoch 558/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1426 - val_ac
c: 0.7760
Epoch 559/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0196 - acc: 0.9714 - val_loss: 0.1454 - val_ac
c: 0.7720
Epoch 560/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0176 - acc: 0.9786 - val_loss: 0.1499 - val_ac
c: 0.7600
Epoch 561/900
1/1 [==============================] - 0s 184ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1527 - val_ac
c: 0.7640
Epoch 562/900
1/1 [==============================] - 0s 183ms/step - loss: 0.0177 - acc: 0.9929 - val_loss: 0.1546 - val_ac
c: 0.7660
Epoch 563/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0170 - acc: 0.9857 - val_loss: 0.1538 - val_ac
c: 0.7720
Epoch 564/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0172 - acc: 0.9857 - val_loss: 0.1510 - val_ac
c: 0.7760
Epoch 565/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0165 - acc: 0.9857 - val_loss: 0.1473 - val_ac
c: 0.7860
Epoch 566/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0168 - acc: 0.9857 - val_loss: 0.1434 - val_ac
c: 0.7840
Epoch 567/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0182 - acc: 0.9929 - val_loss: 0.1377 - val_ac
c: 0.7940
Epoch 568/900
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1/1 [==============================] - 0s 171ms/step - loss: 0.0182 - acc: 0.9643 - val_loss: 0.1350 - val_ac
c: 0.7960
Epoch 569/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0172 - acc: 0.9929 - val_loss: 0.1348 - val_ac
c: 0.7980
Epoch 570/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0183 - acc: 0.9429 - val_loss: 0.1358 - val_ac
c: 0.7880
Epoch 571/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0178 - acc: 0.9714 - val_loss: 0.1394 - val_ac
c: 0.7820
Epoch 572/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0185 - acc: 0.9714 - val_loss: 0.1442 - val_ac
c: 0.7520
Epoch 573/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1484 - val_ac
c: 0.7480
Epoch 574/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0175 - acc: 0.9857 - val_loss: 0.1481 - val_ac
c: 0.7600
Epoch 575/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0178 - acc: 0.9857 - val_loss: 0.1491 - val_ac
c: 0.7680
Epoch 576/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0153 - acc: 0.9929 - val_loss: 0.1501 - val_ac
c: 0.7640
Epoch 577/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0163 - acc: 0.9929 - val_loss: 0.1489 - val_ac
c: 0.7640
Epoch 578/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1476 - val_ac
c: 0.7720
Epoch 579/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0179 - acc: 0.9857 - val_loss: 0.1452 - val_ac
c: 0.7660
Epoch 580/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0156 - acc: 1.0000 - val_loss: 0.1451 - val_ac
c: 0.7540
Epoch 581/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0180 - acc: 0.9714 - val_loss: 0.1454 - val_ac
c: 0.7500
Epoch 582/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0171 - acc: 0.9714 - val_loss: 0.1433 - val_ac
c: 0.7620
Epoch 583/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0189 - acc: 0.9714 - val_loss: 0.1428 - val_ac
c: 0.7680
Epoch 584/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0179 - acc: 0.9714 - val_loss: 0.1436 - val_ac
c: 0.7720
Epoch 585/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0158 - acc: 0.9929 - val_loss: 0.1460 - val_ac
c: 0.7760
Epoch 586/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0194 - acc: 0.9714 - val_loss: 0.1438 - val_ac
c: 0.7800
Epoch 587/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0165 - acc: 0.9714 - val_loss: 0.1440 - val_ac
c: 0.7780
Epoch 588/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0175 - acc: 0.9714 - val_loss: 0.1438 - val_ac
c: 0.7900
Epoch 589/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0190 - acc: 0.9643 - val_loss: 0.1470 - val_ac
c: 0.7760
Epoch 590/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0168 - acc: 0.9929 - val_loss: 0.1513 - val_ac
c: 0.7680
Epoch 591/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0178 - acc: 0.9714 - val_loss: 0.1514 - val_ac
c: 0.7640
```

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Epoch 592/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0177 - acc: 0.9714 - val_loss: 0.1510 - val_ac
c: 0.7560
Epoch 593/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0180 - acc: 0.9714 - val_loss: 0.1510 - val_ac
c: 0.7540
Epoch 594/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1476 - val_ac
c: 0.7560
Epoch 595/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1405 - val_ac
c: 0.7600
Epoch 596/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0169 - acc: 0.9714 - val_loss: 0.1347 - val_ac
c: 0.7760
Epoch 597/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0177 - acc: 0.9857 - val_loss: 0.1330 - val_ac
c: 0.7880
Epoch 598/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1341 - val_ac
c: 0.7880
Epoch 599/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0151 - acc: 0.9857 - val_loss: 0.1375 - val_ac
c: 0.7840
Epoch 600/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0174 - acc: 0.9857 - val_loss: 0.1407 - val_ac
c: 0.7740
Epoch 601/900
1/1 [==============================] - 0s 184ms/step - loss: 0.0172 - acc: 0.9786 - val_loss: 0.1446 - val_ac
c: 0.7680
Epoch 602/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1495 - val_ac
c: 0.7520
Epoch 603/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0159 - acc: 0.9929 - val_loss: 0.1541 - val_ac
c: 0.7440
Epoch 604/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0167 - acc: 0.9714 - val_loss: 0.1570 - val_ac
c: 0.7400
Epoch 605/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1546 - val_ac
c: 0.7420
Epoch 606/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0181 - acc: 0.9643 - val_loss: 0.1518 - val_ac
c: 0.7500
Epoch 607/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0169 - acc: 0.9929 - val_loss: 0.1487 - val_ac
c: 0.7560
Epoch 608/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1453 - val_ac
c: 0.7580
Epoch 609/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0155 - acc: 1.0000 - val_loss: 0.1437 - val_ac
c: 0.7660
Epoch 610/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0159 - acc: 0.9643 - val_loss: 0.1403 - val_ac
c: 0.7660
Epoch 611/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0155 - acc: 0.9786 - val_loss: 0.1395 - val_ac
c: 0.7600
Epoch 612/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1401 - val_ac
c: 0.7660
Epoch 613/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1399 - val_ac
c: 0.7620
Epoch 614/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1409 - val_ac
c: 0.7560
Epoch 615/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0139 - acc: 0.9929 - val_loss: 0.1424 - val_ac
```

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c: 0.7560
Epoch 616/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1426 - val_ac
c: 0.7520
Epoch 617/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0196 - acc: 0.9500 - val_loss: 0.1386 - val_ac
c: 0.7560
Epoch 618/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1402 - val_ac
c: 0.7540
Epoch 619/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0160 - acc: 0.9714 - val_loss: 0.1423 - val_ac
c: 0.7600
Epoch 620/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0169 - acc: 0.9857 - val_loss: 0.1467 - val_ac
c: 0.7500
Epoch 621/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0179 - acc: 0.9500 - val_loss: 0.1493 - val_ac
c: 0.7680
Epoch 622/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0181 - acc: 0.9571 - val_loss: 0.1527 - val_ac
c: 0.7640
Epoch 623/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0170 - acc: 0.9643 - val_loss: 0.1535 - val_ac
c: 0.7660
Epoch 624/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0171 - acc: 0.9714 - val_loss: 0.1516 - val_ac
c: 0.7700
Epoch 625/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0181 - acc: 0.9786 - val_loss: 0.1471 - val_ac
c: 0.7700
Epoch 626/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0157 - acc: 0.9857 - val_loss: 0.1448 - val_ac
c: 0.7660
Epoch 627/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0159 - acc: 0.9929 - val_loss: 0.1450 - val_ac
c: 0.7620
Epoch 628/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0156 - acc: 1.0000 - val_loss: 0.1478 - val_ac
c: 0.7560
Epoch 629/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0170 - acc: 0.9714 - val_loss: 0.1511 - val_ac
c: 0.7500
Epoch 630/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0185 - acc: 0.9571 - val_loss: 0.1512 - val_ac
c: 0.7400
Epoch 631/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0172 - acc: 0.9714 - val_loss: 0.1514 - val_ac
c: 0.7480
Epoch 632/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0175 - acc: 0.9786 - val_loss: 0.1523 - val_ac
c: 0.7500
Epoch 633/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0170 - acc: 0.9929 - val_loss: 0.1543 - val_ac
c: 0.7540
Epoch 634/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0160 - acc: 0.9929 - val_loss: 0.1557 - val_ac
c: 0.7580
Epoch 635/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0148 - acc: 1.0000 - val_loss: 0.1577 - val_ac
c: 0.7540
Epoch 636/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0166 - acc: 0.9714 - val_loss: 0.1563 - val_ac
c: 0.7600
Epoch 637/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0162 - acc: 0.9857 - val_loss: 0.1519 - val_ac
c: 0.7700
Epoch 638/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0176 - acc: 0.9643 - val_loss: 0.1486 - val_ac
c: 0.7640
Epoch 639/900
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1/1 [==============================] - 0s 170ms/step - loss: 0.0177 - acc: 0.9857 - val_loss: 0.1489 - val_ac
c: 0.7580
Epoch 640/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0162 - acc: 0.9929 - val_loss: 0.1484 - val_ac
c: 0.7520
Epoch 641/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0179 - acc: 0.9500 - val_loss: 0.1453 - val_ac
c: 0.7540
Epoch 642/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0181 - acc: 0.9643 - val_loss: 0.1432 - val_ac
c: 0.7640
Epoch 643/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1416 - val_ac
c: 0.7660
Epoch 644/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1424 - val_ac
c: 0.7740
Epoch 645/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0157 - acc: 0.9857 - val_loss: 0.1450 - val_ac
c: 0.7680
Epoch 646/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0152 - acc: 0.9929 - val_loss: 0.1478 - val_ac
c: 0.7680
Epoch 647/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0161 - acc: 0.9929 - val_loss: 0.1493 - val_ac
c: 0.7620
Epoch 648/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0147 - acc: 0.9857 - val_loss: 0.1477 - val_ac
c: 0.7660
Epoch 649/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0149 - acc: 0.9857 - val_loss: 0.1447 - val_ac
c: 0.7640
Epoch 650/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0176 - acc: 0.9643 - val_loss: 0.1409 - val_ac
c: 0.7680
Epoch 651/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0159 - acc: 0.9786 - val_loss: 0.1369 - val_ac
c: 0.7760
Epoch 652/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0164 - acc: 0.9571 - val_loss: 0.1336 - val_ac
c: 0.7720
Epoch 653/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0148 - acc: 0.9786 - val_loss: 0.1307 - val_ac
c: 0.7760
Epoch 654/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0143 - acc: 0.9929 - val_loss: 0.1292 - val_ac
c: 0.7780
Epoch 655/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0181 - acc: 0.9500 - val_loss: 0.1282 - val_ac
c: 0.7740
Epoch 656/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1273 - val_ac
c: 0.7720
Epoch 657/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1306 - val_ac
c: 0.7660
Epoch 658/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1343 - val_ac
c: 0.7640
Epoch 659/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0149 - acc: 0.9786 - val_loss: 0.1370 - val_ac
c: 0.7740
Epoch 660/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0187 - acc: 0.9643 - val_loss: 0.1403 - val_ac
c: 0.7700
Epoch 661/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0150 - acc: 0.9929 - val_loss: 0.1428 - val_ac
c: 0.7640
Epoch 662/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0151 - acc: 0.9857 - val_loss: 0.1431 - val_ac
c: 0.7680
```

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Epoch 663/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0141 - acc: 0.9857 - val_loss: 0.1407 - val_ac
c: 0.7680
Epoch 664/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0150 - acc: 0.9929 - val_loss: 0.1396 - val_ac
c: 0.7700
Epoch 665/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0156 - acc: 0.9786 - val_loss: 0.1396 - val_ac
c: 0.7700
Epoch 666/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0143 - acc: 0.9857 - val_loss: 0.1390 - val_ac
c: 0.7700
Epoch 667/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0166 - acc: 0.9714 - val_loss: 0.1380 - val_ac
c: 0.7700
Epoch 668/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0141 - acc: 0.9929 - val_loss: 0.1358 - val_ac
c: 0.7700
Epoch 669/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1354 - val_ac
c: 0.7680
Epoch 670/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0140 - acc: 0.9929 - val_loss: 0.1356 - val_ac
c: 0.7700
Epoch 671/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0174 - acc: 0.9643 - val_loss: 0.1360 - val_ac
c: 0.7740
Epoch 672/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0160 - acc: 0.9929 - val_loss: 0.1394 - val_ac
c: 0.7800
Epoch 673/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1428 - val_ac
c: 0.7700
Epoch 674/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0149 - acc: 0.9714 - val_loss: 0.1471 - val_ac
c: 0.7580
Epoch 675/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1498 - val_ac
c: 0.7540
Epoch 676/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0161 - acc: 0.9857 - val_loss: 0.1474 - val_ac
c: 0.7540
Epoch 677/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0135 - acc: 0.9929 - val_loss: 0.1418 - val_ac
c: 0.7660
Epoch 678/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0159 - acc: 0.9786 - val_loss: 0.1361 - val_ac
c: 0.7740
Epoch 679/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0139 - acc: 0.9929 - val_loss: 0.1308 - val_ac
c: 0.7880
Epoch 680/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0157 - acc: 0.9786 - val_loss: 0.1264 - val_ac
c: 0.7880
Epoch 681/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0137 - acc: 1.0000 - val_loss: 0.1251 - val_ac
c: 0.7980
Epoch 682/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0150 - acc: 1.0000 - val_loss: 0.1260 - val_ac
c: 0.8000
Epoch 683/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0147 - acc: 0.9857 - val_loss: 0.1271 - val_ac
c: 0.7920
Epoch 684/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0134 - acc: 0.9929 - val_loss: 0.1299 - val_ac
c: 0.7860
Epoch 685/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0153 - acc: 0.9929 - val_loss: 0.1356 - val_ac
c: 0.7760
Epoch 686/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0147 - acc: 0.9786 - val_loss: 0.1450 - val_ac
```

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c: 0.7540
Epoch 687/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0150 - acc: 0.9857 - val_loss: 0.1522 - val_ac
c: 0.7500
Epoch 688/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0126 - acc: 1.0000 - val_loss: 0.1567 - val_ac
c: 0.7440
Epoch 689/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1519 - val_ac
c: 0.7440
Epoch 690/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0172 - acc: 0.9571 - val_loss: 0.1459 - val_ac
c: 0.7500
Epoch 691/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0167 - acc: 0.9571 - val_loss: 0.1386 - val_ac
c: 0.7540
Epoch 692/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1357 - val_ac
c: 0.7620
Epoch 693/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0166 - acc: 0.9643 - val_loss: 0.1375 - val_ac
c: 0.7700
Epoch 694/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0136 - acc: 0.9786 - val_loss: 0.1402 - val_ac
c: 0.7680
Epoch 695/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1414 - val_ac
c: 0.7720
Epoch 696/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0148 - acc: 1.0000 - val_loss: 0.1412 - val_ac
c: 0.7720
Epoch 697/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0173 - acc: 0.9714 - val_loss: 0.1399 - val_ac
c: 0.7760
Epoch 698/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1399 - val_ac
c: 0.7780
Epoch 699/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0155 - acc: 1.0000 - val_loss: 0.1426 - val_ac
c: 0.7700
Epoch 700/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1462 - val_ac
c: 0.7740
Epoch 701/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0163 - acc: 0.9714 - val_loss: 0.1476 - val_ac
c: 0.7560
Epoch 702/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0163 - acc: 0.9929 - val_loss: 0.1479 - val_ac
c: 0.7540
Epoch 703/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1459 - val_ac
c: 0.7580
Epoch 704/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1412 - val_ac
c: 0.7680
Epoch 705/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0188 - acc: 0.9571 - val_loss: 0.1356 - val_ac
c: 0.7840
Epoch 706/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1342 - val_ac
c: 0.7880
Epoch 707/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0154 - acc: 0.9786 - val_loss: 0.1337 - val_ac
c: 0.7920
Epoch 708/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1340 - val_ac
c: 0.7920
Epoch 709/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0158 - acc: 0.9786 - val_loss: 0.1354 - val_ac
c: 0.7880
Epoch 710/900
```

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1/1 [==============================] - 0s 166ms/step - loss: 0.0190 - acc: 0.9643 - val_loss: 0.1381 - val_ac
c: 0.7820
Epoch 711/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0156 - acc: 1.0000 - val_loss: 0.1421 - val_ac
c: 0.7780
Epoch 712/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0174 - acc: 0.9643 - val_loss: 0.1463 - val_ac
c: 0.7660
Epoch 713/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0160 - acc: 0.9929 - val_loss: 0.1492 - val_ac
c: 0.7620
Epoch 714/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0153 - acc: 0.9857 - val_loss: 0.1473 - val_ac
c: 0.7660
Epoch 715/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0171 - acc: 0.9643 - val_loss: 0.1418 - val_ac
c: 0.7780
Epoch 716/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1371 - val_ac
c: 0.7820
Epoch 717/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0177 - acc: 0.9643 - val_loss: 0.1383 - val_ac
c: 0.7720
Epoch 718/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1413 - val_ac
c: 0.7780
Epoch 719/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0168 - acc: 0.9714 - val_loss: 0.1407 - val_ac
c: 0.7720
Epoch 720/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0160 - acc: 1.0000 - val_loss: 0.1390 - val_ac
c: 0.7740
Epoch 721/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0169 - acc: 0.9786 - val_loss: 0.1400 - val_ac
c: 0.7740
Epoch 722/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1480 - val_ac
c: 0.7540
Epoch 723/900
1/1 [==============================] - 0s 183ms/step - loss: 0.0152 - acc: 0.9857 - val_loss: 0.1586 - val_ac
c: 0.7420
Epoch 724/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0180 - acc: 0.9429 - val_loss: 0.1582 - val_ac
c: 0.7360
Epoch 725/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0182 - acc: 0.9643 - val_loss: 0.1535 - val_ac
c: 0.7520
Epoch 726/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1442 - val_ac
c: 0.7660
Epoch 727/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0158 - acc: 0.9929 - val_loss: 0.1380 - val_ac
c: 0.7780
Epoch 728/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1366 - val_ac
c: 0.7820
Epoch 729/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0183 - acc: 0.9786 - val_loss: 0.1390 - val_ac
c: 0.7800
Epoch 730/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1405 - val_ac
c: 0.7760
Epoch 731/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0149 - acc: 1.0000 - val_loss: 0.1442 - val_ac
c: 0.7620
Epoch 732/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0179 - acc: 0.9500 - val_loss: 0.1489 - val_ac
c: 0.7660
Epoch 733/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0156 - acc: 0.9929 - val_loss: 0.1507 - val_ac
c: 0.7580
```

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Epoch 734/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0153 - acc: 0.9929 - val_loss: 0.1508 - val_ac
c: 0.7540
Epoch 735/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0140 - acc: 1.0000 - val_loss: 0.1516 - val_ac
c: 0.7580
Epoch 736/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0179 - acc: 0.9500 - val_loss: 0.1485 - val_ac
c: 0.7620
Epoch 737/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0162 - acc: 0.9857 - val_loss: 0.1427 - val_ac
c: 0.7620
Epoch 738/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0152 - acc: 1.0000 - val_loss: 0.1391 - val_ac
c: 0.7760
Epoch 739/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1374 - val_ac
c: 0.7840
Epoch 740/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0184 - acc: 0.9500 - val_loss: 0.1378 - val_ac
c: 0.7860
Epoch 741/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1401 - val_ac
c: 0.7780
Epoch 742/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0140 - acc: 1.0000 - val_loss: 0.1429 - val_ac
c: 0.7700
Epoch 743/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0150 - acc: 0.9857 - val_loss: 0.1425 - val_ac
c: 0.7720
Epoch 744/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0169 - acc: 0.9643 - val_loss: 0.1437 - val_ac
c: 0.7720
Epoch 745/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0167 - acc: 0.9857 - val_loss: 0.1449 - val_ac
c: 0.7560
Epoch 746/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0158 - acc: 0.9571 - val_loss: 0.1455 - val_ac
c: 0.7600
Epoch 747/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1478 - val_ac
c: 0.7500
Epoch 748/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0166 - acc: 0.9643 - val_loss: 0.1466 - val_ac
c: 0.7540
Epoch 749/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0159 - acc: 0.9786 - val_loss: 0.1442 - val_ac
c: 0.7720
Epoch 750/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0166 - acc: 0.9929 - val_loss: 0.1414 - val_ac
c: 0.7740
Epoch 751/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0168 - acc: 0.9714 - val_loss: 0.1404 - val_ac
c: 0.7740
Epoch 752/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1362 - val_ac
c: 0.7820
Epoch 753/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0166 - acc: 0.9786 - val_loss: 0.1327 - val_ac
c: 0.7860
Epoch 754/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0153 - acc: 0.9857 - val_loss: 0.1318 - val_ac
c: 0.7880
Epoch 755/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1341 - val_ac
c: 0.7840
Epoch 756/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0154 - acc: 0.9929 - val_loss: 0.1368 - val_ac
c: 0.7900
Epoch 757/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0176 - acc: 0.9571 - val_loss: 0.1389 - val_ac
```

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c: 0.7800
Epoch 758/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1398 - val_ac
c: 0.7700
Epoch 759/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0198 - acc: 0.9500 - val_loss: 0.1395 - val_ac
c: 0.7600
Epoch 760/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0159 - acc: 0.9786 - val_loss: 0.1401 - val_ac
c: 0.7680
Epoch 761/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1424 - val_ac
c: 0.7720
Epoch 762/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0170 - acc: 0.9643 - val_loss: 0.1428 - val_ac
c: 0.7700
Epoch 763/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0165 - acc: 0.9786 - val_loss: 0.1422 - val_ac
c: 0.7760
Epoch 764/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0171 - acc: 0.9929 - val_loss: 0.1407 - val_ac
c: 0.7800
Epoch 765/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0176 - acc: 0.9500 - val_loss: 0.1397 - val_ac
c: 0.7880
Epoch 766/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0160 - acc: 0.9786 - val_loss: 0.1404 - val_ac
c: 0.7760
Epoch 767/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0140 - acc: 1.0000 - val_loss: 0.1426 - val_ac
c: 0.7620
Epoch 768/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0149 - acc: 0.9857 - val_loss: 0.1469 - val_ac
c: 0.7500
Epoch 769/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0171 - acc: 0.9857 - val_loss: 0.1523 - val_ac
c: 0.7460
Epoch 770/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0162 - acc: 0.9857 - val_loss: 0.1573 - val_ac
c: 0.7400
Epoch 771/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1575 - val_ac
c: 0.7420
Epoch 772/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0148 - acc: 1.0000 - val_loss: 0.1571 - val_ac
c: 0.7420
Epoch 773/900
1/1 [==============================] - 0s 185ms/step - loss: 0.0157 - acc: 0.9929 - val_loss: 0.1588 - val_ac
c: 0.7540
Epoch 774/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0167 - acc: 0.9714 - val_loss: 0.1612 - val_ac
c: 0.7480
Epoch 775/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0150 - acc: 0.9857 - val_loss: 0.1573 - val_ac
c: 0.7600
Epoch 776/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0168 - acc: 0.9643 - val_loss: 0.1499 - val_ac
c: 0.7700
Epoch 777/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0172 - acc: 0.9429 - val_loss: 0.1443 - val_ac
c: 0.7740
Epoch 778/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0148 - acc: 0.9929 - val_loss: 0.1424 - val_ac
c: 0.7680
Epoch 779/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0152 - acc: 0.9857 - val_loss: 0.1439 - val_ac
c: 0.7540
Epoch 780/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0160 - acc: 0.9857 - val_loss: 0.1422 - val_ac
c: 0.7560
Epoch 781/900
```

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1/1 [==============================] - 0s 169ms/step - loss: 0.0149 - acc: 0.9786 - val_loss: 0.1407 - val_ac
c: 0.7640
Epoch 782/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0136 - acc: 0.9929 - val_loss: 0.1400 - val_ac
c: 0.7640
Epoch 783/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1430 - val_ac
c: 0.7600
Epoch 784/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1461 - val_ac
c: 0.7620
Epoch 785/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0139 - acc: 1.0000 - val_loss: 0.1496 - val_ac
c: 0.7600
Epoch 786/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0157 - acc: 0.9786 - val_loss: 0.1519 - val_ac
c: 0.7560
Epoch 787/900
1/1 [==============================] - 0s 189ms/step - loss: 0.0135 - acc: 0.9929 - val_loss: 0.1546 - val_ac
c: 0.7580
Epoch 788/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1510 - val_ac
c: 0.7600
Epoch 789/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0145 - acc: 0.9929 - val_loss: 0.1486 - val_ac
c: 0.7600
Epoch 790/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1462 - val_ac
c: 0.7680
Epoch 791/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0147 - acc: 0.9929 - val_loss: 0.1425 - val_ac
c: 0.7700
Epoch 792/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0160 - acc: 0.9714 - val_loss: 0.1427 - val_ac
c: 0.7680
Epoch 793/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1463 - val_ac
c: 0.7700
Epoch 794/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0137 - acc: 0.9929 - val_loss: 0.1480 - val_ac
c: 0.7740
Epoch 795/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0166 - acc: 0.9571 - val_loss: 0.1458 - val_ac
c: 0.7800
Epoch 796/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0156 - acc: 0.9714 - val_loss: 0.1439 - val_ac
c: 0.7760
Epoch 797/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0166 - acc: 0.9857 - val_loss: 0.1461 - val_ac
c: 0.7720
Epoch 798/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0136 - acc: 0.9929 - val_loss: 0.1457 - val_ac
c: 0.7700
Epoch 799/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0162 - acc: 0.9714 - val_loss: 0.1461 - val_ac
c: 0.7740
Epoch 800/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0175 - acc: 0.9500 - val_loss: 0.1442 - val_ac
c: 0.7780
Epoch 801/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1464 - val_ac
c: 0.7680
Epoch 802/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0141 - acc: 0.9786 - val_loss: 0.1513 - val_ac
c: 0.7760
Epoch 803/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0143 - acc: 0.9857 - val_loss: 0.1545 - val_ac
c: 0.7680
Epoch 804/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0153 - acc: 1.0000 - val_loss: 0.1529 - val_ac
c: 0.7720
```

```
Epoch 805/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1489 - val_ac
c: 0.7760
Epoch 806/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0157 - acc: 0.9786 - val_loss: 0.1475 - val_ac
c: 0.7680
Epoch 807/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1453 - val_ac
c: 0.7600
Epoch 808/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1452 - val_ac
c: 0.7560
Epoch 809/900
1/1 [==============================] - 0s 192ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1461 - val_ac
c: 0.7540
Epoch 810/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0146 - acc: 1.0000 - val_loss: 0.1478 - val_ac
c: 0.7480
Epoch 811/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0160 - acc: 0.9643 - val_loss: 0.1460 - val_ac
c: 0.7500
Epoch 812/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0161 - acc: 0.9714 - val_loss: 0.1428 - val_ac
c: 0.7640
Epoch 813/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0145 - acc: 0.9786 - val_loss: 0.1413 - val_ac
c: 0.7640
Epoch 814/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0152 - acc: 0.9786 - val_loss: 0.1417 - val_ac
c: 0.7660
Epoch 815/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0178 - acc: 0.9643 - val_loss: 0.1449 - val_ac
c: 0.7740
Epoch 816/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0147 - acc: 0.9929 - val_loss: 0.1506 - val_ac
c: 0.7740
Epoch 817/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0152 - acc: 0.9786 - val_loss: 0.1529 - val_ac
c: 0.7740
Epoch 818/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0179 - acc: 0.9500 - val_loss: 0.1485 - val_ac
c: 0.7720
Epoch 819/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0150 - acc: 0.9714 - val_loss: 0.1445 - val_ac
c: 0.7740
Epoch 820/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0160 - acc: 0.9929 - val_loss: 0.1426 - val_ac
c: 0.7660
Epoch 821/900
1/1 [==============================] - 0s 198ms/step - loss: 0.0162 - acc: 0.9786 - val_loss: 0.1414 - val_ac
c: 0.7700
Epoch 822/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0151 - acc: 0.9857 - val_loss: 0.1402 - val_ac
c: 0.7680
Epoch 823/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0150 - acc: 0.9929 - val_loss: 0.1402 - val_ac
c: 0.7620
Epoch 824/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0166 - acc: 0.9643 - val_loss: 0.1448 - val_ac
c: 0.7620
Epoch 825/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0176 - acc: 0.9714 - val_loss: 0.1524 - val_ac
c: 0.7580
Epoch 826/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0165 - acc: 0.9857 - val_loss: 0.1566 - val_ac
c: 0.7580
Epoch 827/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0157 - acc: 0.9857 - val_loss: 0.1558 - val_ac
c: 0.7600
Epoch 828/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0159 - acc: 0.9714 - val_loss: 0.1508 - val_ac
```

```
c: 0.7660
Epoch 829/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0159 - acc: 0.9929 - val_loss: 0.1483 - val_ac
c: 0.7700
Epoch 830/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0147 - acc: 0.9786 - val_loss: 0.1494 - val_ac
c: 0.7740
Epoch 831/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1562 - val_ac
c: 0.7640
Epoch 832/900
1/1 [==============================] - 0s 182ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1599 - val_ac
c: 0.7560
Epoch 833/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0181 - acc: 0.9714 - val_loss: 0.1580 - val_ac
c: 0.7500
Epoch 834/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0159 - acc: 0.9786 - val_loss: 0.1554 - val_ac
c: 0.7560
Epoch 835/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0174 - acc: 0.9643 - val_loss: 0.1540 - val_ac
c: 0.7480
Epoch 836/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0167 - acc: 0.9714 - val_loss: 0.1554 - val_ac
c: 0.7480
Epoch 837/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0161 - acc: 1.0000 - val_loss: 0.1566 - val_ac
c: 0.7460
Epoch 838/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0187 - acc: 0.9643 - val_loss: 0.1574 - val_ac
c: 0.7360
Epoch 839/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0170 - acc: 0.9643 - val_loss: 0.1596 - val_ac
c: 0.7460
Epoch 840/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0155 - acc: 0.9857 - val_loss: 0.1588 - val_ac
c: 0.7440
Epoch 841/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0174 - acc: 0.9714 - val_loss: 0.1527 - val_ac
c: 0.7560
Epoch 842/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0159 - acc: 0.9857 - val_loss: 0.1444 - val_ac
c: 0.7700
Epoch 843/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0174 - acc: 0.9786 - val_loss: 0.1402 - val_ac
c: 0.7800
Epoch 844/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0147 - acc: 1.0000 - val_loss: 0.1403 - val_ac
c: 0.7740
Epoch 845/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0169 - acc: 0.9643 - val_loss: 0.1451 - val_ac
c: 0.7700
Epoch 846/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0155 - acc: 0.9929 - val_loss: 0.1492 - val_ac
c: 0.7700
Epoch 847/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0167 - acc: 0.9643 - val_loss: 0.1499 - val_ac
c: 0.7700
Epoch 848/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0156 - acc: 0.9714 - val_loss: 0.1512 - val_ac
c: 0.7580
Epoch 849/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0149 - acc: 0.9714 - val_loss: 0.1490 - val_ac
c: 0.7660
Epoch 850/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0165 - acc: 0.9857 - val_loss: 0.1461 - val_ac
c: 0.7620
Epoch 851/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0183 - acc: 0.9429 - val_loss: 0.1419 - val_ac
c: 0.7720
Epoch 852/900
```

```
1/1 [==============================] - 0s 172ms/step - loss: 0.0182 - acc: 0.9786 - val_loss: 0.1374 - val_ac
c: 0.7760
Epoch 853/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0164 - acc: 0.9929 - val_loss: 0.1360 - val_ac
c: 0.7700
Epoch 854/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1355 - val_ac
c: 0.7780
Epoch 855/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0168 - acc: 0.9643 - val_loss: 0.1381 - val_ac
c: 0.7740
Epoch 856/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0158 - acc: 0.9786 - val_loss: 0.1469 - val_ac
c: 0.7680
Epoch 857/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0142 - acc: 1.0000 - val_loss: 0.1529 - val_ac
c: 0.7520
Epoch 858/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0151 - acc: 0.9857 - val_loss: 0.1552 - val_ac
c: 0.7500
Epoch 859/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0172 - acc: 0.9643 - val_loss: 0.1526 - val_ac
c: 0.7600
Epoch 860/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0169 - acc: 0.9714 - val_loss: 0.1488 - val_ac
c: 0.7680
Epoch 861/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0163 - acc: 0.9857 - val_loss: 0.1462 - val_ac
c: 0.7780
Epoch 862/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0154 - acc: 0.9857 - val_loss: 0.1431 - val_ac
c: 0.7680
Epoch 863/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0153 - acc: 0.9929 - val_loss: 0.1391 - val_ac
c: 0.7720
Epoch 864/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0156 - acc: 0.9857 - val_loss: 0.1367 - val_ac
c: 0.7820
Epoch 865/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0173 - acc: 0.9643 - val_loss: 0.1410 - val_ac
c: 0.7800
Epoch 866/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0141 - acc: 0.9857 - val_loss: 0.1475 - val_ac
c: 0.7600
Epoch 867/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0167 - acc: 0.9786 - val_loss: 0.1516 - val_ac
c: 0.7520
Epoch 868/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0164 - acc: 0.9714 - val_loss: 0.1510 - val_ac
c: 0.7480
Epoch 869/900
1/1 [==============================] - 0s 181ms/step - loss: 0.0146 - acc: 0.9857 - val_loss: 0.1501 - val_ac
c: 0.7580
Epoch 870/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0150 - acc: 0.9857 - val_loss: 0.1520 - val_ac
c: 0.7600
Epoch 871/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0150 - acc: 0.9857 - val_loss: 0.1502 - val_ac
c: 0.7660
Epoch 872/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0152 - acc: 0.9857 - val_loss: 0.1453 - val_ac
c: 0.7720
Epoch 873/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0151 - acc: 1.0000 - val_loss: 0.1408 - val_ac
c: 0.7820
Epoch 874/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0149 - acc: 1.0000 - val_loss: 0.1400 - val_ac
c: 0.7700
Epoch 875/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0160 - acc: 0.9643 - val_loss: 0.1425 - val_ac
c: 0.7740
```

```
Epoch 876/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0149 - acc: 0.9929 - val_loss: 0.1443 - val_ac
c: 0.7640
Epoch 877/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0161 - acc: 0.9786 - val_loss: 0.1457 - val_ac
c: 0.7620
Epoch 878/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0152 - acc: 0.9857 - val_loss: 0.1488 - val_ac
c: 0.7640
Epoch 879/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0158 - acc: 0.9857 - val_loss: 0.1465 - val_ac
c: 0.7640
Epoch 880/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0145 - acc: 0.9929 - val_loss: 0.1406 - val_ac
c: 0.7720
Epoch 881/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0147 - acc: 0.9929 - val_loss: 0.1388 - val_ac
c: 0.7800
Epoch 882/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0147 - acc: 0.9714 - val_loss: 0.1386 - val_ac
c: 0.7880
Epoch 883/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0139 - acc: 0.9929 - val_loss: 0.1398 - val_ac
c: 0.7860
Epoch 884/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0146 - acc: 0.9786 - val_loss: 0.1416 - val_ac
c: 0.7780
Epoch 885/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0149 - acc: 0.9786 - val_loss: 0.1411 - val_ac
c: 0.7800
Epoch 886/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0144 - acc: 0.9786 - val_loss: 0.1389 - val_ac
c: 0.7780
Epoch 887/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0147 - acc: 0.9786 - val_loss: 0.1382 - val_ac
c: 0.7780
Epoch 888/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0137 - acc: 0.9857 - val_loss: 0.1396 - val_ac
c: 0.7680
Epoch 889/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0163 - acc: 0.9714 - val_loss: 0.1374 - val_ac
c: 0.7660
Epoch 890/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0152 - acc: 0.9857 - val_loss: 0.1324 - val_ac
c: 0.7800
Epoch 891/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0161 - acc: 0.9571 - val_loss: 0.1314 - val_ac
c: 0.7800
Epoch 892/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0138 - acc: 0.9929 - val_loss: 0.1328 - val_ac
c: 0.7780
Epoch 893/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0152 - acc: 0.9714 - val_loss: 0.1328 - val_ac
c: 0.7740
Epoch 894/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0152 - acc: 0.9643 - val_loss: 0.1326 - val_ac
c: 0.7800
Epoch 895/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0142 - acc: 0.9786 - val_loss: 0.1318 - val_ac
c: 0.7900
Epoch 896/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0165 - acc: 0.9714 - val_loss: 0.1371 - val_ac
c: 0.7840
Epoch 897/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0148 - acc: 0.9857 - val_loss: 0.1402 - val_ac
c: 0.7740
Epoch 898/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0155 - acc: 0.9714 - val_loss: 0.1431 - val_ac
c: 0.7740
Epoch 899/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0146 - acc: 0.9714 - val_loss: 0.1439 - val_ac
```

```
c: 0.7640
Epoch 900/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0164 - acc: 0.9857 - val_loss: 0.1419 - val_ac
c: 0.7600
```

Out[ ]: <tensorflow.python.keras.callbacks.History at 0x240941d9188>

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       0.75      0.71      0.73       114
    Genetic_Algorithms       0.89      0.87      0.88       156
       Neural_Networks       0.80      0.64      0.71       290
 Probabilistic_Methods       0.76      0.78      0.77       172
Reinforcement_Learning       0.51      0.85      0.63        85
         Rule_Learning       0.60      0.73      0.66        60
                Theory       0.64      0.62      0.63       123

              accuracy                           0.73      1000
             macro avg       0.71      0.74      0.72      1000
          weighted avg       0.75      0.73      0.73      1000
```

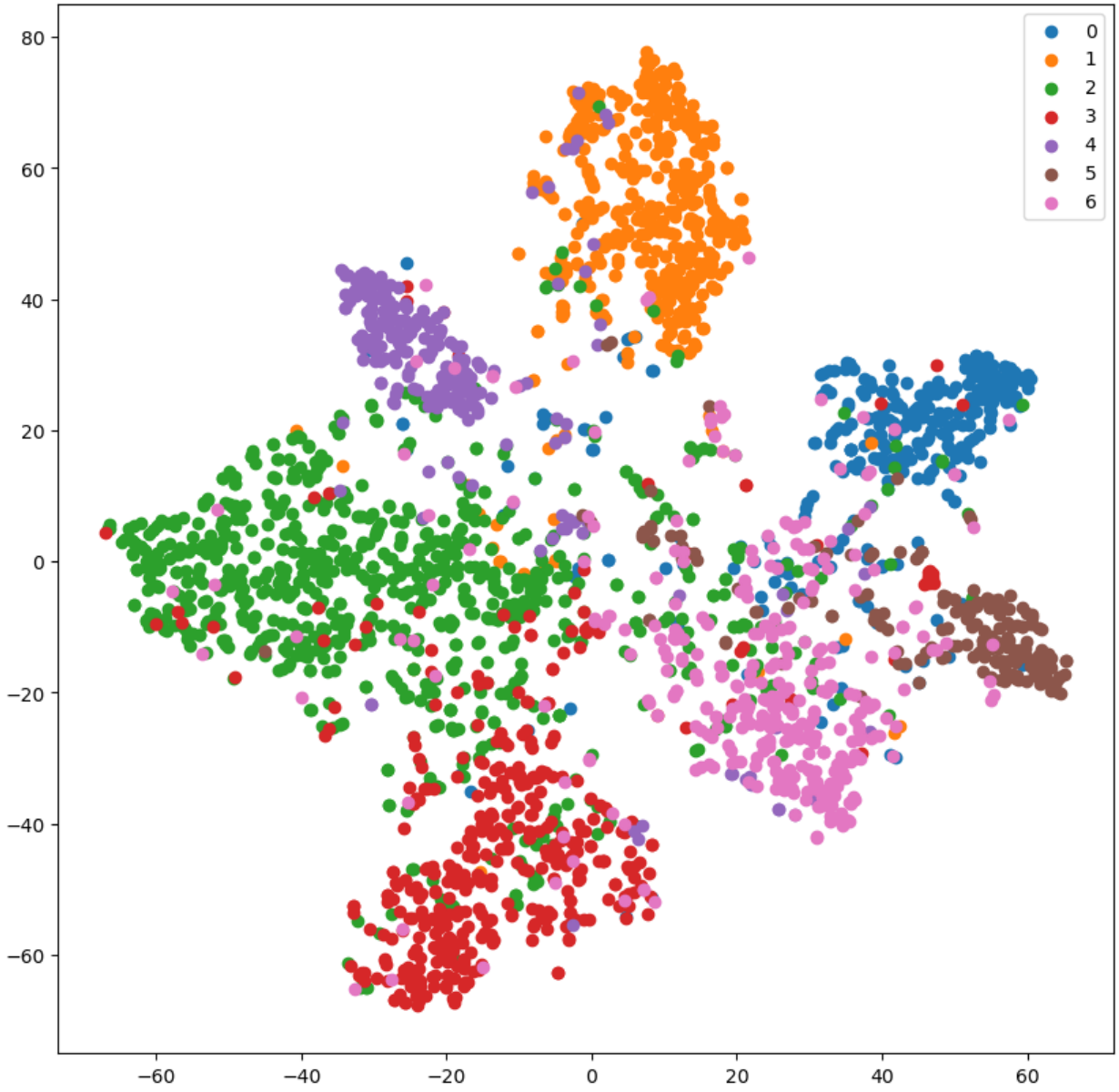
Get hidden layer representation for GCN

In [ ]:
```
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 [ ]:
```
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 = 450
optimizer = Adam(lr=1e-2)
l2_reg = 5e-4
epochs = 900

#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))
```

```
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 1/900
1/1 [==============================] - 0s 250ms/step - loss: 0.2177 - acc: 0.1643 - val_loss: 0.4334 - val_ac
c: 0.2800
Epoch 2/900
1/1 [==============================] - ETA: 0s - loss: 0.1736 - acc: 0.4429WARNING:tensorflow:Method (on_trai
n_batch_end) is slow compared to the batch update (0.137793). Check your callbacks.
1/1 [==============================] - 0s 170ms/step - loss: 0.1736 - acc: 0.4429 - val_loss: 0.3969 - val_ac
c: 0.4160
Epoch 3/900
1/1 [==============================] - 0s 173ms/step - loss: 0.1412 - acc: 0.5429 - val_loss: 0.3657 - val_ac
c: 0.4880
Epoch 4/900
1/1 [==============================] - 0s 172ms/step - loss: 0.1098 - acc: 0.7429 - val_loss: 0.3345 - val_ac
c: 0.5340
Epoch 5/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0850 - acc: 0.8214 - val_loss: 0.3062 - val_ac
c: 0.5500
Epoch 6/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0640 - acc: 0.8500 - val_loss: 0.2797 - val_ac
c: 0.5660
Epoch 7/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0522 - acc: 0.9000 - val_loss: 0.2715 - val_ac
c: 0.5640
Epoch 8/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0450 - acc: 0.9571 - val_loss: 0.2780 - val_ac
c: 0.5740
Epoch 9/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0423 - acc: 0.9643 - val_loss: 0.3029 - val_ac
c: 0.5440
Epoch 10/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0443 - acc: 0.9643 - val_loss: 0.3282 - val_ac
c: 0.5500
Epoch 11/900
1/1 [==============================] - 0s 185ms/step - loss: 0.0417 - acc: 0.9929 - val_loss: 0.3427 - val_ac
c: 0.5540
Epoch 12/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0411 - acc: 0.9929 - val_loss: 0.3601 - val_ac
c: 0.5520
Epoch 13/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0403 - acc: 0.9857 - val_loss: 0.3688 - val_ac
c: 0.5580
Epoch 14/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0378 - acc: 0.9929 - val_loss: 0.3821 - val_ac
c: 0.5720
Epoch 15/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0373 - acc: 0.9929 - val_loss: 0.4108 - val_ac
c: 0.5440
Epoch 16/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0354 - acc: 0.9786 - val_loss: 0.4038 - val_ac
c: 0.5540
Epoch 17/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0321 - acc: 0.9857 - val_loss: 0.4006 - val_ac
c: 0.5520
Epoch 18/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0300 - acc: 0.9714 - val_loss: 0.3888 - val_ac
c: 0.5680
Epoch 19/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0261 - acc: 1.0000 - val_loss: 0.3790 - val_ac
c: 0.5620
Epoch 20/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0237 - acc: 1.0000 - val_loss: 0.3672 - val_ac
c: 0.5660
Epoch 21/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0250 - acc: 0.9857 - val_loss: 0.3774 - val_ac
c: 0.5440
Epoch 22/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0243 - acc: 0.9714 - val_loss: 0.3975 - val_ac
c: 0.5360
Epoch 23/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0218 - acc: 0.9857 - val_loss: 0.4175 - val_ac
c: 0.5060
```

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Epoch 24/900
1/1 [==============================] - 0s 184ms/step - loss: 0.0214 - acc: 0.9786 - val_loss: 0.4166 - val_ac
c: 0.4780
Epoch 25/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0211 - acc: 0.9786 - val_loss: 0.4188 - val_ac
c: 0.4600
Epoch 26/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0214 - acc: 0.9857 - val_loss: 0.3970 - val_ac
c: 0.4860
Epoch 27/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0210 - acc: 0.9857 - val_loss: 0.3789 - val_ac
c: 0.4960
Epoch 28/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0205 - acc: 0.9857 - val_loss: 0.3748 - val_ac
c: 0.5040
Epoch 29/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0217 - acc: 0.9786 - val_loss: 0.3647 - val_ac
c: 0.5060
Epoch 30/900
1/1 [==============================] - 0s 199ms/step - loss: 0.0214 - acc: 0.9857 - val_loss: 0.3474 - val_ac
c: 0.5160
Epoch 31/900
1/1 [==============================] - 0s 217ms/step - loss: 0.0208 - acc: 0.9929 - val_loss: 0.3323 - val_ac
c: 0.5260
Epoch 32/900
1/1 [==============================] - 0s 242ms/step - loss: 0.0215 - acc: 0.9929 - val_loss: 0.3223 - val_ac
c: 0.5280
Epoch 33/900
1/1 [==============================] - 0s 234ms/step - loss: 0.0237 - acc: 0.9714 - val_loss: 0.3220 - val_ac
c: 0.5160
Epoch 34/900
1/1 [==============================] - 0s 258ms/step - loss: 0.0246 - acc: 0.9857 - val_loss: 0.3228 - val_ac
c: 0.5240
Epoch 35/900
1/1 [==============================] - 0s 290ms/step - loss: 0.0241 - acc: 0.9857 - val_loss: 0.3311 - val_ac
c: 0.5240
Epoch 36/900
1/1 [==============================] - 0s 296ms/step - loss: 0.0225 - acc: 0.9857 - val_loss: 0.3363 - val_ac
c: 0.5200
Epoch 37/900
1/1 [==============================] - 0s 219ms/step - loss: 0.0215 - acc: 1.0000 - val_loss: 0.3381 - val_ac
c: 0.5180
Epoch 38/900
1/1 [==============================] - 0s 225ms/step - loss: 0.0229 - acc: 0.9857 - val_loss: 0.3392 - val_ac
c: 0.5140
Epoch 39/900
1/1 [==============================] - 0s 213ms/step - loss: 0.0229 - acc: 0.9857 - val_loss: 0.3322 - val_ac
c: 0.5360
Epoch 40/900
1/1 [==============================] - 0s 239ms/step - loss: 0.0225 - acc: 0.9857 - val_loss: 0.3231 - val_ac
c: 0.5420
Epoch 41/900
1/1 [==============================] - 0s 221ms/step - loss: 0.0226 - acc: 0.9857 - val_loss: 0.3210 - val_ac
c: 0.5440
Epoch 42/900
1/1 [==============================] - 0s 231ms/step - loss: 0.0219 - acc: 0.9857 - val_loss: 0.3221 - val_ac
c: 0.5460
Epoch 43/900
1/1 [==============================] - 0s 275ms/step - loss: 0.0220 - acc: 0.9786 - val_loss: 0.3251 - val_ac
c: 0.5320
Epoch 44/900
1/1 [==============================] - 0s 229ms/step - loss: 0.0213 - acc: 0.9786 - val_loss: 0.3361 - val_ac
c: 0.5120
Epoch 45/900
1/1 [==============================] - 0s 218ms/step - loss: 0.0201 - acc: 0.9929 - val_loss: 0.3523 - val_ac
c: 0.4900
Epoch 46/900
1/1 [==============================] - 0s 268ms/step - loss: 0.0201 - acc: 0.9857 - val_loss: 0.3754 - val_ac
c: 0.4820
Epoch 47/900
1/1 [==============================] - 0s 237ms/step - loss: 0.0193 - acc: 0.9929 - val_loss: 0.3956 - val_ac
```

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c: 0.4700
Epoch 48/900
1/1 [==============================] - 0s 222ms/step - loss: 0.0215 - acc: 0.9786 - val_loss: 0.4050 - val_ac
c: 0.4660
Epoch 49/900
1/1 [==============================] - 0s 221ms/step - loss: 0.0188 - acc: 1.0000 - val_loss: 0.4081 - val_ac
c: 0.4560
Epoch 50/900
1/1 [==============================] - 0s 248ms/step - loss: 0.0194 - acc: 0.9786 - val_loss: 0.4021 - val_ac
c: 0.4660
Epoch 51/900
1/1 [==============================] - 0s 242ms/step - loss: 0.0180 - acc: 1.0000 - val_loss: 0.3999 - val_ac
c: 0.4740
Epoch 52/900
1/1 [==============================] - 0s 221ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.3913 - val_ac
c: 0.4840
Epoch 53/900
1/1 [==============================] - 0s 225ms/step - loss: 0.0184 - acc: 0.9929 - val_loss: 0.3787 - val_ac
c: 0.4880
Epoch 54/900
1/1 [==============================] - 0s 214ms/step - loss: 0.0209 - acc: 0.9786 - val_loss: 0.3649 - val_ac
c: 0.4980
Epoch 55/900
1/1 [==============================] - 0s 204ms/step - loss: 0.0184 - acc: 0.9857 - val_loss: 0.3625 - val_ac
c: 0.5000
Epoch 56/900
1/1 [==============================] - 0s 235ms/step - loss: 0.0194 - acc: 0.9857 - val_loss: 0.3584 - val_ac
c: 0.5100
Epoch 57/900
1/1 [==============================] - 0s 245ms/step - loss: 0.0190 - acc: 0.9857 - val_loss: 0.3539 - val_ac
c: 0.5180
Epoch 58/900
1/1 [==============================] - 0s 192ms/step - loss: 0.0183 - acc: 0.9929 - val_loss: 0.3526 - val_ac
c: 0.5140
Epoch 59/900
1/1 [==============================] - 0s 210ms/step - loss: 0.0186 - acc: 0.9929 - val_loss: 0.3544 - val_ac
c: 0.5160
Epoch 60/900
1/1 [==============================] - 0s 213ms/step - loss: 0.0191 - acc: 0.9857 - val_loss: 0.3630 - val_ac
c: 0.5020
Epoch 61/900
1/1 [==============================] - 0s 235ms/step - loss: 0.0202 - acc: 0.9857 - val_loss: 0.3699 - val_ac
c: 0.5080
Epoch 62/900
1/1 [==============================] - 0s 203ms/step - loss: 0.0207 - acc: 0.9786 - val_loss: 0.3696 - val_ac
c: 0.5140
Epoch 63/900
1/1 [==============================] - 0s 195ms/step - loss: 0.0185 - acc: 1.0000 - val_loss: 0.3675 - val_ac
c: 0.5140
Epoch 64/900
1/1 [==============================] - 0s 186ms/step - loss: 0.0198 - acc: 0.9857 - val_loss: 0.3553 - val_ac
c: 0.5260
Epoch 65/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0194 - acc: 0.9929 - val_loss: 0.3526 - val_ac
c: 0.5160
Epoch 66/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0225 - acc: 0.9643 - val_loss: 0.3539 - val_ac
c: 0.5100
Epoch 67/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0210 - acc: 0.9786 - val_loss: 0.3630 - val_ac
c: 0.5040
Epoch 68/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0199 - acc: 0.9929 - val_loss: 0.3658 - val_ac
c: 0.5040
Epoch 69/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0199 - acc: 0.9929 - val_loss: 0.3691 - val_ac
c: 0.5020
Epoch 70/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0215 - acc: 0.9714 - val_loss: 0.3770 - val_ac
c: 0.4900
Epoch 71/900
```

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1/1 [==============================] - 0s 171ms/step - loss: 0.0234 - acc: 0.9714 - val_loss: 0.3879 - val_ac
c: 0.4780
Epoch 72/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0215 - acc: 0.9786 - val_loss: 0.4020 - val_ac
c: 0.4900
Epoch 73/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0250 - acc: 0.9643 - val_loss: 0.4008 - val_ac
c: 0.4980
Epoch 74/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0202 - acc: 0.9929 - val_loss: 0.4069 - val_ac
c: 0.4940
Epoch 75/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0208 - acc: 1.0000 - val_loss: 0.4065 - val_ac
c: 0.5060
Epoch 76/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0224 - acc: 0.9857 - val_loss: 0.3983 - val_ac
c: 0.5120
Epoch 77/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0214 - acc: 1.0000 - val_loss: 0.3780 - val_ac
c: 0.5200
Epoch 78/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0219 - acc: 0.9929 - val_loss: 0.3567 - val_ac
c: 0.5340
Epoch 79/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0225 - acc: 0.9929 - val_loss: 0.3490 - val_ac
c: 0.5440
Epoch 80/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0239 - acc: 0.9714 - val_loss: 0.3492 - val_ac
c: 0.5360
Epoch 81/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0245 - acc: 0.9857 - val_loss: 0.3569 - val_ac
c: 0.5220
Epoch 82/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0264 - acc: 0.9786 - val_loss: 0.3821 - val_ac
c: 0.5040
Epoch 83/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0253 - acc: 0.9714 - val_loss: 0.3934 - val_ac
c: 0.4960
Epoch 84/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0235 - acc: 0.9857 - val_loss: 0.4059 - val_ac
c: 0.4920
Epoch 85/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0243 - acc: 0.9786 - val_loss: 0.4168 - val_ac
c: 0.4880
Epoch 86/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0245 - acc: 0.9857 - val_loss: 0.4185 - val_ac
c: 0.4760
Epoch 87/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0265 - acc: 0.9643 - val_loss: 0.3923 - val_ac
c: 0.5020
Epoch 88/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0240 - acc: 0.9929 - val_loss: 0.3747 - val_ac
c: 0.5100
Epoch 89/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0264 - acc: 0.9786 - val_loss: 0.3647 - val_ac
c: 0.5180
Epoch 90/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0239 - acc: 1.0000 - val_loss: 0.3654 - val_ac
c: 0.5360
Epoch 91/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0273 - acc: 0.9786 - val_loss: 0.3658 - val_ac
c: 0.5460
Epoch 92/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0284 - acc: 0.9643 - val_loss: 0.3661 - val_ac
c: 0.5380
Epoch 93/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0255 - acc: 0.9929 - val_loss: 0.3715 - val_ac
c: 0.5240
Epoch 94/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0279 - acc: 0.9643 - val_loss: 0.3790 - val_ac
c: 0.5140
```

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Epoch 95/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0257 - acc: 0.9929 - val_loss: 0.3862 - val_ac
c: 0.5060
Epoch 96/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0274 - acc: 0.9929 - val_loss: 0.3928 - val_ac
c: 0.5100
Epoch 97/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0279 - acc: 0.9857 - val_loss: 0.3890 - val_ac
c: 0.5140
Epoch 98/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0300 - acc: 0.9643 - val_loss: 0.3844 - val_ac
c: 0.5180
Epoch 99/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0284 - acc: 0.9786 - val_loss: 0.3882 - val_ac
c: 0.5220
Epoch 100/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0318 - acc: 0.9786 - val_loss: 0.3827 - val_ac
c: 0.5360
Epoch 101/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0306 - acc: 0.9786 - val_loss: 0.3751 - val_ac
c: 0.5420
Epoch 102/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0336 - acc: 0.9714 - val_loss: 0.3776 - val_ac
c: 0.5500
Epoch 103/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0295 - acc: 0.9929 - val_loss: 0.3779 - val_ac
c: 0.5500
Epoch 104/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0293 - acc: 0.9929 - val_loss: 0.3824 - val_ac
c: 0.5440
Epoch 105/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0327 - acc: 0.9643 - val_loss: 0.3953 - val_ac
c: 0.5280
Epoch 106/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0312 - acc: 0.9786 - val_loss: 0.4002 - val_ac
c: 0.5180
Epoch 107/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0299 - acc: 0.9786 - val_loss: 0.4096 - val_ac
c: 0.5020
Epoch 108/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0315 - acc: 0.9714 - val_loss: 0.4031 - val_ac
c: 0.4980
Epoch 109/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0329 - acc: 0.9929 - val_loss: 0.3929 - val_ac
c: 0.5060
Epoch 110/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0317 - acc: 0.9786 - val_loss: 0.3881 - val_ac
c: 0.5220
Epoch 111/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0309 - acc: 0.9643 - val_loss: 0.3872 - val_ac
c: 0.5280
Epoch 112/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0301 - acc: 0.9929 - val_loss: 0.3874 - val_ac
c: 0.5260
Epoch 113/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0295 - acc: 0.9929 - val_loss: 0.3896 - val_ac
c: 0.5340
Epoch 114/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0304 - acc: 0.9857 - val_loss: 0.3917 - val_ac
c: 0.5400
Epoch 115/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0307 - acc: 0.9857 - val_loss: 0.3957 - val_ac
c: 0.5320
Epoch 116/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0284 - acc: 1.0000 - val_loss: 0.3984 - val_ac
c: 0.5360
Epoch 117/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0297 - acc: 0.9857 - val_loss: 0.3945 - val_ac
c: 0.5420
Epoch 118/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0310 - acc: 0.9786 - val_loss: 0.3952 - val_ac
```

```
c: 0.5500
Epoch 119/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0312 - acc: 0.9857 - val_loss: 0.4055 - val_ac
c: 0.5440
Epoch 120/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0290 - acc: 0.9929 - val_loss: 0.4189 - val_ac
c: 0.5300
Epoch 121/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0281 - acc: 0.9857 - val_loss: 0.4258 - val_ac
c: 0.5260
Epoch 122/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0280 - acc: 0.9929 - val_loss: 0.4223 - val_ac
c: 0.5320
Epoch 123/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0309 - acc: 0.9786 - val_loss: 0.4058 - val_ac
c: 0.5420
Epoch 124/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0283 - acc: 0.9929 - val_loss: 0.3981 - val_ac
c: 0.5520
Epoch 125/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0269 - acc: 0.9857 - val_loss: 0.3937 - val_ac
c: 0.5700
Epoch 126/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0264 - acc: 0.9929 - val_loss: 0.3928 - val_ac
c: 0.5560
Epoch 127/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0264 - acc: 0.9857 - val_loss: 0.3969 - val_ac
c: 0.5560
Epoch 128/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0267 - acc: 0.9786 - val_loss: 0.3981 - val_ac
c: 0.5500
Epoch 129/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0251 - acc: 0.9929 - val_loss: 0.4032 - val_ac
c: 0.5560
Epoch 130/900
1/1 [==============================] - 0s 189ms/step - loss: 0.0289 - acc: 0.9714 - val_loss: 0.4002 - val_ac
c: 0.5560
Epoch 131/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0290 - acc: 0.9714 - val_loss: 0.4056 - val_ac
c: 0.5520
Epoch 132/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0259 - acc: 0.9857 - val_loss: 0.4136 - val_ac
c: 0.5420
Epoch 133/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0248 - acc: 1.0000 - val_loss: 0.4212 - val_ac
c: 0.5420
Epoch 134/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0272 - acc: 0.9857 - val_loss: 0.4297 - val_ac
c: 0.5440
Epoch 135/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0274 - acc: 0.9786 - val_loss: 0.4276 - val_ac
c: 0.5240
Epoch 136/900
1/1 [==============================] - 0s 185ms/step - loss: 0.0287 - acc: 0.9714 - val_loss: 0.4439 - val_ac
c: 0.5080
Epoch 137/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0284 - acc: 0.9786 - val_loss: 0.4522 - val_ac
c: 0.5020
Epoch 138/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0278 - acc: 0.9857 - val_loss: 0.4427 - val_ac
c: 0.5000
Epoch 139/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0295 - acc: 0.9786 - val_loss: 0.4390 - val_ac
c: 0.4940
Epoch 140/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0284 - acc: 0.9786 - val_loss: 0.4285 - val_ac
c: 0.4980
Epoch 141/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0296 - acc: 0.9857 - val_loss: 0.4174 - val_ac
c: 0.5100
Epoch 142/900
```

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1/1 [==============================] - 0s 163ms/step - loss: 0.0290 - acc: 0.9786 - val_loss: 0.4122 - val_ac
c: 0.5160
Epoch 143/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0316 - acc: 0.9643 - val_loss: 0.4002 - val_ac
c: 0.5260
Epoch 144/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0295 - acc: 0.9857 - val_loss: 0.3971 - val_ac
c: 0.5180
Epoch 145/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0310 - acc: 0.9857 - val_loss: 0.3928 - val_ac
c: 0.5340
Epoch 146/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0343 - acc: 0.9857 - val_loss: 0.3879 - val_ac
c: 0.5360
Epoch 147/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0347 - acc: 0.9643 - val_loss: 0.3826 - val_ac
c: 0.5300
Epoch 148/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0331 - acc: 0.9929 - val_loss: 0.3802 - val_ac
c: 0.5200
Epoch 149/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0329 - acc: 0.9857 - val_loss: 0.3781 - val_ac
c: 0.5240
Epoch 150/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0321 - acc: 1.0000 - val_loss: 0.3791 - val_ac
c: 0.5240
Epoch 151/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0345 - acc: 0.9786 - val_loss: 0.3832 - val_ac
c: 0.5160
Epoch 152/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0339 - acc: 0.9857 - val_loss: 0.3873 - val_ac
c: 0.5040
Epoch 153/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0341 - acc: 0.9714 - val_loss: 0.3868 - val_ac
c: 0.5020
Epoch 154/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0338 - acc: 0.9857 - val_loss: 0.3928 - val_ac
c: 0.5000
Epoch 155/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0351 - acc: 0.9786 - val_loss: 0.3943 - val_ac
c: 0.5080
Epoch 156/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0349 - acc: 0.9643 - val_loss: 0.3943 - val_ac
c: 0.5140
Epoch 157/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0374 - acc: 0.9500 - val_loss: 0.3834 - val_ac
c: 0.5100
Epoch 158/900
1/1 [==============================] - 0s 202ms/step - loss: 0.0336 - acc: 0.9857 - val_loss: 0.3752 - val_ac
c: 0.5260
Epoch 159/900
1/1 [==============================] - 0s 191ms/step - loss: 0.0357 - acc: 0.9857 - val_loss: 0.3751 - val_ac
c: 0.5320
Epoch 160/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0340 - acc: 0.9786 - val_loss: 0.3772 - val_ac
c: 0.5400
Epoch 161/900
1/1 [==============================] - 0s 192ms/step - loss: 0.0391 - acc: 0.9643 - val_loss: 0.3771 - val_ac
c: 0.5400
Epoch 162/900
1/1 [==============================] - 0s 192ms/step - loss: 0.0336 - acc: 0.9857 - val_loss: 0.3746 - val_ac
c: 0.5580
Epoch 163/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0372 - acc: 0.9714 - val_loss: 0.3757 - val_ac
c: 0.5660
Epoch 164/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0348 - acc: 0.9786 - val_loss: 0.3769 - val_ac
c: 0.5720
Epoch 165/900
1/1 [==============================] - 0s 190ms/step - loss: 0.0345 - acc: 0.9786 - val_loss: 0.3797 - val_ac
c: 0.5720
```

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Epoch 166/900
1/1 [==============================] - 0s 190ms/step - loss: 0.0342 - acc: 0.9857 - val_loss: 0.3795 - val_ac
c: 0.5780
Epoch 167/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0365 - acc: 0.9786 - val_loss: 0.3789 - val_ac
c: 0.5640
Epoch 168/900
1/1 [==============================] - 0s 184ms/step - loss: 0.0379 - acc: 0.9714 - val_loss: 0.3807 - val_ac
c: 0.5340
Epoch 169/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0347 - acc: 0.9857 - val_loss: 0.3842 - val_ac
c: 0.5300
Epoch 170/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0352 - acc: 0.9786 - val_loss: 0.3864 - val_ac
c: 0.5320
Epoch 171/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0350 - acc: 0.9929 - val_loss: 0.3855 - val_ac
c: 0.5400
Epoch 172/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0378 - acc: 0.9786 - val_loss: 0.3904 - val_ac
c: 0.5200
Epoch 173/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0359 - acc: 0.9786 - val_loss: 0.3921 - val_ac
c: 0.5260
Epoch 174/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0367 - acc: 0.9571 - val_loss: 0.3813 - val_ac
c: 0.5220
Epoch 175/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0337 - acc: 1.0000 - val_loss: 0.3730 - val_ac
c: 0.5300
Epoch 176/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0338 - acc: 0.9929 - val_loss: 0.3732 - val_ac
c: 0.5240
Epoch 177/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0350 - acc: 0.9929 - val_loss: 0.3750 - val_ac
c: 0.5180
Epoch 178/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0394 - acc: 0.9714 - val_loss: 0.3657 - val_ac
c: 0.5300
Epoch 179/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0384 - acc: 0.9571 - val_loss: 0.3641 - val_ac
c: 0.5320
Epoch 180/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0333 - acc: 0.9857 - val_loss: 0.3609 - val_ac
c: 0.5320
Epoch 181/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0367 - acc: 0.9643 - val_loss: 0.3604 - val_ac
c: 0.5300
Epoch 182/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0324 - acc: 0.9929 - val_loss: 0.3607 - val_ac
c: 0.5320
Epoch 183/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0380 - acc: 0.9643 - val_loss: 0.3592 - val_ac
c: 0.5280
Epoch 184/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0330 - acc: 0.9929 - val_loss: 0.3599 - val_ac
c: 0.5360
Epoch 185/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0362 - acc: 0.9643 - val_loss: 0.3616 - val_ac
c: 0.5240
Epoch 186/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0332 - acc: 0.9714 - val_loss: 0.3586 - val_ac
c: 0.5300
Epoch 187/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0335 - acc: 0.9857 - val_loss: 0.3683 - val_ac
c: 0.5300
Epoch 188/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0342 - acc: 0.9929 - val_loss: 0.3827 - val_ac
c: 0.5120
Epoch 189/900
1/1 [==============================] - 0s 215ms/step - loss: 0.0348 - acc: 0.9714 - val_loss: 0.3878 - val_ac
```

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c: 0.5180
Epoch 190/900
1/1 [==============================] - 0s 182ms/step - loss: 0.0346 - acc: 0.9786 - val_loss: 0.3922 - val_ac
c: 0.5200
Epoch 191/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0335 - acc: 0.9786 - val_loss: 0.4004 - val_ac
c: 0.5260
Epoch 192/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0353 - acc: 0.9714 - val_loss: 0.3967 - val_ac
c: 0.5300
Epoch 193/900
1/1 [==============================] - 0s 201ms/step - loss: 0.0352 - acc: 0.9643 - val_loss: 0.3801 - val_ac
c: 0.5180
Epoch 194/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0321 - acc: 1.0000 - val_loss: 0.3742 - val_ac
c: 0.5320
Epoch 195/900
1/1 [==============================] - 0s 181ms/step - loss: 0.0341 - acc: 0.9929 - val_loss: 0.3770 - val_ac
c: 0.5280
Epoch 196/900
1/1 [==============================] - 0s 182ms/step - loss: 0.0335 - acc: 0.9857 - val_loss: 0.3875 - val_ac
c: 0.5380
Epoch 197/900
1/1 [==============================] - 0s 214ms/step - loss: 0.0339 - acc: 0.9857 - val_loss: 0.4005 - val_ac
c: 0.5260
Epoch 198/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0358 - acc: 0.9571 - val_loss: 0.4089 - val_ac
c: 0.5160
Epoch 199/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0343 - acc: 0.9786 - val_loss: 0.4179 - val_ac
c: 0.5120
Epoch 200/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0366 - acc: 0.9857 - val_loss: 0.4267 - val_ac
c: 0.4960
Epoch 201/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0378 - acc: 0.9714 - val_loss: 0.4320 - val_ac
c: 0.4920
Epoch 202/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0387 - acc: 0.9786 - val_loss: 0.4201 - val_ac
c: 0.5020
Epoch 203/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0371 - acc: 0.9643 - val_loss: 0.3983 - val_ac
c: 0.5160
Epoch 204/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0366 - acc: 0.9643 - val_loss: 0.3750 - val_ac
c: 0.5380
Epoch 205/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0342 - acc: 0.9929 - val_loss: 0.3659 - val_ac
c: 0.5520
Epoch 206/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0378 - acc: 0.9571 - val_loss: 0.3668 - val_ac
c: 0.5440
Epoch 207/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0339 - acc: 0.9929 - val_loss: 0.3677 - val_ac
c: 0.5440
Epoch 208/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0355 - acc: 0.9857 - val_loss: 0.3698 - val_ac
c: 0.5480
Epoch 209/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0379 - acc: 0.9571 - val_loss: 0.3656 - val_ac
c: 0.5460
Epoch 210/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0355 - acc: 0.9857 - val_loss: 0.3610 - val_ac
c: 0.5380
Epoch 211/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0391 - acc: 0.9714 - val_loss: 0.3540 - val_ac
c: 0.5520
Epoch 212/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0409 - acc: 0.9571 - val_loss: 0.3582 - val_ac
c: 0.5500
Epoch 213/900
```

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1/1 [==============================] - 0s 171ms/step - loss: 0.0427 - acc: 0.9500 - val_loss: 0.3557 - val_ac
c: 0.5500
Epoch 214/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0393 - acc: 0.9643 - val_loss: 0.3599 - val_ac
c: 0.5380
Epoch 215/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0380 - acc: 0.9714 - val_loss: 0.3798 - val_ac
c: 0.5140
Epoch 216/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0387 - acc: 0.9714 - val_loss: 0.4063 - val_ac
c: 0.4800
Epoch 217/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0401 - acc: 0.9571 - val_loss: 0.4105 - val_ac
c: 0.4700
Epoch 218/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0383 - acc: 0.9786 - val_loss: 0.4103 - val_ac
c: 0.4720
Epoch 219/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0370 - acc: 0.9786 - val_loss: 0.4132 - val_ac
c: 0.4780
Epoch 220/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0407 - acc: 0.9571 - val_loss: 0.4065 - val_ac
c: 0.4880
Epoch 221/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0396 - acc: 0.9857 - val_loss: 0.4033 - val_ac
c: 0.5040
Epoch 222/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0387 - acc: 0.9857 - val_loss: 0.3994 - val_ac
c: 0.5220
Epoch 223/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0424 - acc: 0.9500 - val_loss: 0.3956 - val_ac
c: 0.5200
Epoch 224/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0472 - acc: 0.9357 - val_loss: 0.3927 - val_ac
c: 0.5200
Epoch 225/900
1/1 [==============================] - 0s 192ms/step - loss: 0.0384 - acc: 0.9929 - val_loss: 0.3962 - val_ac
c: 0.5200
Epoch 226/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0400 - acc: 0.9786 - val_loss: 0.4011 - val_ac
c: 0.5180
Epoch 227/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0437 - acc: 0.9571 - val_loss: 0.4086 - val_ac
c: 0.5120
Epoch 228/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0445 - acc: 0.9643 - val_loss: 0.4236 - val_ac
c: 0.4940
Epoch 229/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0500 - acc: 0.9500 - val_loss: 0.4426 - val_ac
c: 0.4960
Epoch 230/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0422 - acc: 0.9714 - val_loss: 0.4539 - val_ac
c: 0.4920
Epoch 231/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0446 - acc: 0.9643 - val_loss: 0.4551 - val_ac
c: 0.4980
Epoch 232/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0467 - acc: 0.9714 - val_loss: 0.4523 - val_ac
c: 0.5000
Epoch 233/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0427 - acc: 0.9857 - val_loss: 0.4537 - val_ac
c: 0.5000
Epoch 234/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0445 - acc: 0.9786 - val_loss: 0.4538 - val_ac
c: 0.4980
Epoch 235/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0457 - acc: 0.9786 - val_loss: 0.4549 - val_ac
c: 0.5060
Epoch 236/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0472 - acc: 0.9571 - val_loss: 0.4483 - val_ac
c: 0.5100
```

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Epoch 237/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0475 - acc: 0.9714 - val_loss: 0.4421 - val_ac
c: 0.5180
Epoch 238/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0445 - acc: 0.9714 - val_loss: 0.4323 - val_ac
c: 0.5220
Epoch 239/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0460 - acc: 0.9714 - val_loss: 0.4271 - val_ac
c: 0.5300
Epoch 240/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0538 - acc: 0.9286 - val_loss: 0.4211 - val_ac
c: 0.5340
Epoch 241/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0480 - acc: 0.9714 - val_loss: 0.4095 - val_ac
c: 0.5360
Epoch 242/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0434 - acc: 0.9786 - val_loss: 0.4029 - val_ac
c: 0.5300
Epoch 243/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0461 - acc: 0.9714 - val_loss: 0.3952 - val_ac
c: 0.5380
Epoch 244/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0454 - acc: 0.9643 - val_loss: 0.3976 - val_ac
c: 0.5380
Epoch 245/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0427 - acc: 0.9786 - val_loss: 0.3996 - val_ac
c: 0.5240
Epoch 246/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0426 - acc: 0.9857 - val_loss: 0.4027 - val_ac
c: 0.5180
Epoch 247/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0433 - acc: 0.9714 - val_loss: 0.4030 - val_ac
c: 0.5120
Epoch 248/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0442 - acc: 0.9643 - val_loss: 0.3933 - val_ac
c: 0.5040
Epoch 249/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0434 - acc: 0.9857 - val_loss: 0.3848 - val_ac
c: 0.5080
Epoch 250/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0468 - acc: 0.9643 - val_loss: 0.3824 - val_ac
c: 0.5100
Epoch 251/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0474 - acc: 0.9571 - val_loss: 0.3847 - val_ac
c: 0.4980
Epoch 252/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0425 - acc: 0.9786 - val_loss: 0.3880 - val_ac
c: 0.4980
Epoch 253/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0405 - acc: 0.9857 - val_loss: 0.3956 - val_ac
c: 0.4860
Epoch 254/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0412 - acc: 0.9714 - val_loss: 0.4044 - val_ac
c: 0.4840
Epoch 255/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0420 - acc: 0.9714 - val_loss: 0.4140 - val_ac
c: 0.4860
Epoch 256/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0420 - acc: 0.9857 - val_loss: 0.4202 - val_ac
c: 0.4720
Epoch 257/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0410 - acc: 0.9714 - val_loss: 0.4196 - val_ac
c: 0.4740
Epoch 258/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0424 - acc: 0.9714 - val_loss: 0.4132 - val_ac
c: 0.4700
Epoch 259/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0378 - acc: 0.9929 - val_loss: 0.4147 - val_ac
c: 0.4820
Epoch 260/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0383 - acc: 0.9714 - val_loss: 0.4182 - val_ac
```

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c: 0.4960
Epoch 261/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0398 - acc: 0.9571 - val_loss: 0.4129 - val_ac
c: 0.4920
Epoch 262/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0399 - acc: 0.9714 - val_loss: 0.4027 - val_ac
c: 0.5140
Epoch 263/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0406 - acc: 0.9714 - val_loss: 0.3955 - val_ac
c: 0.5080
Epoch 264/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0384 - acc: 0.9714 - val_loss: 0.3842 - val_ac
c: 0.5200
Epoch 265/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0381 - acc: 0.9857 - val_loss: 0.3783 - val_ac
c: 0.5040
Epoch 266/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0385 - acc: 0.9643 - val_loss: 0.3714 - val_ac
c: 0.5020
Epoch 267/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0355 - acc: 0.9857 - val_loss: 0.3740 - val_ac
c: 0.5140
Epoch 268/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0397 - acc: 0.9714 - val_loss: 0.3773 - val_ac
c: 0.5240
Epoch 269/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0371 - acc: 0.9786 - val_loss: 0.3795 - val_ac
c: 0.5280
Epoch 270/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0431 - acc: 0.9500 - val_loss: 0.3706 - val_ac
c: 0.5220
Epoch 271/900
1/1 [==============================] - 0s 181ms/step - loss: 0.0411 - acc: 0.9571 - val_loss: 0.3622 - val_ac
c: 0.5280
Epoch 272/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0372 - acc: 0.9786 - val_loss: 0.3589 - val_ac
c: 0.5400
Epoch 273/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0363 - acc: 0.9857 - val_loss: 0.3636 - val_ac
c: 0.5460
Epoch 274/900
1/1 [==============================] - 0s 185ms/step - loss: 0.0362 - acc: 0.9857 - val_loss: 0.3739 - val_ac
c: 0.5440
Epoch 275/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0393 - acc: 0.9643 - val_loss: 0.3836 - val_ac
c: 0.5400
Epoch 276/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0396 - acc: 0.9643 - val_loss: 0.3946 - val_ac
c: 0.5360
Epoch 277/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0378 - acc: 0.9786 - val_loss: 0.4050 - val_ac
c: 0.5200
Epoch 278/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0397 - acc: 0.9643 - val_loss: 0.4054 - val_ac
c: 0.5240
Epoch 279/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0425 - acc: 0.9571 - val_loss: 0.4044 - val_ac
c: 0.5140
Epoch 280/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0373 - acc: 0.9786 - val_loss: 0.4030 - val_ac
c: 0.5160
Epoch 281/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0381 - acc: 0.9714 - val_loss: 0.3975 - val_ac
c: 0.5080
Epoch 282/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0386 - acc: 0.9714 - val_loss: 0.3924 - val_ac
c: 0.5060
Epoch 283/900
1/1 [==============================] - 0s 187ms/step - loss: 0.0431 - acc: 0.9429 - val_loss: 0.3924 - val_ac
c: 0.5280
Epoch 284/900
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1/1 [==============================] - 0s 177ms/step - loss: 0.0389 - acc: 0.9643 - val_loss: 0.3985 - val_ac
c: 0.5280
Epoch 285/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0420 - acc: 0.9500 - val_loss: 0.4061 - val_ac
c: 0.5380
Epoch 286/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0430 - acc: 0.9714 - val_loss: 0.4146 - val_ac
c: 0.5380
Epoch 287/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0423 - acc: 0.9714 - val_loss: 0.4231 - val_ac
c: 0.5260
Epoch 288/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0429 - acc: 0.9714 - val_loss: 0.4325 - val_ac
c: 0.5020
Epoch 289/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0403 - acc: 0.9786 - val_loss: 0.4518 - val_ac
c: 0.4720
Epoch 290/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0395 - acc: 0.9786 - val_loss: 0.4693 - val_ac
c: 0.4480
Epoch 291/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0420 - acc: 0.9714 - val_loss: 0.4878 - val_ac
c: 0.4460
Epoch 292/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0437 - acc: 0.9714 - val_loss: 0.4962 - val_ac
c: 0.4540
Epoch 293/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0418 - acc: 0.9786 - val_loss: 0.5015 - val_ac
c: 0.4560
Epoch 294/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0424 - acc: 0.9786 - val_loss: 0.4976 - val_ac
c: 0.4640
Epoch 295/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0501 - acc: 0.9429 - val_loss: 0.4621 - val_ac
c: 0.4740
Epoch 296/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0451 - acc: 0.9714 - val_loss: 0.4397 - val_ac
c: 0.4960
Epoch 297/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0419 - acc: 0.9786 - val_loss: 0.4262 - val_ac
c: 0.5160
Epoch 298/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0409 - acc: 0.9857 - val_loss: 0.4162 - val_ac
c: 0.5280
Epoch 299/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0432 - acc: 0.9786 - val_loss: 0.4098 - val_ac
c: 0.5480
Epoch 300/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0445 - acc: 0.9786 - val_loss: 0.4072 - val_ac
c: 0.5500
Epoch 301/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0432 - acc: 0.9786 - val_loss: 0.4079 - val_ac
c: 0.5520
Epoch 302/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0454 - acc: 0.9643 - val_loss: 0.4071 - val_ac
c: 0.5480
Epoch 303/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0415 - acc: 0.9786 - val_loss: 0.4108 - val_ac
c: 0.5380
Epoch 304/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0436 - acc: 0.9643 - val_loss: 0.4187 - val_ac
c: 0.5120
Epoch 305/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0413 - acc: 0.9857 - val_loss: 0.4302 - val_ac
c: 0.4960
Epoch 306/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0516 - acc: 0.9500 - val_loss: 0.4319 - val_ac
c: 0.4980
Epoch 307/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0463 - acc: 0.9571 - val_loss: 0.4371 - val_ac
c: 0.4960
```

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Epoch 308/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0439 - acc: 0.9857 - val_loss: 0.4447 - val_ac
c: 0.5000
Epoch 309/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0471 - acc: 0.9643 - val_loss: 0.4524 - val_ac
c: 0.4880
Epoch 310/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0442 - acc: 0.9571 - val_loss: 0.4613 - val_ac
c: 0.4820
Epoch 311/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0430 - acc: 0.9857 - val_loss: 0.4737 - val_ac
c: 0.4780
Epoch 312/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0413 - acc: 0.9786 - val_loss: 0.4829 - val_ac
c: 0.4600
Epoch 313/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0425 - acc: 0.9643 - val_loss: 0.4876 - val_ac
c: 0.4520
Epoch 314/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0423 - acc: 0.9714 - val_loss: 0.4877 - val_ac
c: 0.4660
Epoch 315/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0443 - acc: 0.9786 - val_loss: 0.4809 - val_ac
c: 0.4680
Epoch 316/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0410 - acc: 0.9857 - val_loss: 0.4645 - val_ac
c: 0.4800
Epoch 317/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0432 - acc: 0.9714 - val_loss: 0.4662 - val_ac
c: 0.4880
Epoch 318/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0456 - acc: 0.9643 - val_loss: 0.4580 - val_ac
c: 0.4820
Epoch 319/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0389 - acc: 0.9929 - val_loss: 0.4537 - val_ac
c: 0.4740
Epoch 320/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0458 - acc: 0.9643 - val_loss: 0.4516 - val_ac
c: 0.4660
Epoch 321/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0428 - acc: 0.9714 - val_loss: 0.4520 - val_ac
c: 0.4400
Epoch 322/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0388 - acc: 0.9786 - val_loss: 0.4592 - val_ac
c: 0.4460
Epoch 323/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0407 - acc: 0.9643 - val_loss: 0.4578 - val_ac
c: 0.4420
Epoch 324/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0427 - acc: 0.9714 - val_loss: 0.4473 - val_ac
c: 0.4440
Epoch 325/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0401 - acc: 0.9786 - val_loss: 0.4355 - val_ac
c: 0.4600
Epoch 326/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0370 - acc: 0.9857 - val_loss: 0.4259 - val_ac
c: 0.4680
Epoch 327/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0452 - acc: 0.9500 - val_loss: 0.4088 - val_ac
c: 0.4820
Epoch 328/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0370 - acc: 0.9929 - val_loss: 0.3956 - val_ac
c: 0.4920
Epoch 329/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0367 - acc: 0.9857 - val_loss: 0.3850 - val_ac
c: 0.5120
Epoch 330/900
1/1 [==============================] - 0s 185ms/step - loss: 0.0362 - acc: 1.0000 - val_loss: 0.3777 - val_ac
c: 0.5120
Epoch 331/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0355 - acc: 1.0000 - val_loss: 0.3703 - val_ac
```

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c: 0.5280
Epoch 332/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0389 - acc: 0.9714 - val_loss: 0.3605 - val_ac
c: 0.5380
Epoch 333/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0403 - acc: 0.9500 - val_loss: 0.3544 - val_ac
c: 0.5500
Epoch 334/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0400 - acc: 0.9714 - val_loss: 0.3504 - val_ac
c: 0.5560
Epoch 335/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0355 - acc: 0.9857 - val_loss: 0.3468 - val_ac
c: 0.5560
Epoch 336/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0365 - acc: 0.9714 - val_loss: 0.3481 - val_ac
c: 0.5460
Epoch 337/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0414 - acc: 0.9643 - val_loss: 0.3474 - val_ac
c: 0.5460
Epoch 338/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0369 - acc: 0.9929 - val_loss: 0.3497 - val_ac
c: 0.5480
Epoch 339/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0378 - acc: 0.9714 - val_loss: 0.3476 - val_ac
c: 0.5580
Epoch 340/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0365 - acc: 0.9714 - val_loss: 0.3502 - val_ac
c: 0.5460
Epoch 341/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0381 - acc: 0.9500 - val_loss: 0.3514 - val_ac
c: 0.5400
Epoch 342/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0343 - acc: 0.9857 - val_loss: 0.3557 - val_ac
c: 0.5360
Epoch 343/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0367 - acc: 0.9714 - val_loss: 0.3591 - val_ac
c: 0.5320
Epoch 344/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0340 - acc: 0.9857 - val_loss: 0.3641 - val_ac
c: 0.5280
Epoch 345/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0336 - acc: 0.9857 - val_loss: 0.3708 - val_ac
c: 0.5240
Epoch 346/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0350 - acc: 0.9714 - val_loss: 0.3726 - val_ac
c: 0.5300
Epoch 347/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0335 - acc: 0.9929 - val_loss: 0.3773 - val_ac
c: 0.5260
Epoch 348/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0338 - acc: 0.9929 - val_loss: 0.3848 - val_ac
c: 0.5060
Epoch 349/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0378 - acc: 0.9571 - val_loss: 0.3802 - val_ac
c: 0.5180
Epoch 350/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0435 - acc: 0.9643 - val_loss: 0.3721 - val_ac
c: 0.5280
Epoch 351/900
1/1 [==============================] - 0s 178ms/step - loss: 0.0355 - acc: 0.9500 - val_loss: 0.3732 - val_ac
c: 0.5320
Epoch 352/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0386 - acc: 0.9643 - val_loss: 0.3776 - val_ac
c: 0.5200
Epoch 353/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0385 - acc: 0.9429 - val_loss: 0.3875 - val_ac
c: 0.5080
Epoch 354/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0386 - acc: 0.9643 - val_loss: 0.3986 - val_ac
c: 0.5000
Epoch 355/900
```

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1/1 [==============================] - 0s 169ms/step - loss: 0.0403 - acc: 0.9429 - val_loss: 0.4035 - val_ac
c: 0.5000
Epoch 356/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0344 - acc: 0.9929 - val_loss: 0.4129 - val_ac
c: 0.4920
Epoch 357/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0418 - acc: 0.9500 - val_loss: 0.4185 - val_ac
c: 0.4740
Epoch 358/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0411 - acc: 0.9500 - val_loss: 0.4158 - val_ac
c: 0.4660
Epoch 359/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0363 - acc: 0.9714 - val_loss: 0.4067 - val_ac
c: 0.4720
Epoch 360/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0373 - acc: 0.9714 - val_loss: 0.4065 - val_ac
c: 0.4900
Epoch 361/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0405 - acc: 0.9571 - val_loss: 0.4055 - val_ac
c: 0.4900
Epoch 362/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0369 - acc: 0.9714 - val_loss: 0.4079 - val_ac
c: 0.4740
Epoch 363/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0384 - acc: 0.9571 - val_loss: 0.4107 - val_ac
c: 0.4820
Epoch 364/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0355 - acc: 0.9929 - val_loss: 0.4140 - val_ac
c: 0.4960
Epoch 365/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0388 - acc: 0.9643 - val_loss: 0.4172 - val_ac
c: 0.4840
Epoch 366/900
1/1 [==============================] - 0s 177ms/step - loss: 0.0408 - acc: 0.9714 - val_loss: 0.4140 - val_ac
c: 0.5040
Epoch 367/900
1/1 [==============================] - 0s 180ms/step - loss: 0.0424 - acc: 0.9643 - val_loss: 0.4103 - val_ac
c: 0.5140
Epoch 368/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0434 - acc: 0.9929 - val_loss: 0.4056 - val_ac
c: 0.5200
Epoch 369/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0400 - acc: 0.9857 - val_loss: 0.4034 - val_ac
c: 0.5160
Epoch 370/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0416 - acc: 0.9714 - val_loss: 0.4025 - val_ac
c: 0.5160
Epoch 371/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0460 - acc: 0.9429 - val_loss: 0.3973 - val_ac
c: 0.5280
Epoch 372/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0415 - acc: 0.9786 - val_loss: 0.3935 - val_ac
c: 0.5340
Epoch 373/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0413 - acc: 0.9643 - val_loss: 0.3916 - val_ac
c: 0.5300
Epoch 374/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0434 - acc: 0.9571 - val_loss: 0.3923 - val_ac
c: 0.5220
Epoch 375/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0441 - acc: 0.9571 - val_loss: 0.3952 - val_ac
c: 0.5260
Epoch 376/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0391 - acc: 0.9929 - val_loss: 0.4034 - val_ac
c: 0.5100
Epoch 377/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0482 - acc: 0.9571 - val_loss: 0.4231 - val_ac
c: 0.5120
Epoch 378/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0446 - acc: 0.9500 - val_loss: 0.4440 - val_ac
c: 0.4900
```

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Epoch 379/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0448 - acc: 0.9714 - val_loss: 0.4634 - val_ac
c: 0.4720
Epoch 380/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0415 - acc: 0.9786 - val_loss: 0.4810 - val_ac
c: 0.4680
Epoch 381/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0422 - acc: 0.9786 - val_loss: 0.4910 - val_ac
c: 0.4660
Epoch 382/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0428 - acc: 0.9714 - val_loss: 0.4952 - val_ac
c: 0.4660
Epoch 383/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0472 - acc: 0.9571 - val_loss: 0.4976 - val_ac
c: 0.4600
Epoch 384/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0478 - acc: 0.9357 - val_loss: 0.4948 - val_ac
c: 0.4720
Epoch 385/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0467 - acc: 0.9571 - val_loss: 0.4801 - val_ac
c: 0.4780
Epoch 386/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0419 - acc: 0.9857 - val_loss: 0.4634 - val_ac
c: 0.4960
Epoch 387/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0505 - acc: 0.9571 - val_loss: 0.4520 - val_ac
c: 0.5080
Epoch 388/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0469 - acc: 0.9500 - val_loss: 0.4337 - val_ac
c: 0.5300
Epoch 389/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0440 - acc: 0.9714 - val_loss: 0.4211 - val_ac
c: 0.5300
Epoch 390/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0431 - acc: 0.9786 - val_loss: 0.4125 - val_ac
c: 0.5220
Epoch 391/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0462 - acc: 0.9714 - val_loss: 0.4154 - val_ac
c: 0.5160
Epoch 392/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0449 - acc: 0.9714 - val_loss: 0.4204 - val_ac
c: 0.5120
Epoch 393/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0440 - acc: 0.9786 - val_loss: 0.4291 - val_ac
c: 0.5040
Epoch 394/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0459 - acc: 0.9643 - val_loss: 0.4298 - val_ac
c: 0.4980
Epoch 395/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0486 - acc: 0.9786 - val_loss: 0.4361 - val_ac
c: 0.5000
Epoch 396/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0475 - acc: 0.9714 - val_loss: 0.4343 - val_ac
c: 0.4980
Epoch 397/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0490 - acc: 0.9571 - val_loss: 0.4272 - val_ac
c: 0.5060
Epoch 398/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0453 - acc: 0.9714 - val_loss: 0.4211 - val_ac
c: 0.5240
Epoch 399/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0501 - acc: 0.9500 - val_loss: 0.4184 - val_ac
c: 0.5160
Epoch 400/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0448 - acc: 0.9786 - val_loss: 0.4186 - val_ac
c: 0.5180
Epoch 401/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0482 - acc: 0.9786 - val_loss: 0.4194 - val_ac
c: 0.5180
Epoch 402/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0488 - acc: 0.9643 - val_loss: 0.4286 - val_ac
```

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c: 0.5180
Epoch 403/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0452 - acc: 0.9786 - val_loss: 0.4397 - val_ac
c: 0.5120
Epoch 404/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0551 - acc: 0.9357 - val_loss: 0.4492 - val_ac
c: 0.4920
Epoch 405/900
1/1 [==============================] - 0s 161ms/step - loss: 0.0495 - acc: 0.9643 - val_loss: 0.4465 - val_ac
c: 0.5020
Epoch 406/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0444 - acc: 0.9857 - val_loss: 0.4490 - val_ac
c: 0.4980
Epoch 407/900
1/1 [==============================] - 0s 197ms/step - loss: 0.0490 - acc: 0.9643 - val_loss: 0.4475 - val_ac
c: 0.4980
Epoch 408/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0616 - acc: 0.9357 - val_loss: 0.4472 - val_ac
c: 0.5040
Epoch 409/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0436 - acc: 0.9929 - val_loss: 0.4500 - val_ac
c: 0.5020
Epoch 410/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0461 - acc: 0.9786 - val_loss: 0.4540 - val_ac
c: 0.5020
Epoch 411/900
1/1 [==============================] - 0s 191ms/step - loss: 0.0443 - acc: 0.9857 - val_loss: 0.4600 - val_ac
c: 0.5020
Epoch 412/900
1/1 [==============================] - 0s 172ms/step - loss: 0.0469 - acc: 0.9714 - val_loss: 0.4533 - val_ac
c: 0.5040
Epoch 413/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0459 - acc: 0.9643 - val_loss: 0.4491 - val_ac
c: 0.5240
Epoch 414/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0453 - acc: 0.9571 - val_loss: 0.4502 - val_ac
c: 0.5120
Epoch 415/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0474 - acc: 0.9786 - val_loss: 0.4522 - val_ac
c: 0.5180
Epoch 416/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0440 - acc: 0.9786 - val_loss: 0.4521 - val_ac
c: 0.5160
Epoch 417/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0536 - acc: 0.9714 - val_loss: 0.4484 - val_ac
c: 0.5160
Epoch 418/900
1/1 [==============================] - 0s 175ms/step - loss: 0.0448 - acc: 0.9714 - val_loss: 0.4501 - val_ac
c: 0.5220
Epoch 419/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0466 - acc: 0.9571 - val_loss: 0.4572 - val_ac
c: 0.5220
Epoch 420/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0475 - acc: 0.9571 - val_loss: 0.4729 - val_ac
c: 0.5060
Epoch 421/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0445 - acc: 0.9714 - val_loss: 0.4867 - val_ac
c: 0.4980
Epoch 422/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0441 - acc: 0.9786 - val_loss: 0.4912 - val_ac
c: 0.5000
Epoch 423/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0410 - acc: 1.0000 - val_loss: 0.4955 - val_ac
c: 0.4960
Epoch 424/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0438 - acc: 0.9786 - val_loss: 0.4830 - val_ac
c: 0.4960
Epoch 425/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0438 - acc: 0.9714 - val_loss: 0.4691 - val_ac
c: 0.5100
Epoch 426/900
```

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1/1 [==============================] - 0s 167ms/step - loss: 0.0428 - acc: 0.9857 - val_loss: 0.4534 - val_ac
c: 0.5120
Epoch 427/900
1/1 [==============================] - 0s 182ms/step - loss: 0.0425 - acc: 0.9929 - val_loss: 0.4347 - val_ac
c: 0.5300
Epoch 428/900
1/1 [==============================] - 0s 166ms/step - loss: 0.0440 - acc: 0.9857 - val_loss: 0.4255 - val_ac
c: 0.5300
Epoch 429/900
1/1 [==============================] - 0s 176ms/step - loss: 0.0450 - acc: 0.9714 - val_loss: 0.4135 - val_ac
c: 0.5320
Epoch 430/900
1/1 [==============================] - 0s 191ms/step - loss: 0.0402 - acc: 0.9857 - val_loss: 0.4098 - val_ac
c: 0.5320
Epoch 431/900
1/1 [==============================] - 0s 200ms/step - loss: 0.0412 - acc: 0.9786 - val_loss: 0.4091 - val_ac
c: 0.5320
Epoch 432/900
1/1 [==============================] - 0s 169ms/step - loss: 0.0396 - acc: 0.9786 - val_loss: 0.4087 - val_ac
c: 0.5400
Epoch 433/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0409 - acc: 0.9786 - val_loss: 0.4059 - val_ac
c: 0.5340
Epoch 434/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0502 - acc: 0.9500 - val_loss: 0.3965 - val_ac
c: 0.5280
Epoch 435/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0390 - acc: 0.9786 - val_loss: 0.3903 - val_ac
c: 0.5220
Epoch 436/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0414 - acc: 0.9786 - val_loss: 0.3839 - val_ac
c: 0.5240
Epoch 437/900
1/1 [==============================] - 0s 179ms/step - loss: 0.0402 - acc: 0.9786 - val_loss: 0.3817 - val_ac
c: 0.5280
Epoch 438/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0427 - acc: 0.9643 - val_loss: 0.3820 - val_ac
c: 0.5180
Epoch 439/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0384 - acc: 0.9857 - val_loss: 0.3862 - val_ac
c: 0.5220
Epoch 440/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0414 - acc: 0.9571 - val_loss: 0.3886 - val_ac
c: 0.5200
Epoch 441/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0377 - acc: 0.9929 - val_loss: 0.3941 - val_ac
c: 0.5160
Epoch 442/900
1/1 [==============================] - 0s 171ms/step - loss: 0.0412 - acc: 0.9786 - val_loss: 0.4009 - val_ac
c: 0.5000
Epoch 443/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0393 - acc: 0.9786 - val_loss: 0.4101 - val_ac
c: 0.4920
Epoch 444/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0398 - acc: 0.9643 - val_loss: 0.4152 - val_ac
c: 0.4780
Epoch 445/900
1/1 [==============================] - 0s 162ms/step - loss: 0.0412 - acc: 0.9786 - val_loss: 0.4240 - val_ac
c: 0.4820
Epoch 446/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0385 - acc: 0.9786 - val_loss: 0.4334 - val_ac
c: 0.4600
Epoch 447/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0421 - acc: 0.9643 - val_loss: 0.4366 - val_ac
c: 0.4560
Epoch 448/900
1/1 [==============================] - 0s 173ms/step - loss: 0.0389 - acc: 0.9714 - val_loss: 0.4346 - val_ac
c: 0.4640
Epoch 449/900
1/1 [==============================] - 0s 160ms/step - loss: 0.0475 - acc: 0.9286 - val_loss: 0.4396 - val_ac
c: 0.4500
```

```
Epoch 450/900
1/1 [==============================] - 0s 185ms/step - loss: 0.0375 - acc: 0.9857 - val_loss: 0.4420 - val_ac
c: 0.4460
Epoch 451/900
1/1 [==============================] - 0s 168ms/step - loss: 0.0439 - acc: 0.9357 - val_loss: 0.4357 - val_ac
c: 0.4500
Epoch 452/900
1/1 [==============================] - 0s 163ms/step - loss: 0.0436 - acc: 0.9643 - val_loss: 0.4306 - val_ac
c: 0.4540
Epoch 453/900
1/1 [==============================] - 0s 170ms/step - loss: 0.0406 - acc: 0.9643 - val_loss: 0.4281 - val_ac
c: 0.4660
Epoch 454/900
1/1 [==============================] - 0s 164ms/step - loss: 0.0437 - acc: 0.9643 - val_loss: 0.4279 - val_ac
c: 0.4600
Epoch 455/900
1/1 [==============================] - 0s 165ms/step - loss: 0.0402 - acc: 0.9643 - val_loss: 0.4312 - val_ac
c: 0.4560
Epoch 456/900
1/1 [==============================] - 0s 167ms/step - loss: 0.0481 - acc: 0.9500 - val_loss: 0.4276 - val_ac
c: 0.4660
Epoch 457/900
1/1 [==============================] - 0s 174ms/step - loss: 0.0423 - acc: 0.9571 - val_loss: 0.4253 - val_ac
c: 0.4640
```

Out[ ]: <tensorflow.python.keras.callbacks.History at 0x240951b3ac8>

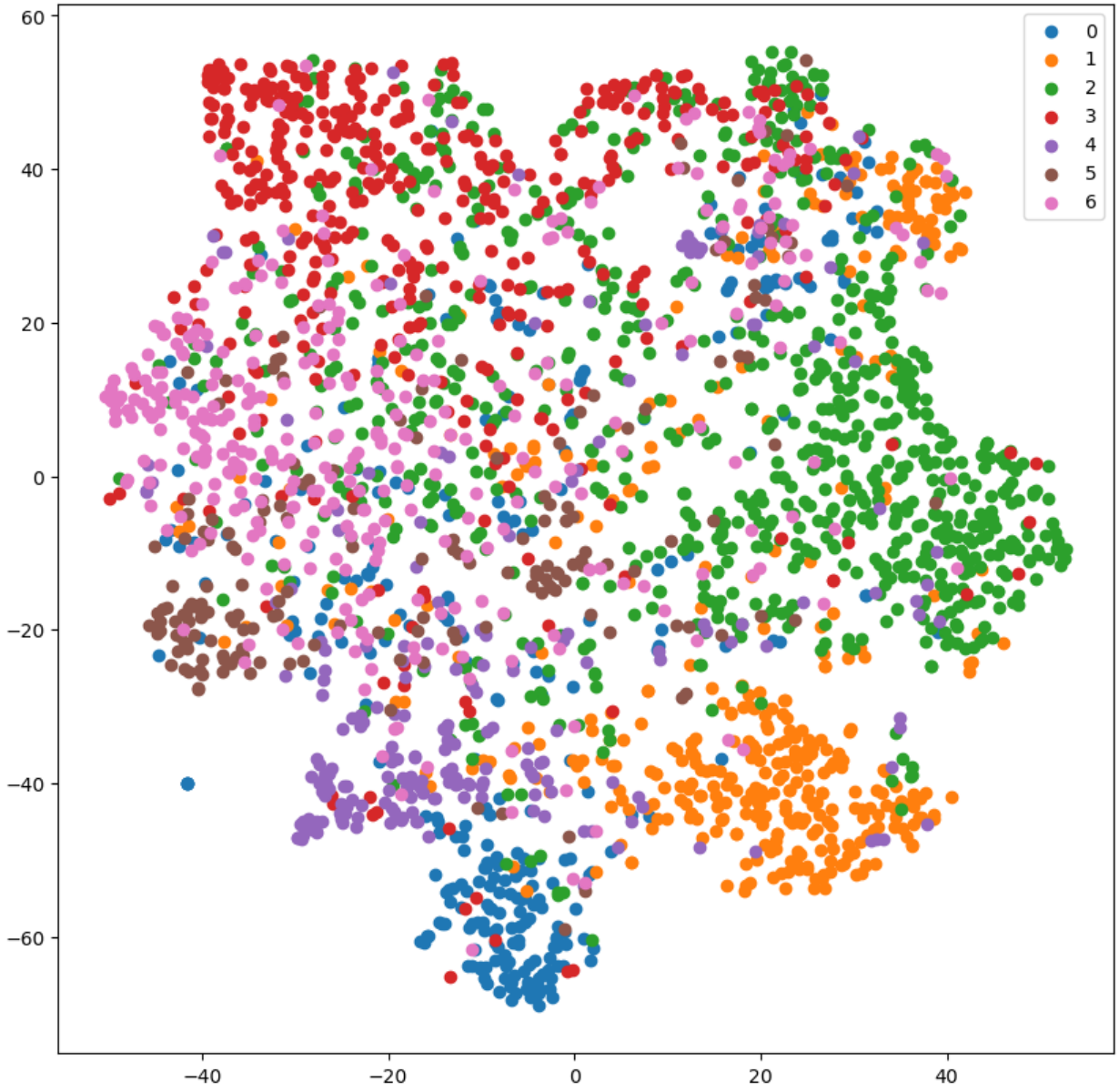
In [ ]:
```
# Evaluate model
y_pred = model_fnn.predict(X_te)
report = classification_report(np.argmax(y_te,axis=1), np.argmax(y_pred,axis=1), target_names=classes)
print('FCNN Classification Report: \n {}'.format(report))
```

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

            Case_Based       0.58      0.58      0.58       114
    Genetic_Algorithms       0.73      0.74      0.73       156
       Neural_Networks       0.74      0.51      0.60       290
 Probabilistic_Methods       0.75      0.52      0.62       172
Reinforcement_Learning       0.37      0.60      0.46        85
         Rule_Learning       0.39      0.62      0.48        60
                Theory       0.37      0.54      0.44       123

              accuracy                           0.57      1000
             macro avg       0.56      0.59      0.56      1000
          weighted avg       0.63      0.57      0.58      1000
```

Get hidden layer representation for FNN

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



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