Lab 4: Neural Networks (II)

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Link: https://colab.research.google.com/drive/1aX5FEUi7oO4oCHlANGWBX_aRerYixkeD#scrollTo=-OaCQ1HzevPV

IMPORTANT: The first step is always to SAVE A COPY OF THIS NOTEBOOK in your own Google Drive and do the work on your own document. (File --> Save a copy in Drive)

In this lab we will continue exploring different types of deep architectures for audio processing, and we will pay special attention to system evaluation.

In [ ]:

```
# As always, we import the relevant packages
import numpy as np
import matplotlib.pyplot as plt
from pathlib import Path
import librosa
import sklearn
import tensorflow as tf
plt.style.use('seaborn')
```

Exercise 1: Data Preparation I

We will continue working with the ESC-50 dataset. Download it to your notebook following the same steps as in Lab 2 and Lab 3.

In [ ]:

```
!apt-get install subversion
!svn checkout https://github.com/karolpiczak/ESC-50/trunk/audio
```

```
Reading package lists... Done
Building dependency tree
Reading state information... Done
subversion is already the newest version (1.9.7-4ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 15 not upgraded.
Checked out revision 28.
```

Create a list containing the audio files and another one with the corresponding labels (as in Lab 3):

In [ ]:

```
audiofiles = [str(file) for file in Path().glob('audio/*.wav')]
labels = []
for i,file in enumerate(audiofiles):
  fileid = file.split('.wav')[-2]
  target = fileid.split('-')[-1]
  labels.append(int(target))
```

Instead of working with 50 classes, we limit our dataset to only 10 classes. Filter you two files (the one with file paths and the one with labels) to contain only those belonging to classes [0-9].

In [ ]:

```
files = [audiofiles[i] for i,l in enumerate(labels) if l<10]
labels = [l for l in labels if l<10]
```

We load the signals and get the Mel spectrogram for each signal. Create a list called "signals" storing the raw waveforms of each file in your list and another one called "melspecs" that stores the Mel spectrogram for each signal.

In [ ]:

```
signals = list(librosa.load(file)[0] for file in files)
melspecs = list(librosa.feature.melspectrogram(signal) for signal in signals)
```

Exercise 2: Data preparation II

Convert your "melspecs" and "labels" list to numpy arrays, called "Xdata" and "Ydata". Check that the result has size (400, 128, 216) for Xdata and (400,) for Ydata.

In [ ]:

```
Xdata = np.asarray(melspecs)
Ydata = np.asarray(labels)

print("Xdata has size ", Xdata.shape)
print("Ydata has size ", Ydata.shape)
```

```
Xdata has size  (400, 128, 216)
Ydata has size  (400,)
```

Split your dataset into 3 partitions, 1 for training (70%), 1 for validation (20%) and 1 for test (10%). Check that the resulting arrays have the correct shape:

- **X_train → (280,128,216)**
- **X_val → (80,128,216)**
- **X_test → (40,128,216)**
- **y_train → (280,)**
- **y_val → (80,)**
- **y_test → (40,)**

In [ ]:

```
from sklearn.model_selection import train_test_split # List containing train-test split o
f inputs.

X_train, x, y_train, y = train_test_split(Xdata, Ydata, train_size=0.7)
X_val, X_test, y_val, y_test = train_test_split(x,y,test_size = 0.33)
```

In [ ]:

```
# Shapes for each partition
print(X_train.shape)
print(X_val.shape)
print(X_test.shape)
print(y_train.shape)
print(y_val.shape)
print(y_test.shape)
```

```
(280, 128, 216)
(80, 128, 216)
```

```
(40, 128, 216)
(280,)
(80,)
(40,)
```

In the next exercise we will create a time-distributed 1D-CNN to process our dataset. By default, Keras assumes that the last dimension corresponds to the number of channels in our input. Since we are going to use 1D-CNN, each frequency band will be processed as an independent frequency channel. Therefore, we need to reorder the dimensions in our data to move the frequency channels to the last dimension.

Use the numpy function "moveaxis" to create the data matrices X_train_rs, X_val_rs and X_test_rs, with dimensions (280, 216, 128), (80, 216, 128) and (40, 216, 128):

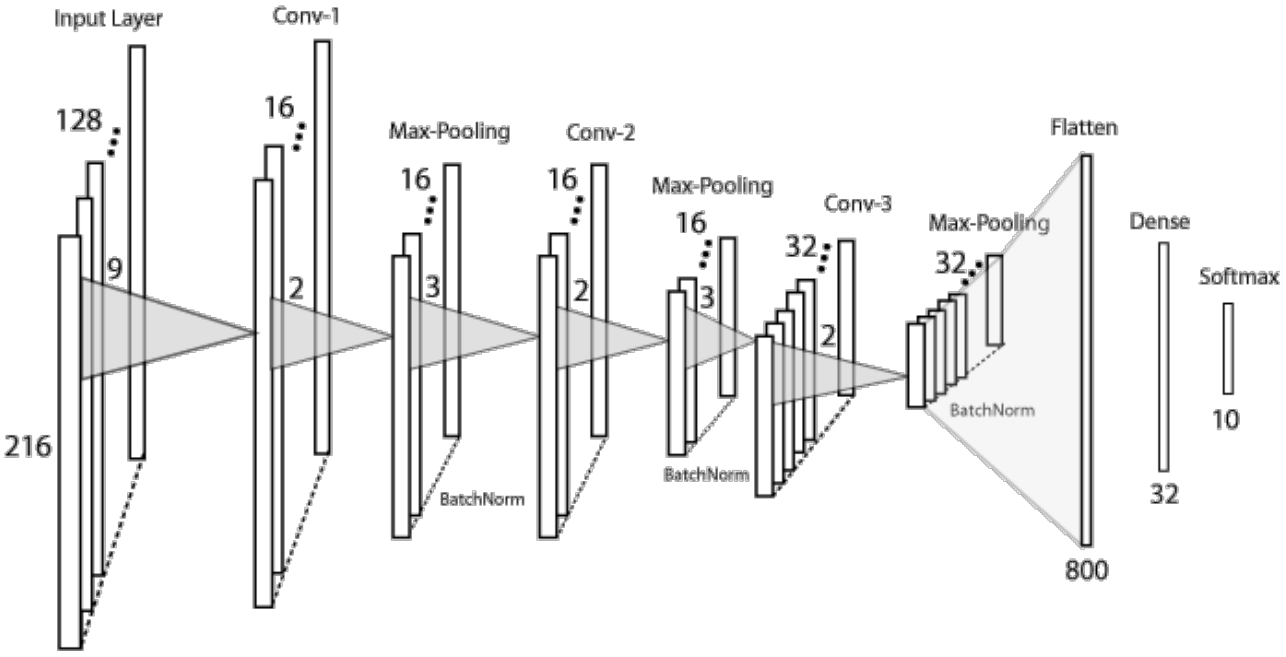
In [ ]:

```
X_train_rs = np.moveaxis(X_train,1,2)
X_val_rs = np.moveaxis(X_val,1,2)
X_test_rs = np.moveaxis(X_test,1,2)
print(X_train_rs.shape)
print(X_val_rs.shape)
print(X_test_rs.shape)
```

```
(280, 216, 128)
(80, 216, 128)
(40, 216, 128)
```

Exercise 3: 1D-Convolutional Neural Network

Create the following 1D-CNN architecture with Keras:



In [ ]:

```
input_shape = (X_train_rs.shape[1], X_train_rs.shape[2])
print("Input shape: ", input_shape)

model_1D_CNN = tf.keras.models.Sequential()

# 1st convolutional layer
model_1D_CNN.add(tf.keras.layers.Conv1D(filters=16, kernel_size=9, activation='relu', in
put_shape=input_shape))
model_1D_CNN.add(tf.keras.layers.MaxPooling1D(pool_size=2, padding='same'))
model_1D_CNN.add(tf.keras.layers.BatchNormalization())


# 2nd convolutional layer
model_1D_CNN.add(tf.keras.layers.Conv1D(filters=16, kernel_size=3, activation='relu'))
```

```
model_1D_CNN.add(tf.keras.layers.MaxPooling1D(pool_size=2, padding='same'))
model_1D_CNN.add(tf.keras.layers.BatchNormalization())


# 3rd convolutional layer
model_1D_CNN.add(tf.keras.layers.Conv1D(filters=32, kernel_size=3, activation='relu'))
model_1D_CNN.add(tf.keras.layers.MaxPooling1D(pool_size=2, padding='same'))
model_1D_CNN.add(tf.keras.layers.BatchNormalization())
# flatten output and feed it to a dense layer
model_1D_CNN.add(tf.keras.layers.Flatten())
model_1D_CNN.add(tf.keras.layers.Dense(32, activation='relu', kernel_regularizer=tf.kera
s.regularizers.l2(0.1)))
model_1D_CNN.add(tf.keras.layers.Dropout(0.7))

# output layer
model_1D_CNN.add(tf.keras.layers.Dense(10, activation='softmax'))#, kernel_regularizer=t
f.keras.regularizers.l2(0.01)))
model_1D_CNN.summary()
```

```
Input shape:  (216, 128)
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d (Conv1D)              (None, 208, 16)           18448
_________________________________________________________________
max_pooling1d (MaxPooling1D) (None, 104, 16)           0
_________________________________________________________________
batch_normalization (BatchNo (None, 104, 16)           64
_________________________________________________________________
conv1d_1 (Conv1D)            (None, 102, 16)           784
_________________________________________________________________
max_pooling1d_1 (MaxPooling1 (None, 51, 16)            0
_________________________________________________________________
batch_normalization_1 (Batch (None, 51, 16)            64
_________________________________________________________________
conv1d_2 (Conv1D)            (None, 49, 32)            1568
_________________________________________________________________
max_pooling1d_2 (MaxPooling1 (None, 25, 32)            0
_________________________________________________________________
batch_normalization_2 (Batch (None, 25, 32)            128
_________________________________________________________________
flatten (Flatten)            (None, 800)               0
_________________________________________________________________
dense (Dense)                (None, 32)                25632
_________________________________________________________________
dropout (Dropout)            (None, 32)                0
_________________________________________________________________
dense_1 (Dense)              (None, 10)                330
=================================================================
Total params: 47,018
Trainable params: 46,890
Non-trainable params: 128
_________________________________________________________________
```

Iniatialize Keras Callbacks:

- **CSVLogger.**
- **Early_Stop with patience 100 epochs, working on validation loss.**
- **ModelCheckpoint working on validation accuracy (monitor = 'val_accuracy').**

In [ ]:

```
from tensorflow.keras.callbacks import CSVLogger, ModelCheckpoint, EarlyStopping

log_file_path = 'training_1D_CNN.log'
csv_logger = CSVLogger(log_file_path, append=False)

patience = 100
early_stop = EarlyStopping('val_loss', patience=patience)
```

```
model_name = '1D_CNN.hdf5'
model_checkpoint = ModelCheckpoint(filepath=model_name, monitor='val_accuracy', verbose=
1, save_best_only=True)

#Callbacks List
callbacks = [model_checkpoint, csv_logger, early_stop]
```

Train the network using Adam optimizer and a batch size of 32. Remember to include the created callbacks.

In [ ]:

```
# compile model
adamopt = tf.keras.optimizers.Adam(learning_rate=0.0008)
model_1D_CNN.compile(optimizer=adamopt, loss='sparse_categorical_crossentropy', metrics=
['accuracy'])

# model fit
history_1D_CNN = model_1D_CNN.fit(X_train_rs,y_train, validation_data = (X_val_rs, y_val
), batch_size=32, epochs=300, callbacks=callbacks)
```

```
Epoch 1/300
9/9 [==============================] - 4s 89ms/step - loss: 9.2376 - accuracy: 0.1377 - v
al_loss: 9.6734 - val_accuracy: 0.1750

Epoch 00001: val_accuracy improved from -inf to 0.17500, saving model to 1D_CNN.hdf5
Epoch 2/300
9/9 [==============================] - 0s 28ms/step - loss: 8.5355 - accuracy: 0.1391 - v
al_loss: 8.1939 - val_accuracy: 0.1875

Epoch 00002: val_accuracy improved from 0.17500 to 0.18750, saving model to 1D_CNN.hdf5
Epoch 3/300
9/9 [==============================] - 0s 12ms/step - loss: 7.9055 - accuracy: 0.1656 - v
al_loss: 7.5429 - val_accuracy: 0.1500

Epoch 00003: val_accuracy did not improve from 0.18750
Epoch 4/300
9/9 [==============================] - 0s 13ms/step - loss: 7.2790 - accuracy: 0.1954 - v
al_loss: 7.1177 - val_accuracy: 0.1500

Epoch 00004: val_accuracy did not improve from 0.18750
Epoch 5/300
9/9 [==============================] - 0s 12ms/step - loss: 6.7990 - accuracy: 0.1695 - v
al_loss: 6.7360 - val_accuracy: 0.1750

Epoch 00005: val_accuracy did not improve from 0.18750
Epoch 6/300
9/9 [==============================] - 0s 12ms/step - loss: 6.4040 - accuracy: 0.1879 - v
al_loss: 6.4102 - val_accuracy: 0.1625

Epoch 00006: val_accuracy did not improve from 0.18750
Epoch 7/300
9/9 [==============================] - 0s 12ms/step - loss: 5.9994 - accuracy: 0.1981 - v
al_loss: 6.0826 - val_accuracy: 0.1625

Epoch 00007: val_accuracy did not improve from 0.18750
Epoch 8/300
9/9 [==============================] - 0s 12ms/step - loss: 5.6755 - accuracy: 0.2061 - v
al_loss: 5.7831 - val_accuracy: 0.1500

Epoch 00008: val_accuracy did not improve from 0.18750
Epoch 9/300
9/9 [==============================] - 0s 13ms/step - loss: 5.3633 - accuracy: 0.2370 - v
al_loss: 5.5115 - val_accuracy: 0.1250

Epoch 00009: val_accuracy did not improve from 0.18750
Epoch 10/300
9/9 [==============================] - 0s 10ms/step - loss: 5.0642 - accuracy: 0.2642 - v
al_loss: 5.2559 - val_accuracy: 0.1375

Epoch 00010: val_accuracy did not improve from 0.18750
```

```
Epoch 11/300
9/9 [==============================] - 0s 10ms/step - loss: 4.9127 - accuracy: 0.2257 - v
al_loss: 5.0129 - val_accuracy: 0.1500

Epoch 00011: val_accuracy did not improve from 0.18750
Epoch 12/300
9/9 [==============================] - 0s 10ms/step - loss: 4.5877 - accuracy: 0.2998 - v
al_loss: 4.8003 - val_accuracy: 0.1875

Epoch 00012: val_accuracy did not improve from 0.18750
Epoch 13/300
9/9 [==============================] - 0s 11ms/step - loss: 4.3542 - accuracy: 0.2857 - v
al_loss: 4.6086 - val_accuracy: 0.1625

Epoch 00013: val_accuracy did not improve from 0.18750
Epoch 14/300
9/9 [==============================] - 0s 11ms/step - loss: 4.1284 - accuracy: 0.3486 - v
al_loss: 4.4343 - val_accuracy: 0.1500

Epoch 00014: val_accuracy did not improve from 0.18750
Epoch 15/300
9/9 [==============================] - 0s 10ms/step - loss: 3.9534 - accuracy: 0.3283 - v
al_loss: 4.2589 - val_accuracy: 0.2000

Epoch 00015: val_accuracy improved from 0.18750 to 0.20000, saving model to 1D_CNN.hdf5
Epoch 16/300
9/9 [==============================] - 0s 10ms/step - loss: 3.8139 - accuracy: 0.3428 - v
al_loss: 4.0987 - val_accuracy: 0.2250

Epoch 00016: val_accuracy improved from 0.20000 to 0.22500, saving model to 1D_CNN.hdf5
Epoch 17/300
9/9 [==============================] - 0s 12ms/step - loss: 3.5683 - accuracy: 0.3720 - v
al_loss: 3.9581 - val_accuracy: 0.2500

Epoch 00017: val_accuracy improved from 0.22500 to 0.25000, saving model to 1D_CNN.hdf5
Epoch 18/300
9/9 [==============================] - 0s 13ms/step - loss: 3.4658 - accuracy: 0.3572 - v
al_loss: 3.8184 - val_accuracy: 0.2625

Epoch 00018: val_accuracy improved from 0.25000 to 0.26250, saving model to 1D_CNN.hdf5
Epoch 19/300
9/9 [==============================] - 0s 12ms/step - loss: 3.2856 - accuracy: 0.3412 - v
al_loss: 3.6894 - val_accuracy: 0.2500

Epoch 00019: val_accuracy did not improve from 0.26250
Epoch 20/300
9/9 [==============================] - 0s 13ms/step - loss: 3.1996 - accuracy: 0.3978 - v
al_loss: 3.5598 - val_accuracy: 0.2625

Epoch 00020: val_accuracy did not improve from 0.26250
Epoch 21/300
9/9 [==============================] - 0s 12ms/step - loss: 3.0541 - accuracy: 0.4094 - v
al_loss: 3.4381 - val_accuracy: 0.2750

Epoch 00021: val_accuracy improved from 0.26250 to 0.27500, saving model to 1D_CNN.hdf5
Epoch 22/300
9/9 [==============================] - 0s 13ms/step - loss: 2.8658 - accuracy: 0.4106 - v
al_loss: 3.3307 - val_accuracy: 0.2625

Epoch 00022: val_accuracy did not improve from 0.27500
Epoch 23/300
9/9 [==============================] - 0s 12ms/step - loss: 2.7712 - accuracy: 0.4048 - v
al_loss: 3.2479 - val_accuracy: 0.2625

Epoch 00023: val_accuracy did not improve from 0.27500
Epoch 24/300
9/9 [==============================] - 0s 13ms/step - loss: 2.7177 - accuracy: 0.4092 - v
al_loss: 3.1905 - val_accuracy: 0.2375

Epoch 00024: val_accuracy did not improve from 0.27500
Epoch 25/300
9/9 [==============================] - 0s 13ms/step - loss: 2.5513 - accuracy: 0.4423 - v
```

```
al_loss: 3.1114 - val_accuracy: 0.2625

Epoch 00025: val_accuracy did not improve from 0.27500
Epoch 26/300
9/9 [==============================] - 0s 12ms/step - loss: 2.5083 - accuracy: 0.4502 - v
al_loss: 3.0320 - val_accuracy: 0.2375

Epoch 00026: val_accuracy did not improve from 0.27500
Epoch 27/300
9/9 [==============================] - 0s 11ms/step - loss: 2.4787 - accuracy: 0.4031 - v
al_loss: 2.9485 - val_accuracy: 0.2250

Epoch 00027: val_accuracy did not improve from 0.27500
Epoch 28/300
9/9 [==============================] - 0s 10ms/step - loss: 2.3335 - accuracy: 0.4764 - v
al_loss: 2.8717 - val_accuracy: 0.2375

Epoch 00028: val_accuracy did not improve from 0.27500
Epoch 29/300
9/9 [==============================] - 0s 10ms/step - loss: 2.2234 - accuracy: 0.4842 - v
al_loss: 2.8048 - val_accuracy: 0.2500

Epoch 00029: val_accuracy did not improve from 0.27500
Epoch 30/300
9/9 [==============================] - 0s 12ms/step - loss: 2.2049 - accuracy: 0.5115 - v
al_loss: 2.7537 - val_accuracy: 0.2750

Epoch 00030: val_accuracy did not improve from 0.27500
Epoch 31/300
9/9 [==============================] - 0s 11ms/step - loss: 2.2549 - accuracy: 0.4727 - v
al_loss: 2.6928 - val_accuracy: 0.2625

Epoch 00031: val_accuracy did not improve from 0.27500
Epoch 32/300
9/9 [==============================] - 0s 10ms/step - loss: 2.0217 - accuracy: 0.5841 - v
al_loss: 2.6251 - val_accuracy: 0.2625

Epoch 00032: val_accuracy did not improve from 0.27500
Epoch 33/300
9/9 [==============================] - 0s 12ms/step - loss: 2.1486 - accuracy: 0.4395 - v
al_loss: 2.6027 - val_accuracy: 0.2250

Epoch 00033: val_accuracy did not improve from 0.27500
Epoch 34/300
9/9 [==============================] - 0s 10ms/step - loss: 1.9340 - accuracy: 0.5817 - v
al_loss: 2.5749 - val_accuracy: 0.2375

Epoch 00034: val_accuracy did not improve from 0.27500
Epoch 35/300
9/9 [==============================] - 0s 11ms/step - loss: 1.9335 - accuracy: 0.5367 - v
al_loss: 2.5242 - val_accuracy: 0.2375

Epoch 00035: val_accuracy did not improve from 0.27500
Epoch 36/300
9/9 [==============================] - 0s 10ms/step - loss: 1.8078 - accuracy: 0.5855 - v
al_loss: 2.4974 - val_accuracy: 0.2500

Epoch 00036: val_accuracy did not improve from 0.27500
Epoch 37/300
9/9 [==============================] - 0s 11ms/step - loss: 1.8037 - accuracy: 0.5422 - v
al_loss: 2.4601 - val_accuracy: 0.2500

Epoch 00037: val_accuracy did not improve from 0.27500
Epoch 38/300
9/9 [==============================] - 0s 24ms/step - loss: 1.7670 - accuracy: 0.5429 - v
al_loss: 2.4462 - val_accuracy: 0.2625

Epoch 00038: val_accuracy did not improve from 0.27500
Epoch 39/300
9/9 [==============================] - 0s 11ms/step - loss: 1.8401 - accuracy: 0.4696 - v
al_loss: 2.4193 - val_accuracy: 0.2750

Epoch 00039: val_accuracy did not improve from 0.27500
```

```
Epoch 00039: val_accuracy did not improve from 0.27500
Epoch 40/300
9/9 [==============================] - 0s 11ms/step - loss: 1.7247 - accuracy: 0.5449 - v
al_loss: 2.3826 - val_accuracy: 0.2625

Epoch 00040: val_accuracy did not improve from 0.27500
Epoch 41/300
9/9 [==============================] - 0s 10ms/step - loss: 1.6471 - accuracy: 0.5620 - v
al_loss: 2.3665 - val_accuracy: 0.2750

Epoch 00041: val_accuracy did not improve from 0.27500
Epoch 42/300
9/9 [==============================] - 0s 10ms/step - loss: 1.7084 - accuracy: 0.5663 - v
al_loss: 2.3576 - val_accuracy: 0.2875

Epoch 00042: val_accuracy improved from 0.27500 to 0.28750, saving model to 1D_CNN.hdf5
Epoch 43/300
9/9 [==============================] - 0s 11ms/step - loss: 1.6724 - accuracy: 0.5667 - v
al_loss: 2.3519 - val_accuracy: 0.2875

Epoch 00043: val_accuracy did not improve from 0.28750
Epoch 44/300
9/9 [==============================] - 0s 12ms/step - loss: 1.5289 - accuracy: 0.6052 - v
al_loss: 2.3350 - val_accuracy: 0.2875

Epoch 00044: val_accuracy did not improve from 0.28750
Epoch 45/300
9/9 [==============================] - 0s 11ms/step - loss: 1.6885 - accuracy: 0.5562 - v
al_loss: 2.2943 - val_accuracy: 0.3250

Epoch 00045: val_accuracy improved from 0.28750 to 0.32500, saving model to 1D_CNN.hdf5
Epoch 46/300
9/9 [==============================] - 0s 10ms/step - loss: 1.5851 - accuracy: 0.5856 - v
al_loss: 2.2735 - val_accuracy: 0.3625

Epoch 00046: val_accuracy improved from 0.32500 to 0.36250, saving model to 1D_CNN.hdf5
Epoch 47/300
9/9 [==============================] - 0s 11ms/step - loss: 1.5631 - accuracy: 0.5247 - v
al_loss: 2.2629 - val_accuracy: 0.3875

Epoch 00047: val_accuracy improved from 0.36250 to 0.38750, saving model to 1D_CNN.hdf5
Epoch 48/300
9/9 [==============================] - 0s 12ms/step - loss: 1.5285 - accuracy: 0.6116 - v
al_loss: 2.2580 - val_accuracy: 0.3250

Epoch 00048: val_accuracy did not improve from 0.38750
Epoch 49/300
9/9 [==============================] - 0s 13ms/step - loss: 1.5010 - accuracy: 0.5875 - v
al_loss: 2.2488 - val_accuracy: 0.2875

Epoch 00049: val_accuracy did not improve from 0.38750
Epoch 50/300
9/9 [==============================] - 0s 12ms/step - loss: 1.5426 - accuracy: 0.5665 - v
al_loss: 2.2265 - val_accuracy: 0.3125

Epoch 00050: val_accuracy did not improve from 0.38750
Epoch 51/300
9/9 [==============================] - 0s 12ms/step - loss: 1.4114 - accuracy: 0.6383 - v
al_loss: 2.2062 - val_accuracy: 0.3500

Epoch 00051: val_accuracy did not improve from 0.38750
Epoch 52/300
9/9 [==============================] - 0s 13ms/step - loss: 1.3995 - accuracy: 0.6698 - v
al_loss: 2.1899 - val_accuracy: 0.3500

Epoch 00052: val_accuracy did not improve from 0.38750
Epoch 53/300
9/9 [==============================] - 0s 12ms/step - loss: 1.4171 - accuracy: 0.5707 - v
al_loss: 2.1637 - val_accuracy: 0.3375

Epoch 00053: val_accuracy did not improve from 0.38750
Epoch 54/300
```

```
9/9 [==============================] - 0s 11ms/step - loss: 1.2616 - accuracy: 0.7039 - v
al_loss: 2.1370 - val_accuracy: 0.3250

Epoch 00054: val_accuracy did not improve from 0.38750
Epoch 55/300
9/9 [==============================] - 0s 11ms/step - loss: 1.3780 - accuracy: 0.6028 - v
al_loss: 2.1130 - val_accuracy: 0.3625

Epoch 00055: val_accuracy did not improve from 0.38750
Epoch 56/300
9/9 [==============================] - 0s 10ms/step - loss: 1.2836 - accuracy: 0.6660 - v
al_loss: 2.0829 - val_accuracy: 0.3500

Epoch 00056: val_accuracy did not improve from 0.38750
Epoch 57/300
9/9 [==============================] - 0s 12ms/step - loss: 1.2987 - accuracy: 0.6789 - v
al_loss: 2.0840 - val_accuracy: 0.3375

Epoch 00057: val_accuracy did not improve from 0.38750
Epoch 58/300
9/9 [==============================] - 0s 11ms/step - loss: 1.2780 - accuracy: 0.6574 - v
al_loss: 2.0761 - val_accuracy: 0.3500

Epoch 00058: val_accuracy did not improve from 0.38750
Epoch 59/300
9/9 [==============================] - 0s 12ms/step - loss: 1.2905 - accuracy: 0.6463 - v
al_loss: 2.1059 - val_accuracy: 0.3750

Epoch 00059: val_accuracy did not improve from 0.38750
Epoch 60/300
9/9 [==============================] - 0s 12ms/step - loss: 1.3124 - accuracy: 0.6576 - v
al_loss: 2.1288 - val_accuracy: 0.3375

Epoch 00060: val_accuracy did not improve from 0.38750
Epoch 61/300
9/9 [==============================] - 0s 12ms/step - loss: 1.2507 - accuracy: 0.6759 - v
al_loss: 2.1236 - val_accuracy: 0.3125

Epoch 00061: val_accuracy did not improve from 0.38750
Epoch 62/300
9/9 [==============================] - 0s 12ms/step - loss: 1.3296 - accuracy: 0.6731 - v
al_loss: 2.1342 - val_accuracy: 0.3375

Epoch 00062: val_accuracy did not improve from 0.38750
Epoch 63/300
9/9 [==============================] - 0s 11ms/step - loss: 1.2283 - accuracy: 0.6775 - v
al_loss: 2.1103 - val_accuracy: 0.3125

Epoch 00063: val_accuracy did not improve from 0.38750
Epoch 64/300
9/9 [==============================] - 0s 10ms/step - loss: 1.1931 - accuracy: 0.6788 - v
al_loss: 2.0769 - val_accuracy: 0.3625

Epoch 00064: val_accuracy did not improve from 0.38750
Epoch 65/300
9/9 [==============================] - 0s 10ms/step - loss: 1.1932 - accuracy: 0.6993 - v
al_loss: 2.0713 - val_accuracy: 0.3375

Epoch 00065: val_accuracy did not improve from 0.38750
Epoch 66/300
9/9 [==============================] - 0s 11ms/step - loss: 1.1905 - accuracy: 0.7028 - v
al_loss: 2.0356 - val_accuracy: 0.3875

Epoch 00066: val_accuracy did not improve from 0.38750
Epoch 67/300
9/9 [==============================] - 0s 11ms/step - loss: 1.2162 - accuracy: 0.6948 - v
al_loss: 2.0729 - val_accuracy: 0.3125

Epoch 00067: val_accuracy did not improve from 0.38750
Epoch 68/300
9/9 [==============================] - 0s 13ms/step - loss: 1.2429 - accuracy: 0.6541 - v
al_loss: 2.0665 - val_accuracy: 0.3250
```

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Epoch 00068: val_accuracy did not improve from 0.38750
Epoch 69/300
9/9 [==============================] - 0s 24ms/step - loss: 1.2046 - accuracy: 0.6669 - v
al_loss: 2.0818 - val_accuracy: 0.3000

Epoch 00069: val_accuracy did not improve from 0.38750
Epoch 70/300
9/9 [==============================] - 0s 10ms/step - loss: 1.1748 - accuracy: 0.6855 - v
al_loss: 2.0529 - val_accuracy: 0.3000

Epoch 00070: val_accuracy did not improve from 0.38750
Epoch 71/300
9/9 [==============================] - 0s 12ms/step - loss: 1.0398 - accuracy: 0.7672 - v
al_loss: 2.0246 - val_accuracy: 0.3250

Epoch 00071: val_accuracy did not improve from 0.38750
Epoch 72/300
9/9 [==============================] - 0s 13ms/step - loss: 1.1382 - accuracy: 0.6852 - v
al_loss: 2.0299 - val_accuracy: 0.3125

Epoch 00072: val_accuracy did not improve from 0.38750
Epoch 73/300
9/9 [==============================] - 0s 10ms/step - loss: 1.1437 - accuracy: 0.6877 - v
al_loss: 2.0139 - val_accuracy: 0.3375

Epoch 00073: val_accuracy did not improve from 0.38750
Epoch 74/300
9/9 [==============================] - 0s 11ms/step - loss: 1.0870 - accuracy: 0.7397 - v
al_loss: 1.9950 - val_accuracy: 0.3250

Epoch 00074: val_accuracy did not improve from 0.38750
Epoch 75/300
9/9 [==============================] - 0s 10ms/step - loss: 1.0722 - accuracy: 0.7407 - v
al_loss: 2.0140 - val_accuracy: 0.3625

Epoch 00075: val_accuracy did not improve from 0.38750
Epoch 76/300
9/9 [==============================] - 0s 10ms/step - loss: 1.0823 - accuracy: 0.6945 - v
al_loss: 2.0144 - val_accuracy: 0.3500

Epoch 00076: val_accuracy did not improve from 0.38750
Epoch 77/300
9/9 [==============================] - 0s 13ms/step - loss: 1.0870 - accuracy: 0.7140 - v
al_loss: 1.9972 - val_accuracy: 0.3250

Epoch 00077: val_accuracy did not improve from 0.38750
Epoch 78/300
9/9 [==============================] - 0s 10ms/step - loss: 1.0859 - accuracy: 0.7418 - v
al_loss: 2.0106 - val_accuracy: 0.3750

Epoch 00078: val_accuracy did not improve from 0.38750
Epoch 79/300
9/9 [==============================] - 0s 10ms/step - loss: 1.1001 - accuracy: 0.6949 - v
al_loss: 2.0599 - val_accuracy: 0.3250

Epoch 00079: val_accuracy did not improve from 0.38750
Epoch 80/300
9/9 [==============================] - 0s 11ms/step - loss: 1.0338 - accuracy: 0.7634 - v
al_loss: 2.0736 - val_accuracy: 0.3375

Epoch 00080: val_accuracy did not improve from 0.38750
Epoch 81/300
9/9 [==============================] - 0s 11ms/step - loss: 1.0640 - accuracy: 0.7174 - v
al_loss: 2.0539 - val_accuracy: 0.3625

Epoch 00081: val_accuracy did not improve from 0.38750
Epoch 82/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9608 - accuracy: 0.7897 - v
al_loss: 2.0289 - val_accuracy: 0.3875

Epoch 00082: val_accuracy did not improve from 0.38750
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Epoch 83/300
9/9 [==============================] - 0s 12ms/step - loss: 1.1146 - accuracy: 0.6865 - v
al_loss: 1.9744 - val_accuracy: 0.4000

Epoch 00083: val_accuracy improved from 0.38750 to 0.40000, saving model to 1D_CNN.hdf5
Epoch 84/300
9/9 [==============================] - 0s 11ms/step - loss: 1.0574 - accuracy: 0.7419 - v
al_loss: 2.0044 - val_accuracy: 0.4250

Epoch 00084: val_accuracy improved from 0.40000 to 0.42500, saving model to 1D_CNN.hdf5
Epoch 85/300
9/9 [==============================] - 0s 10ms/step - loss: 1.0240 - accuracy: 0.7217 - v
al_loss: 2.0383 - val_accuracy: 0.4000

Epoch 00085: val_accuracy did not improve from 0.42500
Epoch 86/300
9/9 [==============================] - 0s 11ms/step - loss: 1.0565 - accuracy: 0.7559 - v
al_loss: 2.0143 - val_accuracy: 0.3625

Epoch 00086: val_accuracy did not improve from 0.42500
Epoch 87/300
9/9 [==============================] - 0s 10ms/step - loss: 1.0133 - accuracy: 0.7742 - v
al_loss: 2.0000 - val_accuracy: 0.3625

Epoch 00087: val_accuracy did not improve from 0.42500
Epoch 88/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9920 - accuracy: 0.7695 - v
al_loss: 2.0229 - val_accuracy: 0.3500

Epoch 00088: val_accuracy did not improve from 0.42500
Epoch 89/300
9/9 [==============================] - 0s 10ms/step - loss: 1.0378 - accuracy: 0.7383 - v
al_loss: 2.0686 - val_accuracy: 0.3625

Epoch 00089: val_accuracy did not improve from 0.42500
Epoch 90/300
9/9 [==============================] - 0s 10ms/step - loss: 0.9895 - accuracy: 0.7620 - v
al_loss: 2.0480 - val_accuracy: 0.3000

Epoch 00090: val_accuracy did not improve from 0.42500
Epoch 91/300
9/9 [==============================] - 0s 12ms/step - loss: 1.0339 - accuracy: 0.7685 - v
al_loss: 2.0086 - val_accuracy: 0.3250

Epoch 00091: val_accuracy did not improve from 0.42500
Epoch 92/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9621 - accuracy: 0.7483 - v
al_loss: 1.9232 - val_accuracy: 0.3875

Epoch 00092: val_accuracy did not improve from 0.42500
Epoch 93/300
9/9 [==============================] - 0s 13ms/step - loss: 1.0030 - accuracy: 0.7503 - v
al_loss: 1.9128 - val_accuracy: 0.3875

Epoch 00093: val_accuracy did not improve from 0.42500
Epoch 94/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9287 - accuracy: 0.7680 - v
al_loss: 1.9561 - val_accuracy: 0.4000

Epoch 00094: val_accuracy did not improve from 0.42500
Epoch 95/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9337 - accuracy: 0.7874 - v
al_loss: 1.9788 - val_accuracy: 0.4125

Epoch 00095: val_accuracy did not improve from 0.42500
Epoch 96/300
9/9 [==============================] - 0s 14ms/step - loss: 0.9370 - accuracy: 0.7882 - v
al_loss: 1.9703 - val_accuracy: 0.4125

Epoch 00096: val_accuracy did not improve from 0.42500
Epoch 97/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9575 - accuracy: 0.7467 - v
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al_loss: 1.9149 - val_accuracy: 0.4000

Epoch 00097: val_accuracy did not improve from 0.42500
Epoch 98/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9893 - accuracy: 0.7414 - v
al_loss: 1.9361 - val_accuracy: 0.3750

Epoch 00098: val_accuracy did not improve from 0.42500
Epoch 99/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9730 - accuracy: 0.7683 - v
al_loss: 1.9611 - val_accuracy: 0.3750

Epoch 00099: val_accuracy did not improve from 0.42500
Epoch 100/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9657 - accuracy: 0.7575 - v
al_loss: 1.9723 - val_accuracy: 0.3875

Epoch 00100: val_accuracy did not improve from 0.42500
Epoch 101/300
9/9 [==============================] - 0s 11ms/step - loss: 0.8670 - accuracy: 0.8452 - v
al_loss: 1.9994 - val_accuracy: 0.3500

Epoch 00101: val_accuracy did not improve from 0.42500
Epoch 102/300
9/9 [==============================] - 0s 10ms/step - loss: 0.8888 - accuracy: 0.7683 - v
al_loss: 1.9683 - val_accuracy: 0.3750

Epoch 00102: val_accuracy did not improve from 0.42500
Epoch 103/300
9/9 [==============================] - 0s 11ms/step - loss: 0.9079 - accuracy: 0.7934 - v
al_loss: 2.0089 - val_accuracy: 0.4000

Epoch 00103: val_accuracy did not improve from 0.42500
Epoch 104/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9026 - accuracy: 0.7900 - v
al_loss: 2.0039 - val_accuracy: 0.3875

Epoch 00104: val_accuracy did not improve from 0.42500
Epoch 105/300
9/9 [==============================] - 0s 13ms/step - loss: 1.0398 - accuracy: 0.6915 - v
al_loss: 1.9706 - val_accuracy: 0.3875

Epoch 00105: val_accuracy did not improve from 0.42500
Epoch 106/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9060 - accuracy: 0.7805 - v
al_loss: 1.9401 - val_accuracy: 0.3875

Epoch 00106: val_accuracy did not improve from 0.42500
Epoch 107/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9457 - accuracy: 0.7654 - v
al_loss: 2.0262 - val_accuracy: 0.3625

Epoch 00107: val_accuracy did not improve from 0.42500
Epoch 108/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9628 - accuracy: 0.7576 - v
al_loss: 2.0160 - val_accuracy: 0.3750

Epoch 00108: val_accuracy did not improve from 0.42500
Epoch 109/300
9/9 [==============================] - 0s 13ms/step - loss: 0.9345 - accuracy: 0.7308 - v
al_loss: 2.0108 - val_accuracy: 0.3625

Epoch 00109: val_accuracy did not improve from 0.42500
Epoch 110/300
9/9 [==============================] - 0s 14ms/step - loss: 0.8846 - accuracy: 0.7558 - v
al_loss: 1.9586 - val_accuracy: 0.3875

Epoch 00110: val_accuracy did not improve from 0.42500
Epoch 111/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9057 - accuracy: 0.7857 - v
al_loss: 1.9497 - val_accuracy: 0.3875

Epoch 00111: val_accuracy did not improve from 0.42500
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Epoch 00111: val_accuracy did not improve from 0.42500
Epoch 112/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8324 - accuracy: 0.8316 - v
al_loss: 1.9745 - val_accuracy: 0.3625

Epoch 00112: val_accuracy did not improve from 0.42500
Epoch 113/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9546 - accuracy: 0.7272 - v
al_loss: 2.0573 - val_accuracy: 0.3375

Epoch 00113: val_accuracy did not improve from 0.42500
Epoch 114/300
9/9 [==============================] - 0s 28ms/step - loss: 0.8878 - accuracy: 0.7995 - v
al_loss: 1.9754 - val_accuracy: 0.4000

Epoch 00114: val_accuracy did not improve from 0.42500
Epoch 115/300
9/9 [==============================] - 0s 12ms/step - loss: 0.9120 - accuracy: 0.7722 - v
al_loss: 1.9866 - val_accuracy: 0.4000

Epoch 00115: val_accuracy did not improve from 0.42500
Epoch 116/300
9/9 [==============================] - 0s 13ms/step - loss: 1.0213 - accuracy: 0.7254 - v
al_loss: 2.0316 - val_accuracy: 0.3625

Epoch 00116: val_accuracy did not improve from 0.42500
Epoch 117/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8014 - accuracy: 0.8138 - v
al_loss: 1.9945 - val_accuracy: 0.3500

Epoch 00117: val_accuracy did not improve from 0.42500
Epoch 118/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7628 - accuracy: 0.8401 - v
al_loss: 1.9872 - val_accuracy: 0.3875

Epoch 00118: val_accuracy did not improve from 0.42500
Epoch 119/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7819 - accuracy: 0.8232 - v
al_loss: 1.9383 - val_accuracy: 0.4125

Epoch 00119: val_accuracy did not improve from 0.42500
Epoch 120/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8522 - accuracy: 0.8126 - v
al_loss: 1.9307 - val_accuracy: 0.4250

Epoch 00120: val_accuracy did not improve from 0.42500
Epoch 121/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8269 - accuracy: 0.8288 - v
al_loss: 1.9940 - val_accuracy: 0.3750

Epoch 00121: val_accuracy did not improve from 0.42500
Epoch 122/300
9/9 [==============================] - 0s 12ms/step - loss: 0.8562 - accuracy: 0.8176 - v
al_loss: 1.9533 - val_accuracy: 0.3625

Epoch 00122: val_accuracy did not improve from 0.42500
Epoch 123/300
9/9 [==============================] - 0s 14ms/step - loss: 0.9237 - accuracy: 0.7451 - v
al_loss: 1.9360 - val_accuracy: 0.3875

Epoch 00123: val_accuracy did not improve from 0.42500
Epoch 124/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8240 - accuracy: 0.8187 - v
al_loss: 1.9745 - val_accuracy: 0.3625

Epoch 00124: val_accuracy did not improve from 0.42500
Epoch 125/300
9/9 [==============================] - 0s 12ms/step - loss: 0.8622 - accuracy: 0.7795 - v
al_loss: 1.9587 - val_accuracy: 0.4000

Epoch 00125: val_accuracy did not improve from 0.42500
Epoch 126/300
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9/9 [==============================] - 0s 12ms/step - loss: 0.8060 - accuracy: 0.8222 - v
al_loss: 1.9651 - val_accuracy: 0.4125

Epoch 00126: val_accuracy did not improve from 0.42500
Epoch 127/300
9/9 [==============================] - 0s 12ms/step - loss: 0.8403 - accuracy: 0.7783 - v
al_loss: 1.9891 - val_accuracy: 0.3750

Epoch 00127: val_accuracy did not improve from 0.42500
Epoch 128/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8707 - accuracy: 0.7951 - v
al_loss: 1.9382 - val_accuracy: 0.3875

Epoch 00128: val_accuracy did not improve from 0.42500
Epoch 129/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8780 - accuracy: 0.7938 - v
al_loss: 1.8632 - val_accuracy: 0.4125

Epoch 00129: val_accuracy did not improve from 0.42500
Epoch 130/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8625 - accuracy: 0.7839 - v
al_loss: 1.8109 - val_accuracy: 0.4500

Epoch 00130: val_accuracy improved from 0.42500 to 0.45000, saving model to 1D_CNN.hdf5
Epoch 131/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7781 - accuracy: 0.7815 - v
al_loss: 1.9013 - val_accuracy: 0.3625

Epoch 00131: val_accuracy did not improve from 0.45000
Epoch 132/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7321 - accuracy: 0.8422 - v
al_loss: 2.0219 - val_accuracy: 0.3875

Epoch 00132: val_accuracy did not improve from 0.45000
Epoch 133/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7758 - accuracy: 0.8267 - v
al_loss: 1.8584 - val_accuracy: 0.4500

Epoch 00133: val_accuracy did not improve from 0.45000
Epoch 134/300
9/9 [==============================] - 0s 12ms/step - loss: 0.8293 - accuracy: 0.7761 - v
al_loss: 1.8636 - val_accuracy: 0.4250

Epoch 00134: val_accuracy did not improve from 0.45000
Epoch 135/300
9/9 [==============================] - 0s 11ms/step - loss: 0.8705 - accuracy: 0.7505 - v
al_loss: 1.8825 - val_accuracy: 0.4250

Epoch 00135: val_accuracy did not improve from 0.45000
Epoch 136/300
9/9 [==============================] - 0s 11ms/step - loss: 0.8914 - accuracy: 0.7915 - v
al_loss: 1.9088 - val_accuracy: 0.4000

Epoch 00136: val_accuracy did not improve from 0.45000
Epoch 137/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8156 - accuracy: 0.7980 - v
al_loss: 1.9590 - val_accuracy: 0.4000

Epoch 00137: val_accuracy did not improve from 0.45000
Epoch 138/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7863 - accuracy: 0.8205 - v
al_loss: 1.9988 - val_accuracy: 0.4125

Epoch 00138: val_accuracy did not improve from 0.45000
Epoch 139/300
9/9 [==============================] - 0s 14ms/step - loss: 0.7508 - accuracy: 0.8582 - v
al_loss: 2.0782 - val_accuracy: 0.4000

Epoch 00139: val_accuracy did not improve from 0.45000
Epoch 140/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7145 - accuracy: 0.8363 - v
al_loss: 1.9007 - val_accuracy: 0.4000
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Epoch 00140: val_accuracy did not improve from 0.45000
Epoch 141/300
9/9 [==============================] - 0s 13ms/step - loss: 0.8040 - accuracy: 0.7889 - v
al_loss: 1.9415 - val_accuracy: 0.4500

Epoch 00141: val_accuracy did not improve from 0.45000
Epoch 142/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7956 - accuracy: 0.8262 - v
al_loss: 2.0389 - val_accuracy: 0.4250

Epoch 00142: val_accuracy did not improve from 0.45000
Epoch 143/300
9/9 [==============================] - 0s 10ms/step - loss: 0.7947 - accuracy: 0.7791 - v
al_loss: 2.0277 - val_accuracy: 0.4125

Epoch 00143: val_accuracy did not improve from 0.45000
Epoch 144/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7793 - accuracy: 0.8034 - v
al_loss: 1.9452 - val_accuracy: 0.3875

Epoch 00144: val_accuracy did not improve from 0.45000
Epoch 145/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7899 - accuracy: 0.7969 - v
al_loss: 1.8920 - val_accuracy: 0.4250

Epoch 00145: val_accuracy did not improve from 0.45000
Epoch 146/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7483 - accuracy: 0.7934 - v
al_loss: 1.8986 - val_accuracy: 0.4250

Epoch 00146: val_accuracy did not improve from 0.45000
Epoch 147/300
9/9 [==============================] - 0s 11ms/step - loss: 0.8100 - accuracy: 0.8156 - v
al_loss: 2.0020 - val_accuracy: 0.3625

Epoch 00147: val_accuracy did not improve from 0.45000
Epoch 148/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7947 - accuracy: 0.7924 - v
al_loss: 1.9310 - val_accuracy: 0.3500

Epoch 00148: val_accuracy did not improve from 0.45000
Epoch 149/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7400 - accuracy: 0.8144 - v
al_loss: 1.9089 - val_accuracy: 0.3875

Epoch 00149: val_accuracy did not improve from 0.45000
Epoch 150/300
9/9 [==============================] - 0s 24ms/step - loss: 0.7607 - accuracy: 0.8476 - v
al_loss: 2.1389 - val_accuracy: 0.3875

Epoch 00150: val_accuracy did not improve from 0.45000
Epoch 151/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7710 - accuracy: 0.7904 - v
al_loss: 1.9062 - val_accuracy: 0.4125

Epoch 00151: val_accuracy did not improve from 0.45000
Epoch 152/300
9/9 [==============================] - 0s 10ms/step - loss: 0.7912 - accuracy: 0.8051 - v
al_loss: 1.9630 - val_accuracy: 0.3875

Epoch 00152: val_accuracy did not improve from 0.45000
Epoch 153/300
9/9 [==============================] - 0s 11ms/step - loss: 0.8066 - accuracy: 0.8072 - v
al_loss: 1.9847 - val_accuracy: 0.4375

Epoch 00153: val_accuracy did not improve from 0.45000
Epoch 154/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7806 - accuracy: 0.8142 - v
al_loss: 1.8920 - val_accuracy: 0.4250

Epoch 00154: val_accuracy did not improve from 0.45000
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Epoch 155/300
9/9 [==============================] - 0s 10ms/step - loss: 0.7278 - accuracy: 0.8046 - v
al_loss: 1.8763 - val_accuracy: 0.4250

Epoch 00155: val_accuracy did not improve from 0.45000
Epoch 156/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7178 - accuracy: 0.8373 - v
al_loss: 1.8550 - val_accuracy: 0.3875

Epoch 00156: val_accuracy did not improve from 0.45000
Epoch 157/300
9/9 [==============================] - 0s 10ms/step - loss: 0.7720 - accuracy: 0.7990 - v
al_loss: 1.8134 - val_accuracy: 0.4500

Epoch 00157: val_accuracy did not improve from 0.45000
Epoch 158/300
9/9 [==============================] - 0s 10ms/step - loss: 0.7051 - accuracy: 0.8148 - v
al_loss: 1.7895 - val_accuracy: 0.4625

Epoch 00158: val_accuracy improved from 0.45000 to 0.46250, saving model to 1D_CNN.hdf5
Epoch 159/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7471 - accuracy: 0.8048 - v
al_loss: 1.8134 - val_accuracy: 0.4500

Epoch 00159: val_accuracy did not improve from 0.46250
Epoch 160/300
9/9 [==============================] - 0s 11ms/step - loss: 0.8345 - accuracy: 0.7789 - v
al_loss: 1.8405 - val_accuracy: 0.4375

Epoch 00160: val_accuracy did not improve from 0.46250
Epoch 161/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7482 - accuracy: 0.8100 - v
al_loss: 1.7623 - val_accuracy: 0.5125

Epoch 00161: val_accuracy improved from 0.46250 to 0.51250, saving model to 1D_CNN.hdf5
Epoch 162/300
9/9 [==============================] - 0s 11ms/step - loss: 0.7246 - accuracy: 0.8422 - v
al_loss: 1.7592 - val_accuracy: 0.4750

Epoch 00162: val_accuracy did not improve from 0.51250
Epoch 163/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7295 - accuracy: 0.8346 - v
al_loss: 1.7667 - val_accuracy: 0.4625

Epoch 00163: val_accuracy did not improve from 0.51250
Epoch 164/300
9/9 [==============================] - 0s 10ms/step - loss: 0.6803 - accuracy: 0.8640 - v
al_loss: 1.7543 - val_accuracy: 0.4375

Epoch 00164: val_accuracy did not improve from 0.51250
Epoch 165/300
9/9 [==============================] - 0s 14ms/step - loss: 0.7806 - accuracy: 0.7783 - v
al_loss: 1.7375 - val_accuracy: 0.5125

Epoch 00165: val_accuracy did not improve from 0.51250
Epoch 166/300
9/9 [==============================] - 0s 10ms/step - loss: 0.8103 - accuracy: 0.7718 - v
al_loss: 1.7807 - val_accuracy: 0.3875

Epoch 00166: val_accuracy did not improve from 0.51250
Epoch 167/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6360 - accuracy: 0.8870 - v
al_loss: 1.7808 - val_accuracy: 0.4500

Epoch 00167: val_accuracy did not improve from 0.51250
Epoch 168/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7355 - accuracy: 0.8285 - v
al_loss: 1.8090 - val_accuracy: 0.4250

Epoch 00168: val_accuracy did not improve from 0.51250
Epoch 169/300
9/9 [==============================] - 0s 11ms/step - loss: 0.7061 - accuracy: 0.8515 - v
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al_loss: 1.8358 - val_accuracy: 0.4500

Epoch 00169: val_accuracy did not improve from 0.51250
Epoch 170/300
9/9 [==============================] - 0s 11ms/step - loss: 0.7659 - accuracy: 0.8183 - v
al_loss: 1.8156 - val_accuracy: 0.4500

Epoch 00170: val_accuracy did not improve from 0.51250
Epoch 171/300
9/9 [==============================] - 0s 10ms/step - loss: 0.6580 - accuracy: 0.8365 - v
al_loss: 1.8531 - val_accuracy: 0.4250

Epoch 00171: val_accuracy did not improve from 0.51250
Epoch 172/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6898 - accuracy: 0.8285 - v
al_loss: 1.9121 - val_accuracy: 0.4375

Epoch 00172: val_accuracy did not improve from 0.51250
Epoch 173/300
9/9 [==============================] - 0s 14ms/step - loss: 0.7346 - accuracy: 0.8070 - v
al_loss: 1.8473 - val_accuracy: 0.4000

Epoch 00173: val_accuracy did not improve from 0.51250
Epoch 174/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6822 - accuracy: 0.8795 - v
al_loss: 1.8642 - val_accuracy: 0.4250

Epoch 00174: val_accuracy did not improve from 0.51250
Epoch 175/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7118 - accuracy: 0.8282 - v
al_loss: 1.8610 - val_accuracy: 0.4250

Epoch 00175: val_accuracy did not improve from 0.51250
Epoch 176/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6634 - accuracy: 0.8345 - v
al_loss: 1.8565 - val_accuracy: 0.4375

Epoch 00176: val_accuracy did not improve from 0.51250
Epoch 177/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7389 - accuracy: 0.8287 - v
al_loss: 1.8715 - val_accuracy: 0.4250

Epoch 00177: val_accuracy did not improve from 0.51250
Epoch 178/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6715 - accuracy: 0.8328 - v
al_loss: 1.9182 - val_accuracy: 0.3875

Epoch 00178: val_accuracy did not improve from 0.51250
Epoch 179/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7069 - accuracy: 0.8303 - v
al_loss: 1.9448 - val_accuracy: 0.3375

Epoch 00179: val_accuracy did not improve from 0.51250
Epoch 180/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6938 - accuracy: 0.8595 - v
al_loss: 1.8003 - val_accuracy: 0.4500

Epoch 00180: val_accuracy did not improve from 0.51250
Epoch 181/300
9/9 [==============================] - 0s 26ms/step - loss: 0.6737 - accuracy: 0.8367 - v
al_loss: 1.8306 - val_accuracy: 0.4375

Epoch 00181: val_accuracy did not improve from 0.51250
Epoch 182/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6828 - accuracy: 0.8244 - v
al_loss: 1.8286 - val_accuracy: 0.4125

Epoch 00182: val_accuracy did not improve from 0.51250
Epoch 183/300
9/9 [==============================] - 0s 11ms/step - loss: 0.6906 - accuracy: 0.8324 - v
al_loss: 1.7840 - val_accuracy: 0.4500

Epoch 00183: val_accuracy did not improve from 0.51250
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Epoch 00183: val_accuracy did not improve from 0.51250
Epoch 184/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6416 - accuracy: 0.8447 - v
al_loss: 1.8174 - val_accuracy: 0.4250

Epoch 00184: val_accuracy did not improve from 0.51250
Epoch 185/300
9/9 [==============================] - 0s 10ms/step - loss: 0.6768 - accuracy: 0.8123 - v
al_loss: 1.8610 - val_accuracy: 0.4250

Epoch 00185: val_accuracy did not improve from 0.51250
Epoch 186/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6247 - accuracy: 0.8340 - v
al_loss: 1.8764 - val_accuracy: 0.4250

Epoch 00186: val_accuracy did not improve from 0.51250
Epoch 187/300
9/9 [==============================] - 0s 10ms/step - loss: 0.6589 - accuracy: 0.7945 - v
al_loss: 1.8293 - val_accuracy: 0.4250

Epoch 00187: val_accuracy did not improve from 0.51250
Epoch 188/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6557 - accuracy: 0.8452 - v
al_loss: 1.7724 - val_accuracy: 0.4750

Epoch 00188: val_accuracy did not improve from 0.51250
Epoch 189/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6963 - accuracy: 0.8092 - v
al_loss: 1.7509 - val_accuracy: 0.5000

Epoch 00189: val_accuracy did not improve from 0.51250
Epoch 190/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6881 - accuracy: 0.8170 - v
al_loss: 1.7403 - val_accuracy: 0.5250

Epoch 00190: val_accuracy improved from 0.51250 to 0.52500, saving model to 1D_CNN.hdf5
Epoch 191/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6060 - accuracy: 0.8561 - v
al_loss: 1.7124 - val_accuracy: 0.4875

Epoch 00191: val_accuracy did not improve from 0.52500
Epoch 192/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7438 - accuracy: 0.8187 - v
al_loss: 1.8020 - val_accuracy: 0.4500

Epoch 00192: val_accuracy did not improve from 0.52500
Epoch 193/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6683 - accuracy: 0.8448 - v
al_loss: 1.8657 - val_accuracy: 0.4000

Epoch 00193: val_accuracy did not improve from 0.52500
Epoch 194/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5944 - accuracy: 0.8724 - v
al_loss: 1.8103 - val_accuracy: 0.4250

Epoch 00194: val_accuracy did not improve from 0.52500
Epoch 195/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6642 - accuracy: 0.8685 - v
al_loss: 1.6664 - val_accuracy: 0.4875

Epoch 00195: val_accuracy did not improve from 0.52500
Epoch 196/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6079 - accuracy: 0.8585 - v
al_loss: 1.6746 - val_accuracy: 0.4875

Epoch 00196: val_accuracy did not improve from 0.52500
Epoch 197/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6737 - accuracy: 0.8512 - v
al_loss: 1.7222 - val_accuracy: 0.4750

Epoch 00197: val_accuracy did not improve from 0.52500
Epoch 198/300
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9/9 [==============================] - 0s 12ms/step - loss: 0.7646 - accuracy: 0.7539 - v
al_loss: 1.7470 - val_accuracy: 0.4500

Epoch 00198: val_accuracy did not improve from 0.52500
Epoch 199/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7243 - accuracy: 0.8286 - v
al_loss: 1.7052 - val_accuracy: 0.4625

Epoch 00199: val_accuracy did not improve from 0.52500
Epoch 200/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6285 - accuracy: 0.8358 - v
al_loss: 1.8663 - val_accuracy: 0.4250

Epoch 00200: val_accuracy did not improve from 0.52500
Epoch 201/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7380 - accuracy: 0.8289 - v
al_loss: 1.7873 - val_accuracy: 0.4250

Epoch 00201: val_accuracy did not improve from 0.52500
Epoch 202/300
9/9 [==============================] - 0s 10ms/step - loss: 0.6542 - accuracy: 0.8531 - v
al_loss: 1.7189 - val_accuracy: 0.4875

Epoch 00202: val_accuracy did not improve from 0.52500
Epoch 203/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6282 - accuracy: 0.8443 - v
al_loss: 1.7654 - val_accuracy: 0.4375

Epoch 00203: val_accuracy did not improve from 0.52500
Epoch 204/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7762 - accuracy: 0.7715 - v
al_loss: 1.8141 - val_accuracy: 0.4500

Epoch 00204: val_accuracy did not improve from 0.52500
Epoch 205/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6342 - accuracy: 0.8559 - v
al_loss: 1.8015 - val_accuracy: 0.4625

Epoch 00205: val_accuracy did not improve from 0.52500
Epoch 206/300
9/9 [==============================] - 0s 12ms/step - loss: 0.7142 - accuracy: 0.8253 - v
al_loss: 1.8296 - val_accuracy: 0.4750

Epoch 00206: val_accuracy did not improve from 0.52500
Epoch 207/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6616 - accuracy: 0.8190 - v
al_loss: 1.7378 - val_accuracy: 0.5000

Epoch 00207: val_accuracy did not improve from 0.52500
Epoch 208/300
9/9 [==============================] - 0s 15ms/step - loss: 0.6675 - accuracy: 0.8550 - v
al_loss: 1.7566 - val_accuracy: 0.4750

Epoch 00208: val_accuracy did not improve from 0.52500
Epoch 209/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6816 - accuracy: 0.8509 - v
al_loss: 1.7918 - val_accuracy: 0.4875

Epoch 00209: val_accuracy did not improve from 0.52500
Epoch 210/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7327 - accuracy: 0.7961 - v
al_loss: 1.7732 - val_accuracy: 0.4750

Epoch 00210: val_accuracy did not improve from 0.52500
Epoch 211/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6840 - accuracy: 0.8203 - v
al_loss: 1.7546 - val_accuracy: 0.4875

Epoch 00211: val_accuracy did not improve from 0.52500
Epoch 212/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6500 - accuracy: 0.8720 - v
al_loss: 1.9003 - val_accuracy: 0.4500
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Epoch 00212: val_accuracy did not improve from 0.52500
Epoch 213/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6760 - accuracy: 0.8562 - v
al_loss: 2.0169 - val_accuracy: 0.4250

Epoch 00213: val_accuracy did not improve from 0.52500
Epoch 214/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6219 - accuracy: 0.8661 - v
al_loss: 1.7620 - val_accuracy: 0.5125

Epoch 00214: val_accuracy did not improve from 0.52500
Epoch 215/300
9/9 [==============================] - 0s 14ms/step - loss: 0.5918 - accuracy: 0.8722 - v
al_loss: 1.6747 - val_accuracy: 0.5375

Epoch 00215: val_accuracy improved from 0.52500 to 0.53750, saving model to 1D_CNN.hdf5
Epoch 216/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7283 - accuracy: 0.8081 - v
al_loss: 1.6619 - val_accuracy: 0.4875

Epoch 00216: val_accuracy did not improve from 0.53750
Epoch 217/300
9/9 [==============================] - 0s 15ms/step - loss: 0.6693 - accuracy: 0.8492 - v
al_loss: 1.7710 - val_accuracy: 0.5000

Epoch 00217: val_accuracy did not improve from 0.53750
Epoch 218/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5955 - accuracy: 0.8678 - v
al_loss: 1.8079 - val_accuracy: 0.4750

Epoch 00218: val_accuracy did not improve from 0.53750
Epoch 219/300
9/9 [==============================] - 0s 14ms/step - loss: 0.5525 - accuracy: 0.8924 - v
al_loss: 1.8366 - val_accuracy: 0.4750

Epoch 00219: val_accuracy did not improve from 0.53750
Epoch 220/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6239 - accuracy: 0.8683 - v
al_loss: 1.9749 - val_accuracy: 0.4375

Epoch 00220: val_accuracy did not improve from 0.53750
Epoch 221/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6223 - accuracy: 0.8464 - v
al_loss: 2.1271 - val_accuracy: 0.4125

Epoch 00221: val_accuracy did not improve from 0.53750
Epoch 222/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6831 - accuracy: 0.8182 - v
al_loss: 2.0462 - val_accuracy: 0.4125

Epoch 00222: val_accuracy did not improve from 0.53750
Epoch 223/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6695 - accuracy: 0.8335 - v
al_loss: 2.2549 - val_accuracy: 0.3500

Epoch 00223: val_accuracy did not improve from 0.53750
Epoch 224/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6683 - accuracy: 0.8221 - v
al_loss: 2.1403 - val_accuracy: 0.3750

Epoch 00224: val_accuracy did not improve from 0.53750
Epoch 225/300
9/9 [==============================] - 0s 15ms/step - loss: 0.6736 - accuracy: 0.8175 - v
al_loss: 1.9975 - val_accuracy: 0.3875

Epoch 00225: val_accuracy did not improve from 0.53750
Epoch 226/300
9/9 [==============================] - 0s 27ms/step - loss: 0.7108 - accuracy: 0.8322 - v
al_loss: 1.9540 - val_accuracy: 0.4125

Epoch 00226: val_accuracy did not improve from 0.53750
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Epoch 227/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5789 - accuracy: 0.8936 - v
al_loss: 1.9758 - val_accuracy: 0.3875

Epoch 00227: val_accuracy did not improve from 0.53750
Epoch 228/300
9/9 [==============================] - 0s 14ms/step - loss: 0.5958 - accuracy: 0.8658 - v
al_loss: 2.0422 - val_accuracy: 0.3750

Epoch 00228: val_accuracy did not improve from 0.53750
Epoch 229/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6647 - accuracy: 0.8416 - v
al_loss: 2.2496 - val_accuracy: 0.3625

Epoch 00229: val_accuracy did not improve from 0.53750
Epoch 230/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7183 - accuracy: 0.8011 - v
al_loss: 2.0042 - val_accuracy: 0.3625

Epoch 00230: val_accuracy did not improve from 0.53750
Epoch 231/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6009 - accuracy: 0.8312 - v
al_loss: 2.0157 - val_accuracy: 0.3375

Epoch 00231: val_accuracy did not improve from 0.53750
Epoch 232/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5797 - accuracy: 0.8662 - v
al_loss: 2.0837 - val_accuracy: 0.3750

Epoch 00232: val_accuracy did not improve from 0.53750
Epoch 233/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6897 - accuracy: 0.8444 - v
al_loss: 1.9040 - val_accuracy: 0.4625

Epoch 00233: val_accuracy did not improve from 0.53750
Epoch 234/300
9/9 [==============================] - 0s 15ms/step - loss: 0.5861 - accuracy: 0.8829 - v
al_loss: 1.8541 - val_accuracy: 0.4125

Epoch 00234: val_accuracy did not improve from 0.53750
Epoch 235/300
9/9 [==============================] - 0s 11ms/step - loss: 0.6300 - accuracy: 0.8305 - v
al_loss: 2.0058 - val_accuracy: 0.4375

Epoch 00235: val_accuracy did not improve from 0.53750
Epoch 236/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6275 - accuracy: 0.8384 - v
al_loss: 1.8552 - val_accuracy: 0.4625

Epoch 00236: val_accuracy did not improve from 0.53750
Epoch 237/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5984 - accuracy: 0.8510 - v
al_loss: 1.8260 - val_accuracy: 0.4875

Epoch 00237: val_accuracy did not improve from 0.53750
Epoch 238/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5024 - accuracy: 0.8936 - v
al_loss: 1.8610 - val_accuracy: 0.4625

Epoch 00238: val_accuracy did not improve from 0.53750
Epoch 239/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5699 - accuracy: 0.8705 - v
al_loss: 1.8236 - val_accuracy: 0.4375

Epoch 00239: val_accuracy did not improve from 0.53750
Epoch 240/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5472 - accuracy: 0.8663 - v
al_loss: 1.8042 - val_accuracy: 0.4375

Epoch 00240: val_accuracy did not improve from 0.53750
Epoch 241/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5683 - accuracy: 0.8942 - v
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al_loss: 1.8423 - val_accuracy: 0.4500

Epoch 00241: val_accuracy did not improve from 0.53750
Epoch 242/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5175 - accuracy: 0.8762 - v
al_loss: 1.8997 - val_accuracy: 0.3875

Epoch 00242: val_accuracy did not improve from 0.53750
Epoch 243/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6578 - accuracy: 0.8149 - v
al_loss: 1.9441 - val_accuracy: 0.4125

Epoch 00243: val_accuracy did not improve from 0.53750
Epoch 244/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6506 - accuracy: 0.8304 - v
al_loss: 2.1027 - val_accuracy: 0.4125

Epoch 00244: val_accuracy did not improve from 0.53750
Epoch 245/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5618 - accuracy: 0.8563 - v
al_loss: 1.9301 - val_accuracy: 0.5000

Epoch 00245: val_accuracy did not improve from 0.53750
Epoch 246/300
9/9 [==============================] - 0s 14ms/step - loss: 0.5441 - accuracy: 0.8804 - v
al_loss: 1.8556 - val_accuracy: 0.5125

Epoch 00246: val_accuracy did not improve from 0.53750
Epoch 247/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5863 - accuracy: 0.8333 - v
al_loss: 1.9739 - val_accuracy: 0.4125

Epoch 00247: val_accuracy did not improve from 0.53750
Epoch 248/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5597 - accuracy: 0.8586 - v
al_loss: 2.0344 - val_accuracy: 0.4375

Epoch 00248: val_accuracy did not improve from 0.53750
Epoch 249/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5552 - accuracy: 0.8760 - v
al_loss: 2.1107 - val_accuracy: 0.4250

Epoch 00249: val_accuracy did not improve from 0.53750
Epoch 250/300
9/9 [==============================] - 0s 14ms/step - loss: 0.5860 - accuracy: 0.8497 - v
al_loss: 2.2658 - val_accuracy: 0.3500

Epoch 00250: val_accuracy did not improve from 0.53750
Epoch 251/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6694 - accuracy: 0.8467 - v
al_loss: 2.1520 - val_accuracy: 0.3875

Epoch 00251: val_accuracy did not improve from 0.53750
Epoch 252/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6069 - accuracy: 0.8477 - v
al_loss: 2.1142 - val_accuracy: 0.4125

Epoch 00252: val_accuracy did not improve from 0.53750
Epoch 253/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5475 - accuracy: 0.8721 - v
al_loss: 1.9914 - val_accuracy: 0.4875

Epoch 00253: val_accuracy did not improve from 0.53750
Epoch 254/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6205 - accuracy: 0.8264 - v
al_loss: 2.3251 - val_accuracy: 0.4000

Epoch 00254: val_accuracy did not improve from 0.53750
Epoch 255/300
9/9 [==============================] - 0s 13ms/step - loss: 0.7072 - accuracy: 0.8080 - v
al_loss: 1.9114 - val_accuracy: 0.4375

Epoch 00255: val_accuracy did not improve from 0.53750
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Epoch 00255: val_accuracy did not improve from 0.53750
Epoch 256/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6551 - accuracy: 0.8144 - v
al_loss: 1.9902 - val_accuracy: 0.4625

Epoch 00256: val_accuracy did not improve from 0.53750
Epoch 257/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5644 - accuracy: 0.8559 - v
al_loss: 1.9728 - val_accuracy: 0.4375

Epoch 00257: val_accuracy did not improve from 0.53750
Epoch 258/300
9/9 [==============================] - 0s 15ms/step - loss: 0.6389 - accuracy: 0.8389 - v
al_loss: 2.1034 - val_accuracy: 0.4000

Epoch 00258: val_accuracy did not improve from 0.53750
Epoch 259/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6151 - accuracy: 0.8437 - v
al_loss: 1.9224 - val_accuracy: 0.4625

Epoch 00259: val_accuracy did not improve from 0.53750
Epoch 260/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5994 - accuracy: 0.8922 - v
al_loss: 1.9212 - val_accuracy: 0.4750

Epoch 00260: val_accuracy did not improve from 0.53750
Epoch 261/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5886 - accuracy: 0.8814 - v
al_loss: 2.0146 - val_accuracy: 0.3875

Epoch 00261: val_accuracy did not improve from 0.53750
Epoch 262/300
9/9 [==============================] - 0s 28ms/step - loss: 0.5897 - accuracy: 0.8339 - v
al_loss: 2.1498 - val_accuracy: 0.3625

Epoch 00262: val_accuracy did not improve from 0.53750
Epoch 263/300
9/9 [==============================] - 0s 15ms/step - loss: 0.6117 - accuracy: 0.8531 - v
al_loss: 1.9298 - val_accuracy: 0.4250

Epoch 00263: val_accuracy did not improve from 0.53750
Epoch 264/300
9/9 [==============================] - 0s 13ms/step - loss: 0.6016 - accuracy: 0.8635 - v
al_loss: 1.9707 - val_accuracy: 0.4250

Epoch 00264: val_accuracy did not improve from 0.53750
Epoch 265/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6886 - accuracy: 0.8177 - v
al_loss: 2.0583 - val_accuracy: 0.4500

Epoch 00265: val_accuracy did not improve from 0.53750
Epoch 266/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5927 - accuracy: 0.8607 - v
al_loss: 1.9088 - val_accuracy: 0.4375

Epoch 00266: val_accuracy did not improve from 0.53750
Epoch 267/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6016 - accuracy: 0.8555 - v
al_loss: 1.8562 - val_accuracy: 0.4750

Epoch 00267: val_accuracy did not improve from 0.53750
Epoch 268/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5578 - accuracy: 0.8803 - v
al_loss: 2.0607 - val_accuracy: 0.4125

Epoch 00268: val_accuracy did not improve from 0.53750
Epoch 269/300
9/9 [==============================] - 0s 10ms/step - loss: 0.5750 - accuracy: 0.8493 - v
al_loss: 1.8463 - val_accuracy: 0.4375

Epoch 00269: val_accuracy did not improve from 0.53750
Epoch 270/300
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9/9 [==============================] - 0s 13ms/step - loss: 0.5539 - accuracy: 0.8855 - v
al_loss: 1.9580 - val_accuracy: 0.4250

Epoch 00270: val_accuracy did not improve from 0.53750
Epoch 271/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6019 - accuracy: 0.8435 - v
al_loss: 1.9403 - val_accuracy: 0.4375

Epoch 00271: val_accuracy did not improve from 0.53750
Epoch 272/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6053 - accuracy: 0.8310 - v
al_loss: 1.8597 - val_accuracy: 0.4750

Epoch 00272: val_accuracy did not improve from 0.53750
Epoch 273/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5553 - accuracy: 0.8800 - v
al_loss: 1.8851 - val_accuracy: 0.4625

Epoch 00273: val_accuracy did not improve from 0.53750
Epoch 274/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5880 - accuracy: 0.8836 - v
al_loss: 2.0687 - val_accuracy: 0.4625

Epoch 00274: val_accuracy did not improve from 0.53750
Epoch 275/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5452 - accuracy: 0.9002 - v
al_loss: 2.0947 - val_accuracy: 0.4500

Epoch 00275: val_accuracy did not improve from 0.53750
Epoch 276/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5302 - accuracy: 0.8903 - v
al_loss: 1.8839 - val_accuracy: 0.5125

Epoch 00276: val_accuracy did not improve from 0.53750
Epoch 277/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6006 - accuracy: 0.8402 - v
al_loss: 1.9887 - val_accuracy: 0.4875

Epoch 00277: val_accuracy did not improve from 0.53750
Epoch 278/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5705 - accuracy: 0.8579 - v
al_loss: 2.0615 - val_accuracy: 0.4500

Epoch 00278: val_accuracy did not improve from 0.53750
Epoch 279/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5067 - accuracy: 0.8933 - v
al_loss: 1.8871 - val_accuracy: 0.5000

Epoch 00279: val_accuracy did not improve from 0.53750
Epoch 280/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5298 - accuracy: 0.8930 - v
al_loss: 1.8897 - val_accuracy: 0.4750

Epoch 00280: val_accuracy did not improve from 0.53750
Epoch 281/300
9/9 [==============================] - 0s 10ms/step - loss: 0.4998 - accuracy: 0.9143 - v
al_loss: 1.9234 - val_accuracy: 0.4875

Epoch 00281: val_accuracy did not improve from 0.53750
Epoch 282/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5698 - accuracy: 0.8685 - v
al_loss: 1.8899 - val_accuracy: 0.4375

Epoch 00282: val_accuracy did not improve from 0.53750
Epoch 283/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5383 - accuracy: 0.8805 - v
al_loss: 1.8946 - val_accuracy: 0.4625

Epoch 00283: val_accuracy did not improve from 0.53750
Epoch 284/300
9/9 [==============================] - 0s 13ms/step - loss: 0.5568 - accuracy: 0.8566 - v
al_loss: 1.9435 - val_accuracy: 0.5125
```

```
Epoch 00284: val_accuracy did not improve from 0.53750
Epoch 285/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5574 - accuracy: 0.8628 - v
al_loss: 2.0039 - val_accuracy: 0.4750

Epoch 00285: val_accuracy did not improve from 0.53750
Epoch 286/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5490 - accuracy: 0.8490 - v
al_loss: 1.9484 - val_accuracy: 0.4875

Epoch 00286: val_accuracy did not improve from 0.53750
Epoch 287/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6066 - accuracy: 0.8521 - v
al_loss: 1.7569 - val_accuracy: 0.4625

Epoch 00287: val_accuracy did not improve from 0.53750
Epoch 288/300
9/9 [==============================] - 0s 14ms/step - loss: 0.6377 - accuracy: 0.8330 - v
al_loss: 1.9242 - val_accuracy: 0.4000

Epoch 00288: val_accuracy did not improve from 0.53750
Epoch 289/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5039 - accuracy: 0.8946 - v
al_loss: 1.9390 - val_accuracy: 0.5000

Epoch 00289: val_accuracy did not improve from 0.53750
Epoch 290/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5785 - accuracy: 0.8542 - v
al_loss: 1.9429 - val_accuracy: 0.4750

Epoch 00290: val_accuracy did not improve from 0.53750
Epoch 291/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6157 - accuracy: 0.8354 - v
al_loss: 1.9185 - val_accuracy: 0.5250

Epoch 00291: val_accuracy did not improve from 0.53750
Epoch 292/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6158 - accuracy: 0.8349 - v
al_loss: 1.8920 - val_accuracy: 0.5250

Epoch 00292: val_accuracy did not improve from 0.53750
Epoch 293/300
9/9 [==============================] - 0s 28ms/step - loss: 0.6029 - accuracy: 0.8369 - v
al_loss: 1.9152 - val_accuracy: 0.5125

Epoch 00293: val_accuracy did not improve from 0.53750
Epoch 294/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5513 - accuracy: 0.8852 - v
al_loss: 1.9085 - val_accuracy: 0.4875

Epoch 00294: val_accuracy did not improve from 0.53750
Epoch 295/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5995 - accuracy: 0.8626 - v
al_loss: 2.0399 - val_accuracy: 0.4125

Epoch 00295: val_accuracy did not improve from 0.53750
Epoch 296/300
9/9 [==============================] - 0s 11ms/step - loss: 0.5054 - accuracy: 0.8819 - v
al_loss: 1.9307 - val_accuracy: 0.5125

Epoch 00296: val_accuracy did not improve from 0.53750
Epoch 297/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6827 - accuracy: 0.8326 - v
al_loss: 1.8446 - val_accuracy: 0.5125

Epoch 00297: val_accuracy did not improve from 0.53750
Epoch 298/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5051 - accuracy: 0.8781 - v
al_loss: 1.8282 - val_accuracy: 0.5125

Epoch 00298: val_accuracy did not improve from 0.53750
```

```
Epoch 299/300
9/9 [==============================] - 0s 12ms/step - loss: 0.6430 - accuracy: 0.8090 - v
al_loss: 1.8405 - val_accuracy: 0.4625

Epoch 00299: val_accuracy did not improve from 0.53750
Epoch 300/300
9/9 [==============================] - 0s 12ms/step - loss: 0.5328 - accuracy: 0.9010 - v
al_loss: 1.8253 - val_accuracy: 0.4625

Epoch 00300: val_accuracy did not improve from 0.53750
```

Plot the training history. What is your best validation accuracy?

In [ ]:

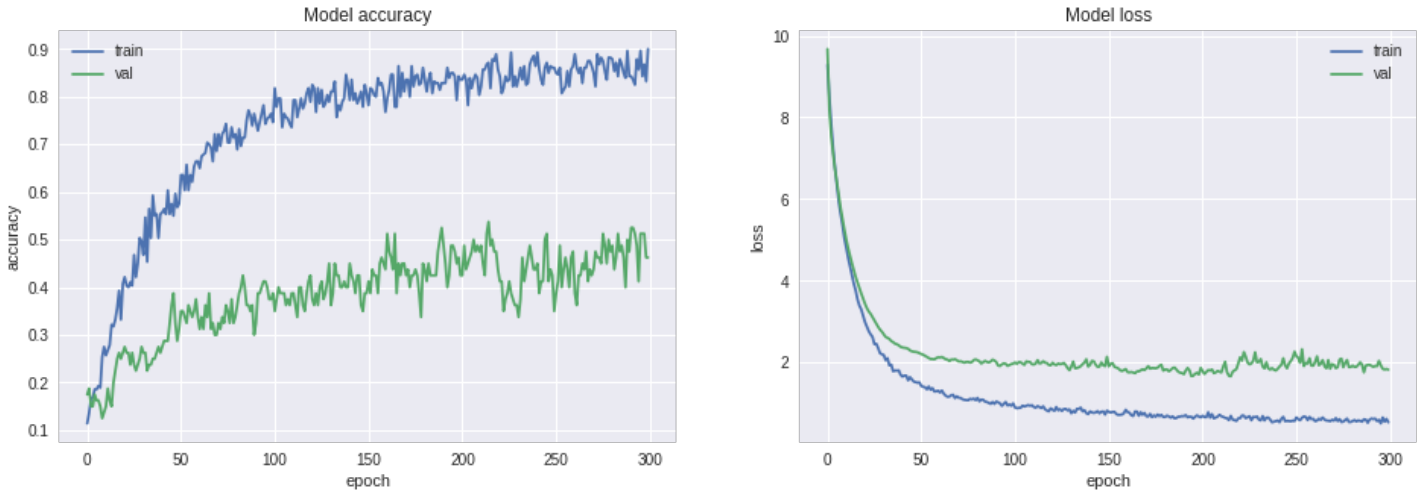
```
plt.figure(figsize=(16,5))

# Accuracy
plt.subplot(1,2,1)
plt.plot(history_1D_CNN.history['accuracy'])
plt.plot(history_1D_CNN.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'val'])

# Loss
plt.subplot(1,2,2)
plt.plot(history_1D_CNN.history['loss'])
plt.plot(history_1D_CNN.history['val_loss'])
plt.title('Model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'val'])

# best validation accuracy
best_acc = np.max(history_1D_CNN.history['val_accuracy'])
print('Best validation accuracy: {0:5.1f} % '.format(best_acc*100))
```

```
Best validation accuracy:  53.8 %
```



Evaluate the model over the test dataset. What is your test accuracy? Is it better or worse than the one in your validation set?

In [ ]:

```
model_1D_best = tf.keras.models.load_model('1D_CNN.hdf5')
```

In [ ]:

```
from sklearn.metrics import accuracy_score

y_pred = np.argmax(model_1D_best.predict(X_test_rs), axis=-1)
```

```
print(y_pred)
print(y_test)
print("Accuracy score: {0:5.1f} % ".format(100*accuracy_score(y_test, y_pred)))
```

```
[5 8 6 7 5 3 3 7 5 9 9 3 4 4 8 9 1 2 9 0 4 9 1 5 0 1 2 3 5 7 8 3 9 8 7 6 9
 3 8 6]
[1 8 6 7 6 2 3 3 2 9 1 3 4 7 8 2 1 2 4 0 6 0 1 4 0 1 6 3 5 7 8 7 9 8 7 8 5
 7 0 1]
Accuracy score:  52.5 %
```

Accuracy on the test set is worse than the validation set

Exercise 4: 1D-CNN Evaluation

Plot your confusion matrix for the validation set and for your test set:

In [ ]:

```
classlist = list(range(0, 10))
classlist
```

Out[ ]:

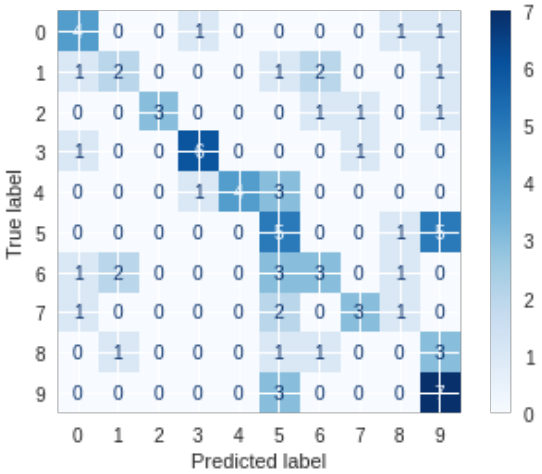
```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [ ]:

```
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay

pred_val = np.argmax(model_1D_CNN.predict(X_val_rs), axis=-1)
cm_val = confusion_matrix(y_val, pred_val)

disp = ConfusionMatrixDisplay(confusion_matrix=cm_val, display_labels=classlist)
disp.plot(cmap='Blues');
```



In [ ]:

```
pred_test = np.argmax(model_1D_CNN.predict(X_test_rs), axis=-1)
cm_test = confusion_matrix(y_test, pred_test)

disp = ConfusionMatrixDisplay(confusion_matrix=cm_test, display_labels=classlist)
disp.plot(cmap='Blues');
```

Exercise 5: Time-Distributed 1D-CNN

In the previous 1D-CNN, each band of the Mel-spectrogram was treated as an independent channel. We want to continue using a similar 1D-CNN architecture but this time using a time-distributed model. Now the input will have several time steps (frames in this case) and 1 single channel.

Reshape your input X_train_rs to create a new input X_train_rss with dimensions (280, 216, 128, 1). You can use numpy's expand_dims.

In [ ]:

```
X_train_rss = np.expand_dims(X_train_rs, axis=3)
X_val_rss = np.expand_dims(X_val_rs, axis=3)
X_test_rss = np.expand_dims(X_test_rs, axis=3)

X_train_rss.shape, X_val_rss.shape, X_test_rss.shape
```

Out[ ]:

```
((280, 216, 128, 1), (80, 216, 128, 1), (40, 216, 128, 1))
```

Create your time-distributed network. A good thing of time-distributed networks is that the time-step dimension does not have to be fixed (it can be None). Thus, you can specify your input shape as:

input_shape = (None, 128, 1)

In [ ]:

```
input_shape = (None, X_train_rs.shape[2], 1)

print(input_shape)
```

```
(None, 128, 1)
```

In [ ]:

```
modeltd = tf.keras.models.Sequential()

# 1st convolutional layer
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Conv1D(filters=8, kernel_siz
e=9, activation='relu'), input_shape=input_shape))
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.MaxPooling1D(pool_size=2, pa
dding='same')))
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.BatchNormalization()))

# 2nd convolutional layer
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Conv1D(filters=16, kernel_si
ze=3, activation='relu')))
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.MaxPooling1D(pool_size=2, pa
dding='same')))
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.BatchNormalization()))



# flatten output and feed it to a dense layer
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Flatten()))
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Dense(32, activation='relu',
kernel_regularizer=tf.keras.regularizers.l2(0.1))))
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Dropout(0.7)))


# output layer
modeltd.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Dense(10, activation='softma
```

```
x')))

# Reduce the dimension from a sequence to a single value - VERY IMPORTANT
modeltd.add(tf.keras.layers.GlobalAveragePooling1D())

# compile model
adamopt = tf.keras.optimizers.Adam(learning_rate=0.001)
modeltd.compile(optimizer= adamopt, loss='sparse_categorical_crossentropy', metrics=['ac
curacy'])

modeltd.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
time_distributed (TimeDistri (None, None, 120, 8)      80
_________________________________________________________________
time_distributed_1 (TimeDist (None, None, 60, 8)       0
_________________________________________________________________
time_distributed_2 (TimeDist (None, None, 60, 8)       32
_________________________________________________________________
time_distributed_3 (TimeDist (None, None, 58, 16)      400
_________________________________________________________________
time_distributed_4 (TimeDist (None, None, 29, 16)      0
_________________________________________________________________
time_distributed_5 (TimeDist (None, None, 29, 16)      64
_________________________________________________________________
time_distributed_6 (TimeDist (None, None, 464)         0
_________________________________________________________________
time_distributed_7 (TimeDist (None, None, 32)          14880
_________________________________________________________________
time_distributed_8 (TimeDist (None, None, 32)          0
_________________________________________________________________
time_distributed_9 (TimeDist (None, None, 10)          330
_________________________________________________________________
global_average_pooling1d (Gl (None, 10)                0
=================================================================
Total params: 15,786
Trainable params: 15,738
Non-trainable params: 48
_________________________________________________________________
```

Train the model using the same callbacks as before.

In [ ]:

```
from tensorflow.keras.callbacks import CSVLogger, ModelCheckpoint, EarlyStopping

log_file_path = 'training_1D_CNN_TD.log'
csv_logger = CSVLogger(log_file_path, append=False)

patience = 100
early_stop = EarlyStopping('val_loss', patience=patience)

model_name = '1D_CNN_TD.hdf5'
model_checkpoint = ModelCheckpoint(filepath=model_name, monitor='val_accuracy', verbose=
1, save_best_only=True)

#Callbacks List
callbacks = [model_checkpoint, csv_logger, early_stop]
```

In [ ]:

```
# model fit
history_td = modeltd.fit(X_train_rss,y_train, validation_data = (X_val_rss, y_val), batc
h_size=32, epochs=300, callbacks=callbacks)
```

```
Epoch 1/300
9/9 [==============================] - 2s 94ms/step - loss: 7.9856 - accuracy: 0.0970 - v
al_loss: 7.0618 - val_accuracy: 0.1000
```

```
Epoch 00001: val_accuracy improved from -inf to 0.10000, saving model to 1D_CNN_TD.hdf5
Epoch 2/300
9/9 [==============================] - 0s 22ms/step - loss: 6.6793 - accuracy: 0.1781 - v
al_loss: 5.9287 - val_accuracy: 0.2125

Epoch 00002: val_accuracy improved from 0.10000 to 0.21250, saving model to 1D_CNN_TD.hdf
5
Epoch 3/300
9/9 [==============================] - 0s 22ms/step - loss: 5.6005 - accuracy: 0.1861 - v
al_loss: 5.0250 - val_accuracy: 0.2250

Epoch 00003: val_accuracy improved from 0.21250 to 0.22500, saving model to 1D_CNN_TD.hdf
5
Epoch 4/300
9/9 [==============================] - 0s 22ms/step - loss: 4.7310 - accuracy: 0.3120 - v
al_loss: 4.3312 - val_accuracy: 0.2125

Epoch 00004: val_accuracy did not improve from 0.22500
Epoch 5/300
9/9 [==============================] - 0s 22ms/step - loss: 4.0357 - accuracy: 0.3349 - v
al_loss: 3.8015 - val_accuracy: 0.2125

Epoch 00005: val_accuracy did not improve from 0.22500
Epoch 6/300
9/9 [==============================] - 0s 22ms/step - loss: 3.5244 - accuracy: 0.3525 - v
al_loss: 3.3929 - val_accuracy: 0.2625

Epoch 00006: val_accuracy improved from 0.22500 to 0.26250, saving model to 1D_CNN_TD.hdf
5
Epoch 7/300
9/9 [==============================] - 0s 38ms/step - loss: 3.1076 - accuracy: 0.3917 - v
al_loss: 3.0844 - val_accuracy: 0.2750

Epoch 00007: val_accuracy improved from 0.26250 to 0.27500, saving model to 1D_CNN_TD.hdf
5
Epoch 8/300
9/9 [==============================] - 0s 23ms/step - loss: 2.8130 - accuracy: 0.3932 - v
al_loss: 2.8511 - val_accuracy: 0.2875

Epoch 00008: val_accuracy improved from 0.27500 to 0.28750, saving model to 1D_CNN_TD.hdf
5
Epoch 9/300
9/9 [==============================] - 0s 23ms/step - loss: 2.5366 - accuracy: 0.4538 - v
al_loss: 2.6795 - val_accuracy: 0.3000

Epoch 00009: val_accuracy improved from 0.28750 to 0.30000, saving model to 1D_CNN_TD.hdf
5
Epoch 10/300
9/9 [==============================] - 0s 23ms/step - loss: 2.3826 - accuracy: 0.4570 - v
al_loss: 2.5384 - val_accuracy: 0.3250

Epoch 00010: val_accuracy improved from 0.30000 to 0.32500, saving model to 1D_CNN_TD.hdf
5
Epoch 11/300
9/9 [==============================] - 0s 23ms/step - loss: 2.2349 - accuracy: 0.5110 - v
al_loss: 2.4368 - val_accuracy: 0.3375

Epoch 00011: val_accuracy improved from 0.32500 to 0.33750, saving model to 1D_CNN_TD.hdf
5
Epoch 12/300
9/9 [==============================] - 0s 23ms/step - loss: 2.1250 - accuracy: 0.5066 - v
al_loss: 2.3618 - val_accuracy: 0.4125

Epoch 00012: val_accuracy improved from 0.33750 to 0.41250, saving model to 1D_CNN_TD.hdf
5
Epoch 13/300
9/9 [==============================] - 0s 23ms/step - loss: 2.0725 - accuracy: 0.5010 - v
al_loss: 2.3127 - val_accuracy: 0.4375

Epoch 00013: val_accuracy improved from 0.41250 to 0.43750, saving model to 1D_CNN_TD.hdf
5
Epoch 14/300
```

```
Epoch 14/300
9/9 [==============================] - 0s 23ms/step - loss: 2.0041 - accuracy: 0.5655 - v
al_loss: 2.2675 - val_accuracy: 0.4750

Epoch 00014: val_accuracy improved from 0.43750 to 0.47500, saving model to 1D_CNN_TD.hdf
5
Epoch 15/300
9/9 [==============================] - 0s 22ms/step - loss: 1.9524 - accuracy: 0.5917 - v
al_loss: 2.2449 - val_accuracy: 0.3875

Epoch 00015: val_accuracy did not improve from 0.47500
Epoch 16/300
9/9 [==============================] - 0s 22ms/step - loss: 1.9044 - accuracy: 0.6065 - v
al_loss: 2.2354 - val_accuracy: 0.3750

Epoch 00016: val_accuracy did not improve from 0.47500
Epoch 17/300
9/9 [==============================] - 0s 23ms/step - loss: 1.8695 - accuracy: 0.5818 - v
al_loss: 2.2200 - val_accuracy: 0.3500

Epoch 00017: val_accuracy did not improve from 0.47500
Epoch 18/300
9/9 [==============================] - 0s 23ms/step - loss: 1.8226 - accuracy: 0.6391 - v
al_loss: 2.2006 - val_accuracy: 0.3750

Epoch 00018: val_accuracy did not improve from 0.47500
Epoch 19/300
9/9 [==============================] - 0s 22ms/step - loss: 1.7895 - accuracy: 0.6162 - v
al_loss: 2.2054 - val_accuracy: 0.3875

Epoch 00019: val_accuracy did not improve from 0.47500
Epoch 20/300
9/9 [==============================] - 0s 22ms/step - loss: 1.8140 - accuracy: 0.6119 - v
al_loss: 2.1887 - val_accuracy: 0.3500

Epoch 00020: val_accuracy did not improve from 0.47500
Epoch 21/300
9/9 [==============================] - 0s 23ms/step - loss: 1.7560 - accuracy: 0.6687 - v
al_loss: 2.1801 - val_accuracy: 0.3500

Epoch 00021: val_accuracy did not improve from 0.47500
Epoch 22/300
9/9 [==============================] - 0s 23ms/step - loss: 1.7394 - accuracy: 0.6669 - v
al_loss: 2.1873 - val_accuracy: 0.3625

Epoch 00022: val_accuracy did not improve from 0.47500
Epoch 23/300
9/9 [==============================] - 0s 23ms/step - loss: 1.7511 - accuracy: 0.6429 - v
al_loss: 2.1810 - val_accuracy: 0.3625

Epoch 00023: val_accuracy did not improve from 0.47500
Epoch 24/300
9/9 [==============================] - 0s 23ms/step - loss: 1.7375 - accuracy: 0.6895 - v
al_loss: 2.1723 - val_accuracy: 0.3125

Epoch 00024: val_accuracy did not improve from 0.47500
Epoch 25/300
9/9 [==============================] - 0s 22ms/step - loss: 1.7016 - accuracy: 0.7123 - v
al_loss: 2.1642 - val_accuracy: 0.3000

Epoch 00025: val_accuracy did not improve from 0.47500
Epoch 26/300
9/9 [==============================] - 0s 22ms/step - loss: 1.7039 - accuracy: 0.6814 - v
al_loss: 2.1657 - val_accuracy: 0.2750

Epoch 00026: val_accuracy did not improve from 0.47500
Epoch 27/300
9/9 [==============================] - 0s 22ms/step - loss: 1.6731 - accuracy: 0.6719 - v
al_loss: 2.1718 - val_accuracy: 0.2375

Epoch 00027: val_accuracy did not improve from 0.47500
Epoch 28/300
```

```
9/9 [==============================] - 0s 22ms/step - loss: 1.6953 - accuracy: 0.6943 - v
al_loss: 2.1796 - val_accuracy: 0.2375

Epoch 00028: val_accuracy did not improve from 0.47500
Epoch 29/300
9/9 [==============================] - 0s 22ms/step - loss: 1.6351 - accuracy: 0.7165 - v
al_loss: 2.1471 - val_accuracy: 0.2750

Epoch 00029: val_accuracy did not improve from 0.47500
Epoch 30/300
9/9 [==============================] - 0s 22ms/step - loss: 1.6133 - accuracy: 0.7157 - v
al_loss: 2.1559 - val_accuracy: 0.2375

Epoch 00030: val_accuracy did not improve from 0.47500
Epoch 31/300
9/9 [==============================] - 0s 22ms/step - loss: 1.6616 - accuracy: 0.6819 - v
al_loss: 2.1296 - val_accuracy: 0.3375

Epoch 00031: val_accuracy did not improve from 0.47500
Epoch 32/300
9/9 [==============================] - 0s 22ms/step - loss: 1.6344 - accuracy: 0.6848 - v
al_loss: 2.0863 - val_accuracy: 0.3250

Epoch 00032: val_accuracy did not improve from 0.47500
Epoch 33/300
9/9 [==============================] - 0s 23ms/step - loss: 1.6045 - accuracy: 0.7072 - v
al_loss: 2.0407 - val_accuracy: 0.4000

Epoch 00033: val_accuracy did not improve from 0.47500
Epoch 34/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5972 - accuracy: 0.6714 - v
al_loss: 2.0577 - val_accuracy: 0.3250

Epoch 00034: val_accuracy did not improve from 0.47500
Epoch 35/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5953 - accuracy: 0.6852 - v
al_loss: 2.0217 - val_accuracy: 0.3875

Epoch 00035: val_accuracy did not improve from 0.47500
Epoch 36/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5827 - accuracy: 0.7135 - v
al_loss: 2.0480 - val_accuracy: 0.3625

Epoch 00036: val_accuracy did not improve from 0.47500
Epoch 37/300
9/9 [==============================] - 0s 23ms/step - loss: 1.6062 - accuracy: 0.6428 - v
al_loss: 1.9699 - val_accuracy: 0.4125

Epoch 00037: val_accuracy did not improve from 0.47500
Epoch 38/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5512 - accuracy: 0.6927 - v
al_loss: 1.9830 - val_accuracy: 0.4000

Epoch 00038: val_accuracy did not improve from 0.47500
Epoch 39/300
9/9 [==============================] - 0s 22ms/step - loss: 1.5688 - accuracy: 0.6594 - v
al_loss: 1.9289 - val_accuracy: 0.5125

Epoch 00039: val_accuracy improved from 0.47500 to 0.51250, saving model to 1D_CNN_TD.hdf
5
Epoch 40/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5455 - accuracy: 0.6207 - v
al_loss: 1.8915 - val_accuracy: 0.5000

Epoch 00040: val_accuracy did not improve from 0.51250
Epoch 41/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5562 - accuracy: 0.6848 - v
al_loss: 1.9154 - val_accuracy: 0.4750

Epoch 00041: val_accuracy did not improve from 0.51250
Epoch 42/300
9/9 [==============================] - 0s 22ms/step - loss: 1.5461 - accuracy: 0.6717 - v
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al_loss: 1.8806 - val_accuracy: 0.4875

Epoch 00042: val_accuracy did not improve from 0.51250
Epoch 43/300
9/9 [==============================] - 0s 22ms/step - loss: 1.4902 - accuracy: 0.7418 - v
al_loss: 1.9198 - val_accuracy: 0.4500

Epoch 00043: val_accuracy did not improve from 0.51250
Epoch 44/300
9/9 [==============================] - 0s 22ms/step - loss: 1.5199 - accuracy: 0.7021 - v
al_loss: 1.8603 - val_accuracy: 0.5625

Epoch 00044: val_accuracy improved from 0.51250 to 0.56250, saving model to 1D_CNN_TD.hdf
5
Epoch 45/300
9/9 [==============================] - 0s 22ms/step - loss: 1.5340 - accuracy: 0.5994 - v
al_loss: 1.8501 - val_accuracy: 0.5375

Epoch 00045: val_accuracy did not improve from 0.56250
Epoch 46/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4897 - accuracy: 0.6738 - v
al_loss: 1.8766 - val_accuracy: 0.4250

Epoch 00046: val_accuracy did not improve from 0.56250
Epoch 47/300
9/9 [==============================] - 0s 24ms/step - loss: 1.4966 - accuracy: 0.6490 - v
al_loss: 1.8396 - val_accuracy: 0.4875

Epoch 00047: val_accuracy did not improve from 0.56250
Epoch 48/300
9/9 [==============================] - 0s 23ms/step - loss: 1.5297 - accuracy: 0.6498 - v
al_loss: 1.8681 - val_accuracy: 0.4250

Epoch 00048: val_accuracy did not improve from 0.56250
Epoch 49/300
9/9 [==============================] - 0s 22ms/step - loss: 1.4789 - accuracy: 0.6789 - v
al_loss: 1.8164 - val_accuracy: 0.4750

Epoch 00049: val_accuracy did not improve from 0.56250
Epoch 50/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4918 - accuracy: 0.6609 - v
al_loss: 1.8167 - val_accuracy: 0.4875

Epoch 00050: val_accuracy did not improve from 0.56250
Epoch 51/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4800 - accuracy: 0.6813 - v
al_loss: 1.8267 - val_accuracy: 0.4250

Epoch 00051: val_accuracy did not improve from 0.56250
Epoch 52/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4512 - accuracy: 0.6689 - v
al_loss: 1.7857 - val_accuracy: 0.5500

Epoch 00052: val_accuracy did not improve from 0.56250
Epoch 53/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4930 - accuracy: 0.6605 - v
al_loss: 1.7897 - val_accuracy: 0.4750

Epoch 00053: val_accuracy did not improve from 0.56250
Epoch 54/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4819 - accuracy: 0.7078 - v
al_loss: 1.7608 - val_accuracy: 0.5625

Epoch 00054: val_accuracy did not improve from 0.56250
Epoch 55/300
9/9 [==============================] - 0s 22ms/step - loss: 1.4439 - accuracy: 0.6845 - v
al_loss: 1.7574 - val_accuracy: 0.5125

Epoch 00055: val_accuracy did not improve from 0.56250
Epoch 56/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4340 - accuracy: 0.7109 - v
al_loss: 1.7876 - val_accuracy: 0.5000
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Epoch 00056: val_accuracy did not improve from 0.56250
Epoch 57/300
9/9 [==============================] - 0s 38ms/step - loss: 1.4733 - accuracy: 0.6709 - v
al_loss: 1.7874 - val_accuracy: 0.4625

Epoch 00057: val_accuracy did not improve from 0.56250
Epoch 58/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4258 - accuracy: 0.6499 - v
al_loss: 1.8395 - val_accuracy: 0.4250

Epoch 00058: val_accuracy did not improve from 0.56250
Epoch 59/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4189 - accuracy: 0.7295 - v
al_loss: 1.8045 - val_accuracy: 0.4500

Epoch 00059: val_accuracy did not improve from 0.56250
Epoch 60/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4264 - accuracy: 0.7056 - v
al_loss: 1.7590 - val_accuracy: 0.5250

Epoch 00060: val_accuracy did not improve from 0.56250
Epoch 61/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4170 - accuracy: 0.7192 - v
al_loss: 1.7895 - val_accuracy: 0.4625

Epoch 00061: val_accuracy did not improve from 0.56250
Epoch 62/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4499 - accuracy: 0.7454 - v
al_loss: 1.7520 - val_accuracy: 0.5500

Epoch 00062: val_accuracy did not improve from 0.56250
Epoch 63/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4221 - accuracy: 0.6987 - v
al_loss: 1.7535 - val_accuracy: 0.5625

Epoch 00063: val_accuracy did not improve from 0.56250
Epoch 64/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4292 - accuracy: 0.7182 - v
al_loss: 1.6759 - val_accuracy: 0.5500

Epoch 00064: val_accuracy did not improve from 0.56250
Epoch 65/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3853 - accuracy: 0.6905 - v
al_loss: 1.6845 - val_accuracy: 0.5375

Epoch 00065: val_accuracy did not improve from 0.56250
Epoch 66/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3973 - accuracy: 0.6968 - v
al_loss: 1.7244 - val_accuracy: 0.5500

Epoch 00066: val_accuracy did not improve from 0.56250
Epoch 67/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3900 - accuracy: 0.7152 - v
al_loss: 1.7031 - val_accuracy: 0.5375

Epoch 00067: val_accuracy did not improve from 0.56250
Epoch 68/300
9/9 [==============================] - 0s 22ms/step - loss: 1.4086 - accuracy: 0.6800 - v
al_loss: 1.6809 - val_accuracy: 0.5750

Epoch 00068: val_accuracy improved from 0.56250 to 0.57500, saving model to 1D_CNN_TD.hdf
5
Epoch 69/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3703 - accuracy: 0.7197 - v
al_loss: 1.7171 - val_accuracy: 0.5250

Epoch 00069: val_accuracy did not improve from 0.57500
Epoch 70/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3927 - accuracy: 0.6747 - v
al_loss: 1.6605 - val_accuracy: 0.6000
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Epoch 00070: val_accuracy improved from 0.57500 to 0.60000, saving model to 1D_CNN_TD.hdf
5
Epoch 71/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3961 - accuracy: 0.7176 - v
al_loss: 1.7149 - val_accuracy: 0.5125

Epoch 00071: val_accuracy did not improve from 0.60000
Epoch 72/300
9/9 [==============================] - 0s 23ms/step - loss: 1.4362 - accuracy: 0.7047 - v
al_loss: 1.6716 - val_accuracy: 0.5625

Epoch 00072: val_accuracy did not improve from 0.60000
Epoch 73/300
9/9 [==============================] - 0s 22ms/step - loss: 1.4033 - accuracy: 0.6609 - v
al_loss: 1.6977 - val_accuracy: 0.5125

Epoch 00073: val_accuracy did not improve from 0.60000
Epoch 74/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3955 - accuracy: 0.7056 - v
al_loss: 1.6906 - val_accuracy: 0.5625

Epoch 00074: val_accuracy did not improve from 0.60000
Epoch 75/300
9/9 [==============================] - 0s 24ms/step - loss: 1.3734 - accuracy: 0.7394 - v
al_loss: 1.6644 - val_accuracy: 0.5875

Epoch 00075: val_accuracy did not improve from 0.60000
Epoch 76/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3637 - accuracy: 0.7320 - v
al_loss: 1.6666 - val_accuracy: 0.5125

Epoch 00076: val_accuracy did not improve from 0.60000
Epoch 77/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3792 - accuracy: 0.6756 - v
al_loss: 1.6926 - val_accuracy: 0.5250

Epoch 00077: val_accuracy did not improve from 0.60000
Epoch 78/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3655 - accuracy: 0.6923 - v
al_loss: 1.7086 - val_accuracy: 0.5500

Epoch 00078: val_accuracy did not improve from 0.60000
Epoch 79/300
9/9 [==============================] - 0s 22ms/step - loss: 1.4125 - accuracy: 0.6710 - v
al_loss: 1.6866 - val_accuracy: 0.4750

Epoch 00079: val_accuracy did not improve from 0.60000
Epoch 80/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3712 - accuracy: 0.6830 - v
al_loss: 1.7454 - val_accuracy: 0.5000

Epoch 00080: val_accuracy did not improve from 0.60000
Epoch 81/300
9/9 [==============================] - 0s 24ms/step - loss: 1.3500 - accuracy: 0.6800 - v
al_loss: 1.6971 - val_accuracy: 0.5375

Epoch 00081: val_accuracy did not improve from 0.60000
Epoch 82/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3373 - accuracy: 0.7162 - v
al_loss: 1.7194 - val_accuracy: 0.5125

Epoch 00082: val_accuracy did not improve from 0.60000
Epoch 83/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3325 - accuracy: 0.7299 - v
al_loss: 1.7311 - val_accuracy: 0.5625

Epoch 00083: val_accuracy did not improve from 0.60000
Epoch 84/300
9/9 [==============================] - 0s 22ms/step - loss: 1.2973 - accuracy: 0.7457 - v
al_loss: 1.7314 - val_accuracy: 0.5125

Epoch 00084: val_accuracy did not improve from 0.60000
Epoch 85/300
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Epoch 85/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3546 - accuracy: 0.6870 - v
al_loss: 1.7141 - val_accuracy: 0.5375

Epoch 00085: val_accuracy did not improve from 0.60000
Epoch 86/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3182 - accuracy: 0.7128 - v
al_loss: 1.6525 - val_accuracy: 0.5750

Epoch 00086: val_accuracy did not improve from 0.60000
Epoch 87/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3081 - accuracy: 0.7597 - v
al_loss: 1.7088 - val_accuracy: 0.5000

Epoch 00087: val_accuracy did not improve from 0.60000
Epoch 88/300
9/9 [==============================] - 0s 24ms/step - loss: 1.2950 - accuracy: 0.7540 - v
al_loss: 1.6945 - val_accuracy: 0.5250

Epoch 00088: val_accuracy did not improve from 0.60000
Epoch 89/300
9/9 [==============================] - 0s 24ms/step - loss: 1.3318 - accuracy: 0.6892 - v
al_loss: 1.6424 - val_accuracy: 0.5375

Epoch 00089: val_accuracy did not improve from 0.60000
Epoch 90/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3137 - accuracy: 0.7529 - v
al_loss: 1.6922 - val_accuracy: 0.5500

Epoch 00090: val_accuracy did not improve from 0.60000
Epoch 91/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3786 - accuracy: 0.6816 - v
al_loss: 1.6475 - val_accuracy: 0.5625

Epoch 00091: val_accuracy did not improve from 0.60000
Epoch 92/300
9/9 [==============================] - 0s 24ms/step - loss: 1.3256 - accuracy: 0.7160 - v
al_loss: 1.6430 - val_accuracy: 0.4875

Epoch 00092: val_accuracy did not improve from 0.60000
Epoch 93/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2998 - accuracy: 0.7491 - v
al_loss: 1.6240 - val_accuracy: 0.5375

Epoch 00093: val_accuracy did not improve from 0.60000
Epoch 94/300
9/9 [==============================] - 0s 24ms/step - loss: 1.3371 - accuracy: 0.6922 - v
al_loss: 1.6520 - val_accuracy: 0.5500

Epoch 00094: val_accuracy did not improve from 0.60000
Epoch 95/300
9/9 [==============================] - 0s 22ms/step - loss: 1.3184 - accuracy: 0.7624 - v
al_loss: 1.6356 - val_accuracy: 0.5750

Epoch 00095: val_accuracy did not improve from 0.60000
Epoch 96/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3043 - accuracy: 0.7392 - v
al_loss: 1.6873 - val_accuracy: 0.5500

Epoch 00096: val_accuracy did not improve from 0.60000
Epoch 97/300
9/9 [==============================] - 0s 37ms/step - loss: 1.2643 - accuracy: 0.7906 - v
al_loss: 1.7341 - val_accuracy: 0.4500

Epoch 00097: val_accuracy did not improve from 0.60000
Epoch 98/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2873 - accuracy: 0.7793 - v
al_loss: 1.6731 - val_accuracy: 0.5375

Epoch 00098: val_accuracy did not improve from 0.60000
Epoch 99/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2717 - accuracy: 0.7470 - v
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al_loss: 1.7109 - val_accuracy: 0.4500

Epoch 00099: val_accuracy did not improve from 0.60000
Epoch 100/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2811 - accuracy: 0.7105 - v
al_loss: 1.6341 - val_accuracy: 0.5000

Epoch 00100: val_accuracy did not improve from 0.60000
Epoch 101/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3020 - accuracy: 0.7513 - v
al_loss: 1.6587 - val_accuracy: 0.5000

Epoch 00101: val_accuracy did not improve from 0.60000
Epoch 102/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2734 - accuracy: 0.7515 - v
al_loss: 1.6657 - val_accuracy: 0.5625

Epoch 00102: val_accuracy did not improve from 0.60000
Epoch 103/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2609 - accuracy: 0.7859 - v
al_loss: 1.6321 - val_accuracy: 0.5000

Epoch 00103: val_accuracy did not improve from 0.60000
Epoch 104/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2465 - accuracy: 0.7531 - v
al_loss: 1.6457 - val_accuracy: 0.5500

Epoch 00104: val_accuracy did not improve from 0.60000
Epoch 105/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3157 - accuracy: 0.7063 - v
al_loss: 1.6388 - val_accuracy: 0.4875

Epoch 00105: val_accuracy did not improve from 0.60000
Epoch 106/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2950 - accuracy: 0.7092 - v
al_loss: 1.6596 - val_accuracy: 0.5250

Epoch 00106: val_accuracy did not improve from 0.60000
Epoch 107/300
9/9 [==============================] - 0s 24ms/step - loss: 1.2799 - accuracy: 0.6954 - v
al_loss: 1.6073 - val_accuracy: 0.5375

Epoch 00107: val_accuracy did not improve from 0.60000
Epoch 108/300
9/9 [==============================] - 0s 23ms/step - loss: 1.3063 - accuracy: 0.7609 - v
al_loss: 1.6953 - val_accuracy: 0.4750

Epoch 00108: val_accuracy did not improve from 0.60000
Epoch 109/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2896 - accuracy: 0.7389 - v
al_loss: 1.6435 - val_accuracy: 0.5375

Epoch 00109: val_accuracy did not improve from 0.60000
Epoch 110/300
9/9 [==============================] - 0s 24ms/step - loss: 1.2468 - accuracy: 0.7373 - v
al_loss: 1.6920 - val_accuracy: 0.5250

Epoch 00110: val_accuracy did not improve from 0.60000
Epoch 111/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2577 - accuracy: 0.8134 - v
al_loss: 1.6733 - val_accuracy: 0.5375

Epoch 00111: val_accuracy did not improve from 0.60000
Epoch 112/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2670 - accuracy: 0.7737 - v
al_loss: 1.7041 - val_accuracy: 0.4000

Epoch 00112: val_accuracy did not improve from 0.60000
Epoch 113/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2385 - accuracy: 0.7412 - v
al_loss: 1.6035 - val_accuracy: 0.5125

Epoch 00113: val_accuracy did not improve from 0.60000
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Epoch 00113: val_accuracy did not improve from 0.60000
Epoch 114/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2906 - accuracy: 0.7635 - v
al_loss: 1.6645 - val_accuracy: 0.4625

Epoch 00114: val_accuracy did not improve from 0.60000
Epoch 115/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2574 - accuracy: 0.7925 - v
al_loss: 1.5706 - val_accuracy: 0.5500

Epoch 00115: val_accuracy did not improve from 0.60000
Epoch 116/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2074 - accuracy: 0.8378 - v
al_loss: 1.6502 - val_accuracy: 0.4875

Epoch 00116: val_accuracy did not improve from 0.60000
Epoch 117/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2573 - accuracy: 0.7951 - v
al_loss: 1.5926 - val_accuracy: 0.4750

Epoch 00117: val_accuracy did not improve from 0.60000
Epoch 118/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2236 - accuracy: 0.7993 - v
al_loss: 1.7974 - val_accuracy: 0.3625

Epoch 00118: val_accuracy did not improve from 0.60000
Epoch 119/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2296 - accuracy: 0.7575 - v
al_loss: 1.7859 - val_accuracy: 0.3750

Epoch 00119: val_accuracy did not improve from 0.60000
Epoch 120/300
9/9 [==============================] - 0s 24ms/step - loss: 1.2441 - accuracy: 0.7851 - v
al_loss: 1.6925 - val_accuracy: 0.4125

Epoch 00120: val_accuracy did not improve from 0.60000
Epoch 121/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2420 - accuracy: 0.7542 - v
al_loss: 1.6163 - val_accuracy: 0.4875

Epoch 00121: val_accuracy did not improve from 0.60000
Epoch 122/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2533 - accuracy: 0.7262 - v
al_loss: 1.6524 - val_accuracy: 0.5000

Epoch 00122: val_accuracy did not improve from 0.60000
Epoch 123/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2665 - accuracy: 0.7554 - v
al_loss: 1.5414 - val_accuracy: 0.5375

Epoch 00123: val_accuracy did not improve from 0.60000
Epoch 124/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2294 - accuracy: 0.7604 - v
al_loss: 1.6942 - val_accuracy: 0.4250

Epoch 00124: val_accuracy did not improve from 0.60000
Epoch 125/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2390 - accuracy: 0.7750 - v
al_loss: 1.7884 - val_accuracy: 0.3875

Epoch 00125: val_accuracy did not improve from 0.60000
Epoch 126/300
9/9 [==============================] - 0s 22ms/step - loss: 1.2062 - accuracy: 0.7916 - v
al_loss: 1.6628 - val_accuracy: 0.4750

Epoch 00126: val_accuracy did not improve from 0.60000
Epoch 127/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1726 - accuracy: 0.7934 - v
al_loss: 1.6640 - val_accuracy: 0.4875

Epoch 00127: val_accuracy did not improve from 0.60000
Epoch 128/300
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9/9 [==============================] - 0s 23ms/step - loss: 1.2128 - accuracy: 0.7746 - v
al_loss: 1.7424 - val_accuracy: 0.4375

Epoch 00128: val_accuracy did not improve from 0.60000
Epoch 129/300
9/9 [==============================] - 0s 22ms/step - loss: 1.2014 - accuracy: 0.8394 - v
al_loss: 1.7361 - val_accuracy: 0.4625

Epoch 00129: val_accuracy did not improve from 0.60000
Epoch 130/300
9/9 [==============================] - 0s 38ms/step - loss: 1.1980 - accuracy: 0.8102 - v
al_loss: 1.7035 - val_accuracy: 0.4625

Epoch 00130: val_accuracy did not improve from 0.60000
Epoch 131/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2369 - accuracy: 0.7698 - v
al_loss: 1.6669 - val_accuracy: 0.4625

Epoch 00131: val_accuracy did not improve from 0.60000
Epoch 132/300
9/9 [==============================] - 0s 22ms/step - loss: 1.2279 - accuracy: 0.7863 - v
al_loss: 1.6750 - val_accuracy: 0.4000

Epoch 00132: val_accuracy did not improve from 0.60000
Epoch 133/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2200 - accuracy: 0.7680 - v
al_loss: 1.7392 - val_accuracy: 0.4500

Epoch 00133: val_accuracy did not improve from 0.60000
Epoch 134/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1769 - accuracy: 0.7885 - v
al_loss: 1.7637 - val_accuracy: 0.4125

Epoch 00134: val_accuracy did not improve from 0.60000
Epoch 135/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1677 - accuracy: 0.8073 - v
al_loss: 1.7515 - val_accuracy: 0.4500

Epoch 00135: val_accuracy did not improve from 0.60000
Epoch 136/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2250 - accuracy: 0.7911 - v
al_loss: 1.7612 - val_accuracy: 0.4000

Epoch 00136: val_accuracy did not improve from 0.60000
Epoch 137/300
9/9 [==============================] - 0s 22ms/step - loss: 1.2161 - accuracy: 0.7709 - v
al_loss: 1.8552 - val_accuracy: 0.3750

Epoch 00137: val_accuracy did not improve from 0.60000
Epoch 138/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1429 - accuracy: 0.8286 - v
al_loss: 1.6819 - val_accuracy: 0.4625

Epoch 00138: val_accuracy did not improve from 0.60000
Epoch 139/300
9/9 [==============================] - 0s 23ms/step - loss: 1.2107 - accuracy: 0.7571 - v
al_loss: 1.8409 - val_accuracy: 0.4250

Epoch 00139: val_accuracy did not improve from 0.60000
Epoch 140/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1891 - accuracy: 0.7936 - v
al_loss: 1.6895 - val_accuracy: 0.4500

Epoch 00140: val_accuracy did not improve from 0.60000
Epoch 141/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1903 - accuracy: 0.7989 - v
al_loss: 1.7648 - val_accuracy: 0.4125

Epoch 00141: val_accuracy did not improve from 0.60000
Epoch 142/300
9/9 [==============================] - 0s 22ms/step - loss: 1.2024 - accuracy: 0.7706 - v
al_loss: 1.6437 - val_accuracy: 0.4500
```

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Epoch 00142: val_accuracy did not improve from 0.60000
Epoch 143/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1858 - accuracy: 0.8081 - v
al_loss: 1.6834 - val_accuracy: 0.4500

Epoch 00143: val_accuracy did not improve from 0.60000
Epoch 144/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1813 - accuracy: 0.8219 - v
al_loss: 1.8034 - val_accuracy: 0.3625

Epoch 00144: val_accuracy did not improve from 0.60000
Epoch 145/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1983 - accuracy: 0.7613 - v
al_loss: 1.7403 - val_accuracy: 0.4000

Epoch 00145: val_accuracy did not improve from 0.60000
Epoch 146/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1380 - accuracy: 0.8371 - v
al_loss: 1.6422 - val_accuracy: 0.4625

Epoch 00146: val_accuracy did not improve from 0.60000
Epoch 147/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1755 - accuracy: 0.7738 - v
al_loss: 1.5687 - val_accuracy: 0.5250

Epoch 00147: val_accuracy did not improve from 0.60000
Epoch 148/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1690 - accuracy: 0.7829 - v
al_loss: 1.5317 - val_accuracy: 0.5250

Epoch 00148: val_accuracy did not improve from 0.60000
Epoch 149/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1727 - accuracy: 0.7779 - v
al_loss: 1.5666 - val_accuracy: 0.5000

Epoch 00149: val_accuracy did not improve from 0.60000
Epoch 150/300
9/9 [==============================] - 0s 22ms/step - loss: 1.1659 - accuracy: 0.7910 - v
al_loss: 1.7662 - val_accuracy: 0.4500

Epoch 00150: val_accuracy did not improve from 0.60000
Epoch 151/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1483 - accuracy: 0.8171 - v
al_loss: 1.5571 - val_accuracy: 0.5000

Epoch 00151: val_accuracy did not improve from 0.60000
Epoch 152/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1346 - accuracy: 0.7987 - v
al_loss: 1.6322 - val_accuracy: 0.4375

Epoch 00152: val_accuracy did not improve from 0.60000
Epoch 153/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1399 - accuracy: 0.7934 - v
al_loss: 1.5843 - val_accuracy: 0.4500

Epoch 00153: val_accuracy did not improve from 0.60000
Epoch 154/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1794 - accuracy: 0.7824 - v
al_loss: 1.9068 - val_accuracy: 0.3375

Epoch 00154: val_accuracy did not improve from 0.60000
Epoch 155/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1654 - accuracy: 0.7957 - v
al_loss: 1.5598 - val_accuracy: 0.5000

Epoch 00155: val_accuracy did not improve from 0.60000
Epoch 156/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1501 - accuracy: 0.8074 - v
al_loss: 1.5453 - val_accuracy: 0.4625

Epoch 00156: val_accuracy did not improve from 0.60000
Epoch 157/300
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Epoch 157/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1833 - accuracy: 0.7778 - v
al_loss: 1.4317 - val_accuracy: 0.5500

Epoch 00157: val_accuracy did not improve from 0.60000
Epoch 158/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1220 - accuracy: 0.8296 - v
al_loss: 1.4134 - val_accuracy: 0.5375

Epoch 00158: val_accuracy did not improve from 0.60000
Epoch 159/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1089 - accuracy: 0.8267 - v
al_loss: 1.3574 - val_accuracy: 0.6500

Epoch 00159: val_accuracy improved from 0.60000 to 0.65000, saving model to 1D_CNN_TD.hdf
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Epoch 160/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1340 - accuracy: 0.7750 - v
al_loss: 1.5662 - val_accuracy: 0.4750

Epoch 00160: val_accuracy did not improve from 0.65000
Epoch 161/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1368 - accuracy: 0.7928 - v
al_loss: 1.3805 - val_accuracy: 0.5750

Epoch 00161: val_accuracy did not improve from 0.65000
Epoch 162/300
9/9 [==============================] - 0s 22ms/step - loss: 1.1540 - accuracy: 0.8070 - v
al_loss: 1.4029 - val_accuracy: 0.5500

Epoch 00162: val_accuracy did not improve from 0.65000
Epoch 163/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1341 - accuracy: 0.8314 - v
al_loss: 1.3349 - val_accuracy: 0.5875

Epoch 00163: val_accuracy did not improve from 0.65000
Epoch 164/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1764 - accuracy: 0.7848 - v
al_loss: 1.4231 - val_accuracy: 0.5500

Epoch 00164: val_accuracy did not improve from 0.65000
Epoch 165/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1281 - accuracy: 0.7960 - v
al_loss: 1.2896 - val_accuracy: 0.6125

Epoch 00165: val_accuracy did not improve from 0.65000
Epoch 166/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1434 - accuracy: 0.7776 - v
al_loss: 1.3601 - val_accuracy: 0.5750

Epoch 00166: val_accuracy did not improve from 0.65000
Epoch 167/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1771 - accuracy: 0.7384 - v
al_loss: 1.3104 - val_accuracy: 0.6000

Epoch 00167: val_accuracy did not improve from 0.65000
Epoch 168/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1414 - accuracy: 0.8102 - v
al_loss: 1.3837 - val_accuracy: 0.5500

Epoch 00168: val_accuracy did not improve from 0.65000
Epoch 169/300
9/9 [==============================] - 0s 22ms/step - loss: 1.1866 - accuracy: 0.7691 - v
al_loss: 1.2776 - val_accuracy: 0.6250

Epoch 00169: val_accuracy did not improve from 0.65000
Epoch 170/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1703 - accuracy: 0.7638 - v
al_loss: 1.3484 - val_accuracy: 0.6125

Epoch 00170: val_accuracy did not improve from 0.65000
Epoch 171/300
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9/9 [==============================] - 0s 23ms/step - loss: 1.1341 - accuracy: 0.7827 - v
al_loss: 1.2833 - val_accuracy: 0.6375

Epoch 00171: val_accuracy did not improve from 0.65000
Epoch 172/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1400 - accuracy: 0.8072 - v
al_loss: 1.2755 - val_accuracy: 0.6250

Epoch 00172: val_accuracy did not improve from 0.65000
Epoch 173/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1421 - accuracy: 0.8267 - v
al_loss: 1.2992 - val_accuracy: 0.6250

Epoch 00173: val_accuracy did not improve from 0.65000
Epoch 174/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1057 - accuracy: 0.8075 - v
al_loss: 1.2868 - val_accuracy: 0.6250

Epoch 00174: val_accuracy did not improve from 0.65000
Epoch 175/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1119 - accuracy: 0.8133 - v
al_loss: 1.2677 - val_accuracy: 0.6375

Epoch 00175: val_accuracy did not improve from 0.65000
Epoch 176/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1168 - accuracy: 0.7911 - v
al_loss: 1.3090 - val_accuracy: 0.5500

Epoch 00176: val_accuracy did not improve from 0.65000
Epoch 177/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1336 - accuracy: 0.7970 - v
al_loss: 1.2699 - val_accuracy: 0.5875

Epoch 00177: val_accuracy did not improve from 0.65000
Epoch 178/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1034 - accuracy: 0.7964 - v
al_loss: 1.3435 - val_accuracy: 0.5375

Epoch 00178: val_accuracy did not improve from 0.65000
Epoch 179/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0986 - accuracy: 0.8039 - v
al_loss: 1.2821 - val_accuracy: 0.6375

Epoch 00179: val_accuracy did not improve from 0.65000
Epoch 180/300
9/9 [==============================] - 0s 38ms/step - loss: 1.1003 - accuracy: 0.8146 - v
al_loss: 1.3421 - val_accuracy: 0.6250

Epoch 00180: val_accuracy did not improve from 0.65000
Epoch 181/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0912 - accuracy: 0.8341 - v
al_loss: 1.3236 - val_accuracy: 0.6000

Epoch 00181: val_accuracy did not improve from 0.65000
Epoch 182/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1096 - accuracy: 0.8248 - v
al_loss: 1.2805 - val_accuracy: 0.6375

Epoch 00182: val_accuracy did not improve from 0.65000
Epoch 183/300
9/9 [==============================] - 0s 22ms/step - loss: 1.1235 - accuracy: 0.7880 - v
al_loss: 1.2954 - val_accuracy: 0.7000

Epoch 00183: val_accuracy improved from 0.65000 to 0.70000, saving model to 1D_CNN_TD.hdf
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Epoch 184/300
9/9 [==============================] - 0s 22ms/step - loss: 1.0587 - accuracy: 0.8665 - v
al_loss: 1.3669 - val_accuracy: 0.5500

Epoch 00184: val_accuracy did not improve from 0.70000
Epoch 185/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0878 - accuracy: 0.8042 - v
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al_loss: 1.3176 - val_accuracy: 0.6375

Epoch 00185: val_accuracy did not improve from 0.70000
Epoch 186/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1260 - accuracy: 0.8278 - v
al_loss: 1.3592 - val_accuracy: 0.6000

Epoch 00186: val_accuracy did not improve from 0.70000
Epoch 187/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0928 - accuracy: 0.8376 - v
al_loss: 1.3756 - val_accuracy: 0.6000

Epoch 00187: val_accuracy did not improve from 0.70000
Epoch 188/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1189 - accuracy: 0.8218 - v
al_loss: 1.2811 - val_accuracy: 0.6125

Epoch 00188: val_accuracy did not improve from 0.70000
Epoch 189/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1002 - accuracy: 0.7926 - v
al_loss: 1.2698 - val_accuracy: 0.6125

Epoch 00189: val_accuracy did not improve from 0.70000
Epoch 190/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0617 - accuracy: 0.8260 - v
al_loss: 1.2549 - val_accuracy: 0.5875

Epoch 00190: val_accuracy did not improve from 0.70000
Epoch 191/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0545 - accuracy: 0.8285 - v
al_loss: 1.2962 - val_accuracy: 0.6250

Epoch 00191: val_accuracy did not improve from 0.70000
Epoch 192/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0480 - accuracy: 0.8505 - v
al_loss: 1.2430 - val_accuracy: 0.5875

Epoch 00192: val_accuracy did not improve from 0.70000
Epoch 193/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0998 - accuracy: 0.8444 - v
al_loss: 1.2256 - val_accuracy: 0.6125

Epoch 00193: val_accuracy did not improve from 0.70000
Epoch 194/300
9/9 [==============================] - 0s 23ms/step - loss: 1.1022 - accuracy: 0.8283 - v
al_loss: 1.2750 - val_accuracy: 0.6250

Epoch 00194: val_accuracy did not improve from 0.70000
Epoch 195/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1014 - accuracy: 0.8341 - v
al_loss: 1.2701 - val_accuracy: 0.6000

Epoch 00195: val_accuracy did not improve from 0.70000
Epoch 196/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0627 - accuracy: 0.8296 - v
al_loss: 1.2742 - val_accuracy: 0.6000

Epoch 00196: val_accuracy did not improve from 0.70000
Epoch 197/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0960 - accuracy: 0.7965 - v
al_loss: 1.2391 - val_accuracy: 0.6000

Epoch 00197: val_accuracy did not improve from 0.70000
Epoch 198/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1037 - accuracy: 0.8156 - v
al_loss: 1.3644 - val_accuracy: 0.5750

Epoch 00198: val_accuracy did not improve from 0.70000
Epoch 199/300
9/9 [==============================] - 0s 22ms/step - loss: 1.1021 - accuracy: 0.7726 - v
al_loss: 1.3126 - val_accuracy: 0.5875

Epoch 00199: val_accuracy did not improve from 0.70000
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Epoch 00199: val_accuracy did not improve from 0.70000
Epoch 200/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0593 - accuracy: 0.8279 - v
al_loss: 1.2449 - val_accuracy: 0.6250

Epoch 00200: val_accuracy did not improve from 0.70000
Epoch 201/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0475 - accuracy: 0.8367 - v
al_loss: 1.2099 - val_accuracy: 0.6500

Epoch 00201: val_accuracy did not improve from 0.70000
Epoch 202/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0937 - accuracy: 0.7827 - v
al_loss: 1.1952 - val_accuracy: 0.6250

Epoch 00202: val_accuracy did not improve from 0.70000
Epoch 203/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0824 - accuracy: 0.8340 - v
al_loss: 1.2375 - val_accuracy: 0.6125

Epoch 00203: val_accuracy did not improve from 0.70000
Epoch 204/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0765 - accuracy: 0.8422 - v
al_loss: 1.3116 - val_accuracy: 0.6375

Epoch 00204: val_accuracy did not improve from 0.70000
Epoch 205/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0716 - accuracy: 0.8336 - v
al_loss: 1.2711 - val_accuracy: 0.5875

Epoch 00205: val_accuracy did not improve from 0.70000
Epoch 206/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0763 - accuracy: 0.7949 - v
al_loss: 1.2201 - val_accuracy: 0.6500

Epoch 00206: val_accuracy did not improve from 0.70000
Epoch 207/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0934 - accuracy: 0.8277 - v
al_loss: 1.2450 - val_accuracy: 0.6125

Epoch 00207: val_accuracy did not improve from 0.70000
Epoch 208/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0503 - accuracy: 0.8410 - v
al_loss: 1.2332 - val_accuracy: 0.6250

Epoch 00208: val_accuracy did not improve from 0.70000
Epoch 209/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0906 - accuracy: 0.8323 - v
al_loss: 1.1849 - val_accuracy: 0.6000

Epoch 00209: val_accuracy did not improve from 0.70000
Epoch 210/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0871 - accuracy: 0.8349 - v
al_loss: 1.2094 - val_accuracy: 0.5875

Epoch 00210: val_accuracy did not improve from 0.70000
Epoch 211/300
9/9 [==============================] - 0s 24ms/step - loss: 1.1006 - accuracy: 0.7888 - v
al_loss: 1.1691 - val_accuracy: 0.6250

Epoch 00211: val_accuracy did not improve from 0.70000
Epoch 212/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0459 - accuracy: 0.8140 - v
al_loss: 1.2481 - val_accuracy: 0.5375

Epoch 00212: val_accuracy did not improve from 0.70000
Epoch 213/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0632 - accuracy: 0.8363 - v
al_loss: 1.3155 - val_accuracy: 0.5375

Epoch 00213: val_accuracy did not improve from 0.70000
Epoch 214/300
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9/9 [==============================] - 0s 24ms/step - loss: 1.0558 - accuracy: 0.8352 - v
al_loss: 1.2576 - val_accuracy: 0.5625

Epoch 00214: val_accuracy did not improve from 0.70000
Epoch 215/300
9/9 [==============================] - 0s 25ms/step - loss: 1.1115 - accuracy: 0.7905 - v
al_loss: 1.3172 - val_accuracy: 0.5375

Epoch 00215: val_accuracy did not improve from 0.70000
Epoch 216/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0520 - accuracy: 0.8451 - v
al_loss: 1.1673 - val_accuracy: 0.6375

Epoch 00216: val_accuracy did not improve from 0.70000
Epoch 217/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0631 - accuracy: 0.8005 - v
al_loss: 1.1856 - val_accuracy: 0.6250

Epoch 00217: val_accuracy did not improve from 0.70000
Epoch 218/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0718 - accuracy: 0.8132 - v
al_loss: 1.1686 - val_accuracy: 0.6500

Epoch 00218: val_accuracy did not improve from 0.70000
Epoch 219/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0594 - accuracy: 0.8063 - v
al_loss: 1.1670 - val_accuracy: 0.6500

Epoch 00219: val_accuracy did not improve from 0.70000
Epoch 220/300
9/9 [==============================] - 0s 37ms/step - loss: 1.0540 - accuracy: 0.8009 - v
al_loss: 1.1581 - val_accuracy: 0.6250

Epoch 00220: val_accuracy did not improve from 0.70000
Epoch 221/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0491 - accuracy: 0.8009 - v
al_loss: 1.2120 - val_accuracy: 0.5875

Epoch 00221: val_accuracy did not improve from 0.70000
Epoch 222/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0538 - accuracy: 0.8327 - v
al_loss: 1.2849 - val_accuracy: 0.6125

Epoch 00222: val_accuracy did not improve from 0.70000
Epoch 223/300
9/9 [==============================] - 0s 25ms/step - loss: 1.0667 - accuracy: 0.7879 - v
al_loss: 1.1954 - val_accuracy: 0.6250

Epoch 00223: val_accuracy did not improve from 0.70000
Epoch 224/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0590 - accuracy: 0.8517 - v
al_loss: 1.2082 - val_accuracy: 0.6125

Epoch 00224: val_accuracy did not improve from 0.70000
Epoch 225/300
9/9 [==============================] - 0s 25ms/step - loss: 1.0625 - accuracy: 0.8082 - v
al_loss: 1.1426 - val_accuracy: 0.6000

Epoch 00225: val_accuracy did not improve from 0.70000
Epoch 226/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0551 - accuracy: 0.8387 - v
al_loss: 1.1564 - val_accuracy: 0.6500

Epoch 00226: val_accuracy did not improve from 0.70000
Epoch 227/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0281 - accuracy: 0.8702 - v
al_loss: 1.1359 - val_accuracy: 0.6625

Epoch 00227: val_accuracy did not improve from 0.70000
Epoch 228/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0846 - accuracy: 0.8333 - v
al_loss: 1.1685 - val_accuracy: 0.6625
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Epoch 00228: val_accuracy did not improve from 0.70000
Epoch 229/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0530 - accuracy: 0.8161 - v
al_loss: 1.1497 - val_accuracy: 0.6125

Epoch 00229: val_accuracy did not improve from 0.70000
Epoch 230/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0876 - accuracy: 0.8273 - v
al_loss: 1.1652 - val_accuracy: 0.5875

Epoch 00230: val_accuracy did not improve from 0.70000
Epoch 231/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0831 - accuracy: 0.8048 - v
al_loss: 1.1730 - val_accuracy: 0.6500

Epoch 00231: val_accuracy did not improve from 0.70000
Epoch 232/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0174 - accuracy: 0.8406 - v
al_loss: 1.2184 - val_accuracy: 0.5625

Epoch 00232: val_accuracy did not improve from 0.70000
Epoch 233/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0506 - accuracy: 0.8279 - v
al_loss: 1.1994 - val_accuracy: 0.5750

Epoch 00233: val_accuracy did not improve from 0.70000
Epoch 234/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0698 - accuracy: 0.8336 - v
al_loss: 1.1866 - val_accuracy: 0.6625

Epoch 00234: val_accuracy did not improve from 0.70000
Epoch 235/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0593 - accuracy: 0.8246 - v
al_loss: 1.1572 - val_accuracy: 0.6375

Epoch 00235: val_accuracy did not improve from 0.70000
Epoch 236/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0334 - accuracy: 0.8211 - v
al_loss: 1.2258 - val_accuracy: 0.5500

Epoch 00236: val_accuracy did not improve from 0.70000
Epoch 237/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0504 - accuracy: 0.8237 - v
al_loss: 1.1636 - val_accuracy: 0.6000

Epoch 00237: val_accuracy did not improve from 0.70000
Epoch 238/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0057 - accuracy: 0.8628 - v
al_loss: 1.2469 - val_accuracy: 0.5875

Epoch 00238: val_accuracy did not improve from 0.70000
Epoch 239/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0462 - accuracy: 0.8282 - v
al_loss: 1.1378 - val_accuracy: 0.6500

Epoch 00239: val_accuracy did not improve from 0.70000
Epoch 240/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0379 - accuracy: 0.8441 - v
al_loss: 1.1728 - val_accuracy: 0.6375

Epoch 00240: val_accuracy did not improve from 0.70000
Epoch 241/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0268 - accuracy: 0.8085 - v
al_loss: 1.1526 - val_accuracy: 0.6250

Epoch 00241: val_accuracy did not improve from 0.70000
Epoch 242/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0343 - accuracy: 0.8215 - v
al_loss: 1.1469 - val_accuracy: 0.5875

Epoch 00242: val_accuracy did not improve from 0.70000
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Epoch 243/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0585 - accuracy: 0.8024 - v
al_loss: 1.1641 - val_accuracy: 0.6500

Epoch 00243: val_accuracy did not improve from 0.70000
Epoch 244/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0523 - accuracy: 0.8289 - v
al_loss: 1.1135 - val_accuracy: 0.6625

Epoch 00244: val_accuracy did not improve from 0.70000
Epoch 245/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0314 - accuracy: 0.8403 - v
al_loss: 1.1187 - val_accuracy: 0.7125

Epoch 00245: val_accuracy improved from 0.70000 to 0.71250, saving model to 1D_CNN_TD.hdf
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Epoch 246/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0337 - accuracy: 0.8517 - v
al_loss: 1.1281 - val_accuracy: 0.6625

Epoch 00246: val_accuracy did not improve from 0.71250
Epoch 247/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0277 - accuracy: 0.8159 - v
al_loss: 1.0997 - val_accuracy: 0.6250

Epoch 00247: val_accuracy did not improve from 0.71250
Epoch 248/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0404 - accuracy: 0.8025 - v
al_loss: 1.1476 - val_accuracy: 0.6125

Epoch 00248: val_accuracy did not improve from 0.71250
Epoch 249/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0258 - accuracy: 0.8216 - v
al_loss: 1.4030 - val_accuracy: 0.5000

Epoch 00249: val_accuracy did not improve from 0.71250
Epoch 250/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0153 - accuracy: 0.8365 - v
al_loss: 1.1042 - val_accuracy: 0.6875

Epoch 00250: val_accuracy did not improve from 0.71250
Epoch 251/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0287 - accuracy: 0.8218 - v
al_loss: 1.1152 - val_accuracy: 0.6500

Epoch 00251: val_accuracy did not improve from 0.71250
Epoch 252/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0512 - accuracy: 0.8218 - v
al_loss: 1.1371 - val_accuracy: 0.6875

Epoch 00252: val_accuracy did not improve from 0.71250
Epoch 253/300
9/9 [==============================] - 0s 39ms/step - loss: 1.0300 - accuracy: 0.8085 - v
al_loss: 1.1421 - val_accuracy: 0.6250

Epoch 00253: val_accuracy did not improve from 0.71250
Epoch 254/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0013 - accuracy: 0.8363 - v
al_loss: 1.1588 - val_accuracy: 0.6625

Epoch 00254: val_accuracy did not improve from 0.71250
Epoch 255/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0226 - accuracy: 0.8430 - v
al_loss: 1.1523 - val_accuracy: 0.6250

Epoch 00255: val_accuracy did not improve from 0.71250
Epoch 256/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0382 - accuracy: 0.8502 - v
al_loss: 1.2454 - val_accuracy: 0.5875

Epoch 00256: val_accuracy did not improve from 0.71250
Epoch 257/300
```

```
9/9 [==============================] - 0s 24ms/step - loss: 1.0226 - accuracy: 0.8170 - v
al_loss: 1.2002 - val_accuracy: 0.6250

Epoch 00257: val_accuracy did not improve from 0.71250
Epoch 258/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0335 - accuracy: 0.8393 - v
al_loss: 1.1606 - val_accuracy: 0.6125

Epoch 00258: val_accuracy did not improve from 0.71250
Epoch 259/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0747 - accuracy: 0.7951 - v
al_loss: 1.1377 - val_accuracy: 0.6250

Epoch 00259: val_accuracy did not improve from 0.71250
Epoch 260/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0493 - accuracy: 0.8045 - v
al_loss: 1.1589 - val_accuracy: 0.5625

Epoch 00260: val_accuracy did not improve from 0.71250
Epoch 261/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0375 - accuracy: 0.8226 - v
al_loss: 1.1734 - val_accuracy: 0.5875

Epoch 00261: val_accuracy did not improve from 0.71250
Epoch 262/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0155 - accuracy: 0.8653 - v
al_loss: 1.1147 - val_accuracy: 0.6500

Epoch 00262: val_accuracy did not improve from 0.71250
Epoch 263/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0302 - accuracy: 0.8107 - v
al_loss: 1.1309 - val_accuracy: 0.6250

Epoch 00263: val_accuracy did not improve from 0.71250
Epoch 264/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0168 - accuracy: 0.8211 - v
al_loss: 1.1107 - val_accuracy: 0.6500

Epoch 00264: val_accuracy did not improve from 0.71250
Epoch 265/300
9/9 [==============================] - 0s 23ms/step - loss: 0.9947 - accuracy: 0.8694 - v
al_loss: 1.1544 - val_accuracy: 0.6875

Epoch 00265: val_accuracy did not improve from 0.71250
Epoch 266/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0030 - accuracy: 0.8339 - v
al_loss: 1.1203 - val_accuracy: 0.5875

Epoch 00266: val_accuracy did not improve from 0.71250
Epoch 267/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0393 - accuracy: 0.8064 - v
al_loss: 1.1279 - val_accuracy: 0.7000

Epoch 00267: val_accuracy did not improve from 0.71250
Epoch 268/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0397 - accuracy: 0.8308 - v
al_loss: 1.1743 - val_accuracy: 0.6000

Epoch 00268: val_accuracy did not improve from 0.71250
Epoch 269/300
9/9 [==============================] - 0s 25ms/step - loss: 1.0343 - accuracy: 0.8191 - v
al_loss: 1.2158 - val_accuracy: 0.6125

Epoch 00269: val_accuracy did not improve from 0.71250
Epoch 270/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0578 - accuracy: 0.8484 - v
al_loss: 1.2012 - val_accuracy: 0.5875

Epoch 00270: val_accuracy did not improve from 0.71250
Epoch 271/300
9/9 [==============================] - 0s 24ms/step - loss: 0.9963 - accuracy: 0.8243 - v
al_loss: 1.0799 - val_accuracy: 0.7375
```

```
Epoch 00271: val_accuracy improved from 0.71250 to 0.73750, saving model to 1D_CNN_TD.hdf
5
Epoch 272/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0074 - accuracy: 0.8353 - v
al_loss: 1.1232 - val_accuracy: 0.6000

Epoch 00272: val_accuracy did not improve from 0.73750
Epoch 273/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0109 - accuracy: 0.8139 - v
al_loss: 1.1324 - val_accuracy: 0.5500

Epoch 00273: val_accuracy did not improve from 0.73750
Epoch 274/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0465 - accuracy: 0.8104 - v
al_loss: 1.2085 - val_accuracy: 0.6250

Epoch 00274: val_accuracy did not improve from 0.73750
Epoch 275/300
9/9 [==============================] - 0s 24ms/step - loss: 0.9924 - accuracy: 0.8225 - v
al_loss: 1.1082 - val_accuracy: 0.6125

Epoch 00275: val_accuracy did not improve from 0.73750
Epoch 276/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0163 - accuracy: 0.7900 - v
al_loss: 1.0919 - val_accuracy: 0.6875

Epoch 00276: val_accuracy did not improve from 0.73750
Epoch 277/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0023 - accuracy: 0.8502 - v
al_loss: 1.0926 - val_accuracy: 0.6875

Epoch 00277: val_accuracy did not improve from 0.73750
Epoch 278/300
9/9 [==============================] - 0s 25ms/step - loss: 1.0302 - accuracy: 0.8215 - v
al_loss: 1.0888 - val_accuracy: 0.6500

Epoch 00278: val_accuracy did not improve from 0.73750
Epoch 279/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0192 - accuracy: 0.8309 - v
al_loss: 1.1490 - val_accuracy: 0.5875

Epoch 00279: val_accuracy did not improve from 0.73750
Epoch 280/300
9/9 [==============================] - 0s 26ms/step - loss: 1.0213 - accuracy: 0.7939 - v
al_loss: 1.1584 - val_accuracy: 0.6000

Epoch 00280: val_accuracy did not improve from 0.73750
Epoch 281/300
9/9 [==============================] - 0s 25ms/step - loss: 0.9868 - accuracy: 0.8631 - v
al_loss: 1.1161 - val_accuracy: 0.6500

Epoch 00281: val_accuracy did not improve from 0.73750
Epoch 282/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0176 - accuracy: 0.8297 - v
al_loss: 1.1963 - val_accuracy: 0.6375

Epoch 00282: val_accuracy did not improve from 0.73750
Epoch 283/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0134 - accuracy: 0.8433 - v
al_loss: 1.1294 - val_accuracy: 0.6750

Epoch 00283: val_accuracy did not improve from 0.73750
Epoch 284/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0235 - accuracy: 0.8215 - v
al_loss: 1.0828 - val_accuracy: 0.6750

Epoch 00284: val_accuracy did not improve from 0.73750
Epoch 285/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0300 - accuracy: 0.8165 - v
al_loss: 1.1122 - val_accuracy: 0.6125
```

```
Epoch 00285: val_accuracy did not improve from 0.73750
Epoch 286/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0557 - accuracy: 0.8271 - v
al_loss: 1.1100 - val_accuracy: 0.6375

Epoch 00286: val_accuracy did not improve from 0.73750
Epoch 287/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0121 - accuracy: 0.8122 - v
al_loss: 1.0909 - val_accuracy: 0.6500

Epoch 00287: val_accuracy did not improve from 0.73750
Epoch 288/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0093 - accuracy: 0.8028 - v
al_loss: 1.1107 - val_accuracy: 0.6625

Epoch 00288: val_accuracy did not improve from 0.73750
Epoch 289/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0114 - accuracy: 0.8183 - v
al_loss: 1.1121 - val_accuracy: 0.6500

Epoch 00289: val_accuracy did not improve from 0.73750
Epoch 290/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0345 - accuracy: 0.8501 - v
al_loss: 1.0947 - val_accuracy: 0.6500

Epoch 00290: val_accuracy did not improve from 0.73750
Epoch 291/300
9/9 [==============================] - 0s 23ms/step - loss: 0.9838 - accuracy: 0.8579 - v
al_loss: 1.1355 - val_accuracy: 0.6375

Epoch 00291: val_accuracy did not improve from 0.73750
Epoch 292/300
9/9 [==============================] - 0s 23ms/step - loss: 0.9896 - accuracy: 0.8300 - v
al_loss: 1.0806 - val_accuracy: 0.6625

Epoch 00292: val_accuracy did not improve from 0.73750
Epoch 293/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0123 - accuracy: 0.8343 - v
al_loss: 1.0880 - val_accuracy: 0.7000

Epoch 00293: val_accuracy did not improve from 0.73750
Epoch 294/300
9/9 [==============================] - 0s 24ms/step - loss: 1.0123 - accuracy: 0.8426 - v
al_loss: 1.0847 - val_accuracy: 0.7125

Epoch 00294: val_accuracy did not improve from 0.73750
Epoch 295/300
9/9 [==============================] - 0s 23ms/step - loss: 0.9954 - accuracy: 0.8198 - v
al_loss: 1.0731 - val_accuracy: 0.7250

Epoch 00295: val_accuracy did not improve from 0.73750
Epoch 296/300
9/9 [==============================] - 0s 24ms/step - loss: 0.9679 - accuracy: 0.8659 - v
al_loss: 1.1295 - val_accuracy: 0.6125

Epoch 00296: val_accuracy did not improve from 0.73750
Epoch 297/300
9/9 [==============================] - 0s 23ms/step - loss: 1.0042 - accuracy: 0.8250 - v
al_loss: 1.0987 - val_accuracy: 0.6875

Epoch 00297: val_accuracy did not improve from 0.73750
Epoch 298/300
9/9 [==============================] - 0s 24ms/step - loss: 0.9965 - accuracy: 0.8282 - v
al_loss: 1.0759 - val_accuracy: 0.6750

Epoch 00298: val_accuracy did not improve from 0.73750
Epoch 299/300
9/9 [==============================] - 0s 24ms/step - loss: 0.9836 - accuracy: 0.8573 - v
al_loss: 1.1331 - val_accuracy: 0.6250

Epoch 00299: val_accuracy did not improve from 0.73750
Epoch 300/300
```

```
9/9 [==============================] - 0s 24ms/step - loss: 1.0117 - accuracy: 0.8398 - v
al_loss: 1.0834 - val_accuracy: 0.6125

Epoch 00300: val_accuracy did not improve from 0.73750
```

Plot the training history.

In [ ]:

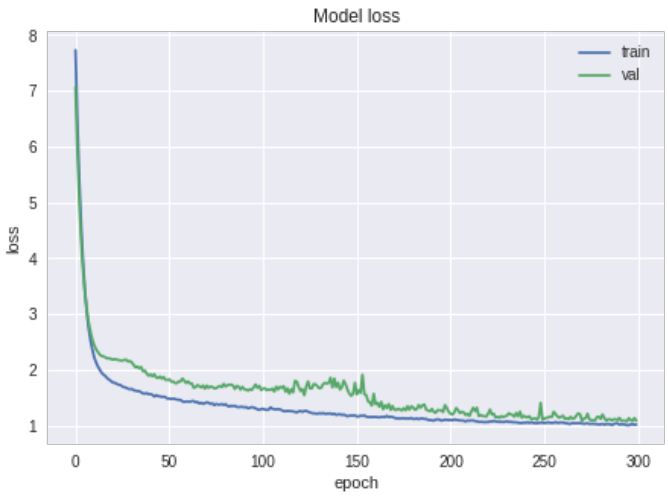
```
plt.figure(figsize=(16,5))

# Accuracy
plt.subplot(1,2,1)
plt.plot(history_td.history['accuracy'])
plt.plot(history_td.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'val'])

# Loss
plt.subplot(1,2,2)
plt.plot(history_td.history['loss'])
plt.plot(history_td.history['val_loss'])
plt.title('Model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'val'])

# best validation accuracy
best_acc = np.max(history_td.history['val_accuracy'])
print('Best validation accuracy: {0:5.1f} % '.format(best_acc*100))
```

```
Best validation accuracy:  73.8 %
```



Looking at the training history, the model seems performing better than the one before.

Plot the validation and test confusion matrices:

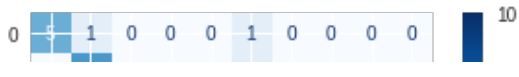
In [ ]:

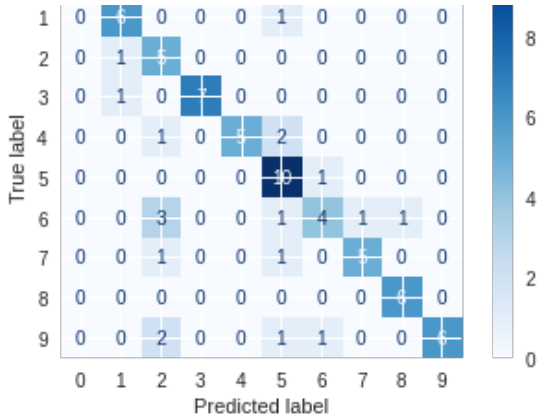
```
modeltd_best = tf.keras.models.load_model('1D_CNN_TD.hdf5')
```

In [ ]:

```
pred_val = np.argmax(modeltd_best.predict(X_val_rss), axis=-1)
cm_val = confusion_matrix(y_val, pred_val)

disp = ConfusionMatrixDisplay(confusion_matrix=cm_val, display_labels=classlist)
disp.plot(cmap='Blues');
```

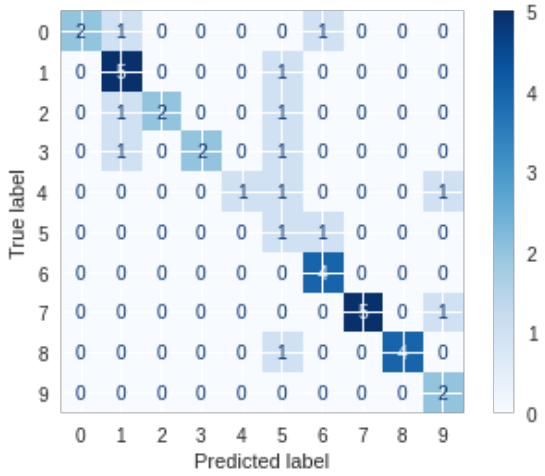




In [ ]:

```
pred_test = np.argmax(modeltd_best.predict(X_test_rss), axis=-1)
cm_test = confusion_matrix(y_test, pred_test)

disp = ConfusionMatrixDisplay(confusion_matrix=cm_test, display_labels=classlist)
disp.plot(cmap='Blues');
```



Exercise 6: Performance metrics

Use sklearn "classification_report" to analyze the performance of the classifier for each class in terms of Precision, Recall and F1.

Show the classification report for evaluation set. Discuss the results.

In [ ]:

```
from sklearn.metrics import classification_report

pred_val = np.argmax(modeltd_best.predict(X_val_rss), axis=-1)
#print(pred_val)
#print(y_val)

print("Classification report for evaluation set")
print(classification_report(y_val, pred_val))
```

```
Classification report for evaluation set
              precision    recall  f1-score   support

           0       1.00      0.71      0.83         7
           1       0.67      0.86      0.75         7
           2       0.42      0.83      0.56         6
           3       1.00      0.88      0.93         8
           4       1.00      0.62      0.77         8
           5       0.59      0.91      0.71        11
           6       0.67      0.40      0.50        10
           7       0.83      0.71      0.77         7
           8       0.86      1.00      0.92         6
```

```
           9       1.00      0.60      0.75        10

    accuracy                           0.74        80
   macro avg       0.80      0.75      0.75        80
weighted avg       0.80      0.74      0.74        80
```

All the measures have high variability. That's because we have a small validation set. It can be seen that some classes have a support of only few examples.

Show the classification report for the test set. Discuss the results.

In [ ]:

```
pred_test = np.argmax(modeltd_best.predict(X_test_rss), axis=-1)

print("Classification report for test set")
print(classification_report(y_test, pred_test))
```

```
Classification report for test set
              precision    recall  f1-score   support

           0       1.00      0.50      0.67         4
           1       0.62      0.83      0.71         6
           2       1.00      0.50      0.67         4
           3       1.00      0.50      0.67         4
           4       1.00      0.33      0.50         3
           5       0.17      0.50      0.25         2
           6       0.67      1.00      0.80         4
           7       1.00      0.83      0.91         6
           8       1.00      0.80      0.89         5
           9       0.50      1.00      0.67         2

    accuracy                           0.70        40
   macro avg       0.80      0.68      0.67        40
weighted avg       0.84      0.70      0.72        40
```

Test set is even smaller. The measures have high variability. However we can see the model is performing well.

Exercise 7: Hybrid CNN-RNN

In this last exercise we are going to mix our previous time-distributed model with a LSTM layer to create a Hybrid CNN-RNN architecture.

Adapt your previous time-distributed model to match the following summary:

In [ ]:

```
model_hybrid = tf.keras.models.Sequential()

# 1st convolutional layer
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Conv1D(filters=16, kern
el_size=9, activation='relu'), input_shape=input_shape))
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.MaxPooling1D(pool_size=
2, padding='same')))
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Dropout(0.5)))

# 2nd convolutional layer
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Conv1D(filters=16, kern
el_size=3, activation='relu')))
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.MaxPooling1D(pool_size=
2, padding='same')))
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Dropout(0.5)))

# 3rd convolutional layer
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Conv1D(filters=32, kern
el_size=3, activation='relu')))
```

```
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Dropout(0.35)))
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.MaxPooling1D(pool_size=
2, padding='same')))

# flatten output and feed it to a dense layer
model_hybrid.add(tf.keras.layers.TimeDistributed(tf.keras.layers.Flatten()))
model_hybrid.add(tf.keras.layers.LSTM(16, return_sequences=True))
model_hybrid.add(tf.keras.layers.GlobalAveragePooling1D())
model_hybrid.add(tf.keras.layers.Dropout(0.35))

# output layer
model_hybrid.add(tf.keras.layers.Dense(10, activation='softmax', kernel_regularizer=tf.k
eras.regularizers.l2(0.001)))

# compile model
adamopt = tf.keras.optimizers.Adam(learning_rate=0.001)
model_hybrid.compile(optimizer= adamopt, loss='sparse_categorical_crossentropy', metrics
=['accuracy'])

model_hybrid.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
time_distributed_10 (TimeDis (None, None, 120, 16)     160
_________________________________________________________________
time_distributed_11 (TimeDis (None, None, 60, 16)      0
_________________________________________________________________
time_distributed_12 (TimeDis (None, None, 60, 16)      0
_________________________________________________________________
time_distributed_13 (TimeDis (None, None, 58, 16)      784
_________________________________________________________________
time_distributed_14 (TimeDis (None, None, 29, 16)      0
_________________________________________________________________
time_distributed_15 (TimeDis (None, None, 29, 16)      0
_________________________________________________________________
time_distributed_16 (TimeDis (None, None, 27, 32)      1568
_________________________________________________________________
time_distributed_17 (TimeDis (None, None, 27, 32)      0
_________________________________________________________________
time_distributed_18 (TimeDis (None, None, 14, 32)      0
_________________________________________________________________
time_distributed_19 (TimeDis (None, None, 448)         0
_________________________________________________________________
lstm (LSTM)                  (None, None, 16)          29760
_________________________________________________________________
global_average_pooling1d_1 ( (None, 16)                0
_________________________________________________________________
dropout_5 (Dropout)          (None, 16)                0
_________________________________________________________________
dense_4 (Dense)              (None, 10)                170
=================================================================
Total params: 32,442
Trainable params: 32,442
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:

```
#_________________________________________________________________
# Layer (type)                 Output Shape              Param #

# Time-Dist Conv1D             (None, None, 120, 16)     160
# _________________________________________________________________
# Time-Dist MaxPool1D 1D       (None, None, 60, 16)      0
# _________________________________________________________________
# Time-Dist Dropout (0.5)      (None, None, 60, 16)      0
# _________________________________________________________________
# Time-Dist Conv1D             (None, None, 58, 16)      784
# _________________________________________________________________
# Time-Dist MaxPool1D          (None, None, 29, 16)      0
```

```
# _________________________________________________________________
# Time-Dist Dropout (0.5)       (None, None, 29, 16)      0
# _________________________________________________________________
# Time-Dist Conv1D              (None, None, 27, 32)      1568
# _________________________________________________________________
# Time-Dist Dropout (0.5)       (None, None, 27, 32)      0
# _________________________________________________________________
# Time-Dist MaxPool1D           (None, None, 14, 32)      0
# _________________________________________________________________
# Time-Dist Flatten             (None, None, 448)         0
# _________________________________________________________________
# LSTM  (16 neurons)            (None, None, 16)          29760
# _________________________________________________________________
# Global Av. Pooling 1D         (None, 16)                0
# _________________________________________________________________
# Dropout (0.35)                (None, 16)                0
# _________________________________________________________________
# Dense                         (None, 10)                170

# Total params: 32,442
# Trainable params: 32,442
# Non-trainable params: 0
# _________________________________________________________________
```

Train the network.

In [ ]:

```
history_hybrid = model_hybrid.fit(X_train_rss,y_train, validation_data = (X_val_rss, y_val), batch_size=32, epochs=300, callbacks=callbacks)
```

```
Epoch 1/300
9/9 [==============================] - 3s 147ms/step - loss: 2.3323 - accuracy: 0.0708 - val_loss: 2.2550 - val_accuracy: 0.1625

Epoch 00001: val_accuracy did not improve from 0.73750
Epoch 2/300
9/9 [==============================] - 0s 40ms/step - loss: 2.2549 - accuracy: 0.1812 - val_loss: 2.1887 - val_accuracy: 0.2875

Epoch 00002: val_accuracy did not improve from 0.73750
Epoch 3/300
9/9 [==============================] - 0s 40ms/step - loss: 2.1653 - accuracy: 0.2307 - val_loss: 2.1086 - val_accuracy: 0.2750

Epoch 00003: val_accuracy did not improve from 0.73750
Epoch 4/300
9/9 [==============================] - 0s 40ms/step - loss: 2.0754 - accuracy: 0.2883 - val_loss: 2.0218 - val_accuracy: 0.3375

Epoch 00004: val_accuracy did not improve from 0.73750
Epoch 5/300
9/9 [==============================] - 0s 39ms/step - loss: 1.9509 - accuracy: 0.3859 - val_loss: 1.9510 - val_accuracy: 0.3750

Epoch 00005: val_accuracy did not improve from 0.73750
Epoch 6/300
9/9 [==============================] - 0s 39ms/step - loss: 1.8654 - accuracy: 0.4227 - val_loss: 1.8970 - val_accuracy: 0.3875

Epoch 00006: val_accuracy did not improve from 0.73750
Epoch 7/300
9/9 [==============================] - 0s 39ms/step - loss: 1.7534 - accuracy: 0.4481 - val_loss: 1.8541 - val_accuracy: 0.3625

Epoch 00007: val_accuracy did not improve from 0.73750
Epoch 8/300
9/9 [==============================] - 0s 40ms/step - loss: 1.6865 - accuracy: 0.5195 - val_loss: 1.7971 - val_accuracy: 0.4125

Epoch 00008: val_accuracy did not improve from 0.73750
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Epoch 9/300
9/9 [==============================] - 0s 40ms/step - loss: 1.6763 - accuracy: 0.4450 - v
al_loss: 1.7643 - val_accuracy: 0.4000

Epoch 00009: val_accuracy did not improve from 0.73750
Epoch 10/300
9/9 [==============================] - 0s 41ms/step - loss: 1.6372 - accuracy: 0.4550 - v
al_loss: 1.7252 - val_accuracy: 0.4125

Epoch 00010: val_accuracy did not improve from 0.73750
Epoch 11/300
9/9 [==============================] - 0s 40ms/step - loss: 1.5392 - accuracy: 0.5133 - v
al_loss: 1.6894 - val_accuracy: 0.4125

Epoch 00011: val_accuracy did not improve from 0.73750
Epoch 12/300
9/9 [==============================] - 0s 39ms/step - loss: 1.5579 - accuracy: 0.5008 - v
al_loss: 1.6799 - val_accuracy: 0.3750

Epoch 00012: val_accuracy did not improve from 0.73750
Epoch 13/300
9/9 [==============================] - 1s 59ms/step - loss: 1.4454 - accuracy: 0.5367 - v
al_loss: 1.6746 - val_accuracy: 0.3625

Epoch 00013: val_accuracy did not improve from 0.73750
Epoch 14/300
9/9 [==============================] - 0s 41ms/step - loss: 1.4703 - accuracy: 0.4987 - v
al_loss: 1.6228 - val_accuracy: 0.4375

Epoch 00014: val_accuracy did not improve from 0.73750
Epoch 15/300
9/9 [==============================] - 0s 39ms/step - loss: 1.5832 - accuracy: 0.4928 - v
al_loss: 1.6271 - val_accuracy: 0.4625

Epoch 00015: val_accuracy did not improve from 0.73750
Epoch 16/300
9/9 [==============================] - 0s 40ms/step - loss: 1.4613 - accuracy: 0.5440 - v
al_loss: 1.6312 - val_accuracy: 0.4375

Epoch 00016: val_accuracy did not improve from 0.73750
Epoch 17/300
9/9 [==============================] - 0s 39ms/step - loss: 1.4438 - accuracy: 0.5397 - v
al_loss: 1.6038 - val_accuracy: 0.4250

Epoch 00017: val_accuracy did not improve from 0.73750
Epoch 18/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3047 - accuracy: 0.5823 - v
al_loss: 1.6117 - val_accuracy: 0.4000

Epoch 00018: val_accuracy did not improve from 0.73750
Epoch 19/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3286 - accuracy: 0.5541 - v
al_loss: 1.6311 - val_accuracy: 0.4250

Epoch 00019: val_accuracy did not improve from 0.73750
Epoch 20/300
9/9 [==============================] - 0s 40ms/step - loss: 1.4126 - accuracy: 0.5316 - v
al_loss: 1.5425 - val_accuracy: 0.4000

Epoch 00020: val_accuracy did not improve from 0.73750
Epoch 21/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3257 - accuracy: 0.5634 - v
al_loss: 1.5400 - val_accuracy: 0.4625

Epoch 00021: val_accuracy did not improve from 0.73750
Epoch 22/300
9/9 [==============================] - 0s 40ms/step - loss: 1.4305 - accuracy: 0.5378 - v
al_loss: 1.5839 - val_accuracy: 0.4125

Epoch 00022: val_accuracy did not improve from 0.73750
Epoch 23/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3376 - accuracy: 0.5592 - v
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al_loss: 1.5825 - val_accuracy: 0.3500

Epoch 00023: val_accuracy did not improve from 0.73750
Epoch 24/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3307 - accuracy: 0.5501 - v
al_loss: 1.5718 - val_accuracy: 0.3875

Epoch 00024: val_accuracy did not improve from 0.73750
Epoch 25/300
9/9 [==============================] - 0s 39ms/step - loss: 1.3579 - accuracy: 0.5291 - v
al_loss: 1.5534 - val_accuracy: 0.5000

Epoch 00025: val_accuracy did not improve from 0.73750
Epoch 26/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2827 - accuracy: 0.5797 - v
al_loss: 1.5543 - val_accuracy: 0.4500

Epoch 00026: val_accuracy did not improve from 0.73750
Epoch 27/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2853 - accuracy: 0.5666 - v
al_loss: 1.5621 - val_accuracy: 0.4750

Epoch 00027: val_accuracy did not improve from 0.73750
Epoch 28/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3206 - accuracy: 0.5636 - v
al_loss: 1.5660 - val_accuracy: 0.4375

Epoch 00028: val_accuracy did not improve from 0.73750
Epoch 29/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3408 - accuracy: 0.5147 - v
al_loss: 1.5743 - val_accuracy: 0.4750

Epoch 00029: val_accuracy did not improve from 0.73750
Epoch 30/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3954 - accuracy: 0.4872 - v
al_loss: 1.5383 - val_accuracy: 0.5125

Epoch 00030: val_accuracy did not improve from 0.73750
Epoch 31/300
9/9 [==============================] - 0s 41ms/step - loss: 1.2773 - accuracy: 0.5824 - v
al_loss: 1.5195 - val_accuracy: 0.5375

Epoch 00031: val_accuracy did not improve from 0.73750
Epoch 32/300
9/9 [==============================] - 0s 41ms/step - loss: 1.2456 - accuracy: 0.5311 - v
al_loss: 1.5081 - val_accuracy: 0.5375

Epoch 00032: val_accuracy did not improve from 0.73750
Epoch 33/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3055 - accuracy: 0.5712 - v
al_loss: 1.4933 - val_accuracy: 0.5375

Epoch 00033: val_accuracy did not improve from 0.73750
Epoch 34/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1793 - accuracy: 0.6288 - v
al_loss: 1.5116 - val_accuracy: 0.5000

Epoch 00034: val_accuracy did not improve from 0.73750
Epoch 35/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2430 - accuracy: 0.5893 - v
al_loss: 1.4928 - val_accuracy: 0.4875

Epoch 00035: val_accuracy did not improve from 0.73750
Epoch 36/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2161 - accuracy: 0.5876 - v
al_loss: 1.5314 - val_accuracy: 0.4875

Epoch 00036: val_accuracy did not improve from 0.73750
Epoch 37/300
9/9 [==============================] - 0s 41ms/step - loss: 1.2565 - accuracy: 0.5853 - v
al_loss: 1.5298 - val_accuracy: 0.5250

Epoch 00037: val_accuracy did not improve from 0.73750
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Epoch 00037: val_accuracy did not improve from 0.73750
Epoch 38/300
9/9 [==============================] - 0s 41ms/step - loss: 1.2389 - accuracy: 0.5885 - v
al_loss: 1.5234 - val_accuracy: 0.5000

Epoch 00038: val_accuracy did not improve from 0.73750
Epoch 39/300
9/9 [==============================] - 0s 41ms/step - loss: 1.1240 - accuracy: 0.6537 - v
al_loss: 1.4949 - val_accuracy: 0.4875

Epoch 00039: val_accuracy did not improve from 0.73750
Epoch 40/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2387 - accuracy: 0.5728 - v
al_loss: 1.5464 - val_accuracy: 0.4750

Epoch 00040: val_accuracy did not improve from 0.73750
Epoch 41/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1316 - accuracy: 0.6369 - v
al_loss: 1.5756 - val_accuracy: 0.4625

Epoch 00041: val_accuracy did not improve from 0.73750
Epoch 42/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1464 - accuracy: 0.6501 - v
al_loss: 1.5388 - val_accuracy: 0.4750

Epoch 00042: val_accuracy did not improve from 0.73750
Epoch 43/300
9/9 [==============================] - 0s 41ms/step - loss: 1.1016 - accuracy: 0.7044 - v
al_loss: 1.5533 - val_accuracy: 0.5125

Epoch 00043: val_accuracy did not improve from 0.73750
Epoch 44/300
9/9 [==============================] - 0s 41ms/step - loss: 1.1887 - accuracy: 0.5818 - v
al_loss: 1.5557 - val_accuracy: 0.5125

Epoch 00044: val_accuracy did not improve from 0.73750
Epoch 45/300
9/9 [==============================] - 0s 41ms/step - loss: 1.2243 - accuracy: 0.5568 - v
al_loss: 1.5356 - val_accuracy: 0.5000

Epoch 00045: val_accuracy did not improve from 0.73750
Epoch 46/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1068 - accuracy: 0.6679 - v
al_loss: 1.5698 - val_accuracy: 0.5000

Epoch 00046: val_accuracy did not improve from 0.73750
Epoch 47/300
9/9 [==============================] - 0s 39ms/step - loss: 1.1279 - accuracy: 0.6413 - v
al_loss: 1.5469 - val_accuracy: 0.4375

Epoch 00047: val_accuracy did not improve from 0.73750
Epoch 48/300
9/9 [==============================] - 0s 41ms/step - loss: 1.1688 - accuracy: 0.6401 - v
al_loss: 1.5528 - val_accuracy: 0.5000

Epoch 00048: val_accuracy did not improve from 0.73750
Epoch 49/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2458 - accuracy: 0.6285 - v
al_loss: 1.5600 - val_accuracy: 0.5250

Epoch 00049: val_accuracy did not improve from 0.73750
Epoch 50/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1389 - accuracy: 0.6197 - v
al_loss: 1.5127 - val_accuracy: 0.5125

Epoch 00050: val_accuracy did not improve from 0.73750
Epoch 51/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1196 - accuracy: 0.6465 - v
al_loss: 1.5168 - val_accuracy: 0.5250

Epoch 00051: val_accuracy did not improve from 0.73750
Epoch 52/300
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9/9 [==============================] - 0s 41ms/step - loss: 1.0372 - accuracy: 0.6815 - v
al_loss: 1.5668 - val_accuracy: 0.4750

Epoch 00052: val_accuracy did not improve from 0.73750
Epoch 53/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0108 - accuracy: 0.7102 - v
al_loss: 1.6193 - val_accuracy: 0.4625

Epoch 00053: val_accuracy did not improve from 0.73750
Epoch 54/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0507 - accuracy: 0.6850 - v
al_loss: 1.6256 - val_accuracy: 0.4500

Epoch 00054: val_accuracy did not improve from 0.73750
Epoch 55/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0259 - accuracy: 0.6560 - v
al_loss: 1.6382 - val_accuracy: 0.4375

Epoch 00055: val_accuracy did not improve from 0.73750
Epoch 56/300
9/9 [==============================] - 0s 57ms/step - loss: 1.0050 - accuracy: 0.6561 - v
al_loss: 1.6011 - val_accuracy: 0.4500

Epoch 00056: val_accuracy did not improve from 0.73750
Epoch 57/300
9/9 [==============================] - 0s 41ms/step - loss: 1.1734 - accuracy: 0.6337 - v
al_loss: 1.4978 - val_accuracy: 0.5000

Epoch 00057: val_accuracy did not improve from 0.73750
Epoch 58/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0405 - accuracy: 0.6553 - v
al_loss: 1.5585 - val_accuracy: 0.4875

Epoch 00058: val_accuracy did not improve from 0.73750
Epoch 59/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0374 - accuracy: 0.6593 - v
al_loss: 1.5769 - val_accuracy: 0.5125

Epoch 00059: val_accuracy did not improve from 0.73750
Epoch 60/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0303 - accuracy: 0.6763 - v
al_loss: 1.5413 - val_accuracy: 0.5125

Epoch 00060: val_accuracy did not improve from 0.73750
Epoch 61/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9989 - accuracy: 0.6988 - v
al_loss: 1.5253 - val_accuracy: 0.5250

Epoch 00061: val_accuracy did not improve from 0.73750
Epoch 62/300
9/9 [==============================] - 0s 39ms/step - loss: 1.0482 - accuracy: 0.6160 - v
al_loss: 1.5703 - val_accuracy: 0.5250

Epoch 00062: val_accuracy did not improve from 0.73750
Epoch 63/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0406 - accuracy: 0.6712 - v
al_loss: 1.5126 - val_accuracy: 0.6125

Epoch 00063: val_accuracy did not improve from 0.73750
Epoch 64/300
9/9 [==============================] - 0s 39ms/step - loss: 1.1737 - accuracy: 0.6196 - v
al_loss: 1.4572 - val_accuracy: 0.5375

Epoch 00064: val_accuracy did not improve from 0.73750
Epoch 65/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1488 - accuracy: 0.5986 - v
al_loss: 1.4312 - val_accuracy: 0.5250

Epoch 00065: val_accuracy did not improve from 0.73750
Epoch 66/300
9/9 [==============================] - 0s 39ms/step - loss: 1.1400 - accuracy: 0.6460 - v
al_loss: 1.4610 - val_accuracy: 0.5625
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Epoch 00066: val_accuracy did not improve from 0.73750
Epoch 67/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0622 - accuracy: 0.6628 - v
al_loss: 1.5644 - val_accuracy: 0.5250

Epoch 00067: val_accuracy did not improve from 0.73750
Epoch 68/300
9/9 [==============================] - 0s 41ms/step - loss: 1.1131 - accuracy: 0.6596 - v
al_loss: 1.4347 - val_accuracy: 0.5125

Epoch 00068: val_accuracy did not improve from 0.73750
Epoch 69/300
9/9 [==============================] - 0s 39ms/step - loss: 1.1069 - accuracy: 0.6557 - v
al_loss: 1.4457 - val_accuracy: 0.5000

Epoch 00069: val_accuracy did not improve from 0.73750
Epoch 70/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1645 - accuracy: 0.5928 - v
al_loss: 1.4464 - val_accuracy: 0.5000

Epoch 00070: val_accuracy did not improve from 0.73750
Epoch 71/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1266 - accuracy: 0.6357 - v
al_loss: 1.4479 - val_accuracy: 0.5375

Epoch 00071: val_accuracy did not improve from 0.73750
Epoch 72/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0629 - accuracy: 0.6410 - v
al_loss: 1.4474 - val_accuracy: 0.5500

Epoch 00072: val_accuracy did not improve from 0.73750
Epoch 73/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0873 - accuracy: 0.6526 - v
al_loss: 1.4468 - val_accuracy: 0.5250

Epoch 00073: val_accuracy did not improve from 0.73750
Epoch 74/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0797 - accuracy: 0.6122 - v
al_loss: 1.4424 - val_accuracy: 0.5375

Epoch 00074: val_accuracy did not improve from 0.73750
Epoch 75/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1644 - accuracy: 0.6028 - v
al_loss: 1.4378 - val_accuracy: 0.5625

Epoch 00075: val_accuracy did not improve from 0.73750
Epoch 76/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0337 - accuracy: 0.6499 - v
al_loss: 1.5006 - val_accuracy: 0.5250

Epoch 00076: val_accuracy did not improve from 0.73750
Epoch 77/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0435 - accuracy: 0.6551 - v
al_loss: 1.5473 - val_accuracy: 0.4875

Epoch 00077: val_accuracy did not improve from 0.73750
Epoch 78/300
9/9 [==============================] - 0s 39ms/step - loss: 1.0127 - accuracy: 0.6613 - v
al_loss: 1.5006 - val_accuracy: 0.5250

Epoch 00078: val_accuracy did not improve from 0.73750
Epoch 79/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0248 - accuracy: 0.6751 - v
al_loss: 1.5097 - val_accuracy: 0.5375

Epoch 00079: val_accuracy did not improve from 0.73750
Epoch 80/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9976 - accuracy: 0.6749 - v
al_loss: 1.4932 - val_accuracy: 0.5500

Epoch 00080: val_accuracy did not improve from 0.73750
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Epoch 81/300
9/9 [==============================] - 0s 39ms/step - loss: 1.0178 - accuracy: 0.6881 - v
al_loss: 1.4484 - val_accuracy: 0.5750

Epoch 00081: val_accuracy did not improve from 0.73750
Epoch 82/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0096 - accuracy: 0.6883 - v
al_loss: 1.4050 - val_accuracy: 0.5500

Epoch 00082: val_accuracy did not improve from 0.73750
Epoch 83/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9294 - accuracy: 0.7105 - v
al_loss: 1.4484 - val_accuracy: 0.5750

Epoch 00083: val_accuracy did not improve from 0.73750
Epoch 84/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9252 - accuracy: 0.6922 - v
al_loss: 1.4701 - val_accuracy: 0.5500

Epoch 00084: val_accuracy did not improve from 0.73750
Epoch 85/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0197 - accuracy: 0.6686 - v
al_loss: 1.5146 - val_accuracy: 0.4875

Epoch 00085: val_accuracy did not improve from 0.73750
Epoch 86/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9313 - accuracy: 0.6798 - v
al_loss: 1.4759 - val_accuracy: 0.5375

Epoch 00086: val_accuracy did not improve from 0.73750
Epoch 87/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0146 - accuracy: 0.6868 - v
al_loss: 1.5511 - val_accuracy: 0.5375

Epoch 00087: val_accuracy did not improve from 0.73750
Epoch 88/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0839 - accuracy: 0.6478 - v
al_loss: 1.5068 - val_accuracy: 0.5125

Epoch 00088: val_accuracy did not improve from 0.73750
Epoch 89/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9632 - accuracy: 0.6571 - v
al_loss: 1.5137 - val_accuracy: 0.5875

Epoch 00089: val_accuracy did not improve from 0.73750
Epoch 90/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9065 - accuracy: 0.7008 - v
al_loss: 1.5168 - val_accuracy: 0.5500

Epoch 00090: val_accuracy did not improve from 0.73750
Epoch 91/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8813 - accuracy: 0.7400 - v
al_loss: 1.5534 - val_accuracy: 0.5750

Epoch 00091: val_accuracy did not improve from 0.73750
Epoch 92/300
9/9 [==============================] - 0s 57ms/step - loss: 0.9524 - accuracy: 0.6866 - v
al_loss: 1.4779 - val_accuracy: 0.5750

Epoch 00092: val_accuracy did not improve from 0.73750
Epoch 93/300
9/9 [==============================] - 0s 42ms/step - loss: 0.8998 - accuracy: 0.6981 - v
al_loss: 1.4599 - val_accuracy: 0.5500

Epoch 00093: val_accuracy did not improve from 0.73750
Epoch 94/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8975 - accuracy: 0.6880 - v
al_loss: 1.4963 - val_accuracy: 0.5625

Epoch 00094: val_accuracy did not improve from 0.73750
Epoch 95/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9407 - accuracy: 0.6811 - v
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al_loss: 1.4801 - val_accuracy: 0.5500

Epoch 00095: val_accuracy did not improve from 0.73750
Epoch 96/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9451 - accuracy: 0.6748 - v
al_loss: 1.5014 - val_accuracy: 0.5375

Epoch 00096: val_accuracy did not improve from 0.73750
Epoch 97/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0219 - accuracy: 0.6512 - v
al_loss: 1.4184 - val_accuracy: 0.5625

Epoch 00097: val_accuracy did not improve from 0.73750
Epoch 98/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9309 - accuracy: 0.7200 - v
al_loss: 1.4918 - val_accuracy: 0.5500

Epoch 00098: val_accuracy did not improve from 0.73750
Epoch 99/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8783 - accuracy: 0.7430 - v
al_loss: 1.5201 - val_accuracy: 0.5750

Epoch 00099: val_accuracy did not improve from 0.73750
Epoch 100/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8118 - accuracy: 0.7396 - v
al_loss: 1.4888 - val_accuracy: 0.5875

Epoch 00100: val_accuracy did not improve from 0.73750
Epoch 101/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9401 - accuracy: 0.6648 - v
al_loss: 1.5470 - val_accuracy: 0.5625

Epoch 00101: val_accuracy did not improve from 0.73750
Epoch 102/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0714 - accuracy: 0.6667 - v
al_loss: 1.8218 - val_accuracy: 0.4375

Epoch 00102: val_accuracy did not improve from 0.73750
Epoch 103/300
9/9 [==============================] - 0s 40ms/step - loss: 1.3555 - accuracy: 0.5190 - v
al_loss: 1.7468 - val_accuracy: 0.3875

Epoch 00103: val_accuracy did not improve from 0.73750
Epoch 104/300
9/9 [==============================] - 0s 40ms/step - loss: 1.2588 - accuracy: 0.5671 - v
al_loss: 1.5814 - val_accuracy: 0.4875

Epoch 00104: val_accuracy did not improve from 0.73750
Epoch 105/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1328 - accuracy: 0.5976 - v
al_loss: 1.6542 - val_accuracy: 0.4375

Epoch 00105: val_accuracy did not improve from 0.73750
Epoch 106/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0994 - accuracy: 0.5841 - v
al_loss: 1.5690 - val_accuracy: 0.4625

Epoch 00106: val_accuracy did not improve from 0.73750
Epoch 107/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0907 - accuracy: 0.6018 - v
al_loss: 1.6149 - val_accuracy: 0.4750

Epoch 00107: val_accuracy did not improve from 0.73750
Epoch 108/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0677 - accuracy: 0.6473 - v
al_loss: 1.7530 - val_accuracy: 0.4375

Epoch 00108: val_accuracy did not improve from 0.73750
Epoch 109/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1064 - accuracy: 0.6361 - v
al_loss: 1.6087 - val_accuracy: 0.5250

Epoch 00109: val_accuracy did not improve from 0.73750
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Epoch 00109: val_accuracy did not improve from 0.73750
Epoch 110/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0929 - accuracy: 0.6362 - v
al_loss: 1.5565 - val_accuracy: 0.5625

Epoch 00110: val_accuracy did not improve from 0.73750
Epoch 111/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9930 - accuracy: 0.6848 - v
al_loss: 1.5284 - val_accuracy: 0.5750

Epoch 00111: val_accuracy did not improve from 0.73750
Epoch 112/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0074 - accuracy: 0.6587 - v
al_loss: 1.5715 - val_accuracy: 0.5500

Epoch 00112: val_accuracy did not improve from 0.73750
Epoch 113/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9216 - accuracy: 0.7136 - v
al_loss: 1.5635 - val_accuracy: 0.5750

Epoch 00113: val_accuracy did not improve from 0.73750
Epoch 114/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8989 - accuracy: 0.6772 - v
al_loss: 1.6230 - val_accuracy: 0.5375

Epoch 00114: val_accuracy did not improve from 0.73750
Epoch 115/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8843 - accuracy: 0.6956 - v
al_loss: 1.5844 - val_accuracy: 0.5125

Epoch 00115: val_accuracy did not improve from 0.73750
Epoch 116/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9664 - accuracy: 0.6905 - v
al_loss: 1.6657 - val_accuracy: 0.5500

Epoch 00116: val_accuracy did not improve from 0.73750
Epoch 117/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9392 - accuracy: 0.6863 - v
al_loss: 1.5937 - val_accuracy: 0.5625

Epoch 00117: val_accuracy did not improve from 0.73750
Epoch 118/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8221 - accuracy: 0.7275 - v
al_loss: 1.5870 - val_accuracy: 0.5500

Epoch 00118: val_accuracy did not improve from 0.73750
Epoch 119/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8836 - accuracy: 0.7384 - v
al_loss: 1.5431 - val_accuracy: 0.5500

Epoch 00119: val_accuracy did not improve from 0.73750
Epoch 120/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9692 - accuracy: 0.6759 - v
al_loss: 1.5344 - val_accuracy: 0.5250

Epoch 00120: val_accuracy did not improve from 0.73750
Epoch 121/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8493 - accuracy: 0.7144 - v
al_loss: 1.5377 - val_accuracy: 0.5625

Epoch 00121: val_accuracy did not improve from 0.73750
Epoch 122/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9123 - accuracy: 0.6821 - v
al_loss: 1.5424 - val_accuracy: 0.5625

Epoch 00122: val_accuracy did not improve from 0.73750
Epoch 123/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8687 - accuracy: 0.7097 - v
al_loss: 1.5251 - val_accuracy: 0.5375

Epoch 00123: val_accuracy did not improve from 0.73750
Epoch 124/300
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9/9 [==============================] - 0s 40ms/step - loss: 0.8568 - accuracy: 0.6985 - v
al_loss: 1.5349 - val_accuracy: 0.5125

Epoch 00124: val_accuracy did not improve from 0.73750
Epoch 125/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7365 - accuracy: 0.7783 - v
al_loss: 1.5023 - val_accuracy: 0.5500

Epoch 00125: val_accuracy did not improve from 0.73750
Epoch 126/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8039 - accuracy: 0.7801 - v
al_loss: 1.4786 - val_accuracy: 0.5375

Epoch 00126: val_accuracy did not improve from 0.73750
Epoch 127/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9024 - accuracy: 0.6875 - v
al_loss: 1.5054 - val_accuracy: 0.5125

Epoch 00127: val_accuracy did not improve from 0.73750
Epoch 128/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8703 - accuracy: 0.6968 - v
al_loss: 1.5875 - val_accuracy: 0.5250

Epoch 00128: val_accuracy did not improve from 0.73750
Epoch 129/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8633 - accuracy: 0.7144 - v
al_loss: 1.5735 - val_accuracy: 0.5125

Epoch 00129: val_accuracy did not improve from 0.73750
Epoch 130/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8741 - accuracy: 0.7023 - v
al_loss: 1.6055 - val_accuracy: 0.4750

Epoch 00130: val_accuracy did not improve from 0.73750
Epoch 131/300
9/9 [==============================] - 0s 42ms/step - loss: 0.8374 - accuracy: 0.7408 - v
al_loss: 1.5991 - val_accuracy: 0.4625

Epoch 00131: val_accuracy did not improve from 0.73750
Epoch 132/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7845 - accuracy: 0.7466 - v
al_loss: 1.5710 - val_accuracy: 0.5500

Epoch 00132: val_accuracy did not improve from 0.73750
Epoch 133/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8133 - accuracy: 0.7175 - v
al_loss: 1.5819 - val_accuracy: 0.5375

Epoch 00133: val_accuracy did not improve from 0.73750
Epoch 134/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7848 - accuracy: 0.7937 - v
al_loss: 1.5639 - val_accuracy: 0.6125

Epoch 00134: val_accuracy did not improve from 0.73750
Epoch 135/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8820 - accuracy: 0.6856 - v
al_loss: 1.4932 - val_accuracy: 0.5875

Epoch 00135: val_accuracy did not improve from 0.73750
Epoch 136/300
9/9 [==============================] - 0s 39ms/step - loss: 0.8415 - accuracy: 0.7431 - v
al_loss: 1.5769 - val_accuracy: 0.5375

Epoch 00136: val_accuracy did not improve from 0.73750
Epoch 137/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8459 - accuracy: 0.7246 - v
al_loss: 1.5014 - val_accuracy: 0.5375

Epoch 00137: val_accuracy did not improve from 0.73750
Epoch 138/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7896 - accuracy: 0.7731 - v
al_loss: 1.6971 - val_accuracy: 0.4375
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Epoch 00138: val_accuracy did not improve from 0.73750
Epoch 139/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9272 - accuracy: 0.7331 - v
al_loss: 1.3809 - val_accuracy: 0.5875

Epoch 00139: val_accuracy did not improve from 0.73750
Epoch 140/300
9/9 [==============================] - 0s 40ms/step - loss: 1.1445 - accuracy: 0.5891 - v
al_loss: 1.3742 - val_accuracy: 0.5875

Epoch 00140: val_accuracy did not improve from 0.73750
Epoch 141/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0483 - accuracy: 0.6176 - v
al_loss: 1.4298 - val_accuracy: 0.5500

Epoch 00141: val_accuracy did not improve from 0.73750
Epoch 142/300
9/9 [==============================] - 0s 40ms/step - loss: 0.9515 - accuracy: 0.6468 - v
al_loss: 1.4414 - val_accuracy: 0.5875

Epoch 00142: val_accuracy did not improve from 0.73750
Epoch 143/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8794 - accuracy: 0.7171 - v
al_loss: 1.5380 - val_accuracy: 0.5500

Epoch 00143: val_accuracy did not improve from 0.73750
Epoch 144/300
9/9 [==============================] - 0s 39ms/step - loss: 0.9744 - accuracy: 0.6806 - v
al_loss: 1.5768 - val_accuracy: 0.5000

Epoch 00144: val_accuracy did not improve from 0.73750
Epoch 145/300
9/9 [==============================] - 0s 57ms/step - loss: 0.9145 - accuracy: 0.6924 - v
al_loss: 1.3453 - val_accuracy: 0.5875

Epoch 00145: val_accuracy did not improve from 0.73750
Epoch 146/300
9/9 [==============================] - 0s 41ms/step - loss: 0.9734 - accuracy: 0.7010 - v
al_loss: 1.3751 - val_accuracy: 0.6250

Epoch 00146: val_accuracy did not improve from 0.73750
Epoch 147/300
9/9 [==============================] - 0s 39ms/step - loss: 0.9146 - accuracy: 0.7205 - v
al_loss: 1.6126 - val_accuracy: 0.5000

Epoch 00147: val_accuracy did not improve from 0.73750
Epoch 148/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0008 - accuracy: 0.6177 - v
al_loss: 1.4919 - val_accuracy: 0.5750

Epoch 00148: val_accuracy did not improve from 0.73750
Epoch 149/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8658 - accuracy: 0.7273 - v
al_loss: 1.3751 - val_accuracy: 0.6125

Epoch 00149: val_accuracy did not improve from 0.73750
Epoch 150/300
9/9 [==============================] - 0s 42ms/step - loss: 0.8702 - accuracy: 0.7263 - v
al_loss: 1.4110 - val_accuracy: 0.5750

Epoch 00150: val_accuracy did not improve from 0.73750
Epoch 151/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7808 - accuracy: 0.7489 - v
al_loss: 1.3821 - val_accuracy: 0.5875

Epoch 00151: val_accuracy did not improve from 0.73750
Epoch 152/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8994 - accuracy: 0.7136 - v
al_loss: 1.4012 - val_accuracy: 0.6000

Epoch 00152: val_accuracy did not improve from 0.73750
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Epoch 153/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8537 - accuracy: 0.7102 - v
al_loss: 1.4115 - val_accuracy: 0.6250

Epoch 00153: val_accuracy did not improve from 0.73750
Epoch 154/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7821 - accuracy: 0.7751 - v
al_loss: 1.4239 - val_accuracy: 0.5875

Epoch 00154: val_accuracy did not improve from 0.73750
Epoch 155/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7942 - accuracy: 0.7750 - v
al_loss: 1.4687 - val_accuracy: 0.5625

Epoch 00155: val_accuracy did not improve from 0.73750
Epoch 156/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7277 - accuracy: 0.7977 - v
al_loss: 1.4199 - val_accuracy: 0.6125

Epoch 00156: val_accuracy did not improve from 0.73750
Epoch 157/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6767 - accuracy: 0.8152 - v
al_loss: 1.3854 - val_accuracy: 0.6250

Epoch 00157: val_accuracy did not improve from 0.73750
Epoch 158/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7141 - accuracy: 0.7811 - v
al_loss: 1.4182 - val_accuracy: 0.6125

Epoch 00158: val_accuracy did not improve from 0.73750
Epoch 159/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7471 - accuracy: 0.7696 - v
al_loss: 1.4233 - val_accuracy: 0.6125

Epoch 00159: val_accuracy did not improve from 0.73750
Epoch 160/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7870 - accuracy: 0.7214 - v
al_loss: 1.4329 - val_accuracy: 0.6250

Epoch 00160: val_accuracy did not improve from 0.73750
Epoch 161/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7406 - accuracy: 0.7520 - v
al_loss: 1.5163 - val_accuracy: 0.5500

Epoch 00161: val_accuracy did not improve from 0.73750
Epoch 162/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8318 - accuracy: 0.6976 - v
al_loss: 1.5692 - val_accuracy: 0.5500

Epoch 00162: val_accuracy did not improve from 0.73750
Epoch 163/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7251 - accuracy: 0.8049 - v
al_loss: 1.4922 - val_accuracy: 0.5625

Epoch 00163: val_accuracy did not improve from 0.73750
Epoch 164/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7656 - accuracy: 0.7817 - v
al_loss: 1.5255 - val_accuracy: 0.5875

Epoch 00164: val_accuracy did not improve from 0.73750
Epoch 165/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7615 - accuracy: 0.7369 - v
al_loss: 1.7147 - val_accuracy: 0.4875

Epoch 00165: val_accuracy did not improve from 0.73750
Epoch 166/300
9/9 [==============================] - 0s 41ms/step - loss: 1.2889 - accuracy: 0.5478 - v
al_loss: 1.6364 - val_accuracy: 0.5000

Epoch 00166: val_accuracy did not improve from 0.73750
Epoch 167/300
9/9 [==============================] - 0s 41ms/step - loss: 1.0801 - accuracy: 0.6357 - v
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al_loss: 1.5837 - val_accuracy: 0.5500

Epoch 00167: val_accuracy did not improve from 0.73750
Epoch 168/300
9/9 [==============================] - 0s 42ms/step - loss: 1.0448 - accuracy: 0.6848 - v
al_loss: 1.5596 - val_accuracy: 0.5125

Epoch 00168: val_accuracy did not improve from 0.73750
Epoch 169/300
9/9 [==============================] - 0s 42ms/step - loss: 0.9332 - accuracy: 0.6871 - v
al_loss: 1.6267 - val_accuracy: 0.4500

Epoch 00169: val_accuracy did not improve from 0.73750
Epoch 170/300
9/9 [==============================] - 0s 40ms/step - loss: 1.0334 - accuracy: 0.6645 - v
al_loss: 1.5947 - val_accuracy: 0.5125

Epoch 00170: val_accuracy did not improve from 0.73750
Epoch 171/300
9/9 [==============================] - 0s 42ms/step - loss: 0.8474 - accuracy: 0.7406 - v
al_loss: 1.5251 - val_accuracy: 0.5000

Epoch 00171: val_accuracy did not improve from 0.73750
Epoch 172/300
9/9 [==============================] - 0s 42ms/step - loss: 0.9307 - accuracy: 0.7123 - v
al_loss: 1.5005 - val_accuracy: 0.6000

Epoch 00172: val_accuracy did not improve from 0.73750
Epoch 173/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8273 - accuracy: 0.7499 - v
al_loss: 1.5098 - val_accuracy: 0.5500

Epoch 00173: val_accuracy did not improve from 0.73750
Epoch 174/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7835 - accuracy: 0.7708 - v
al_loss: 1.4748 - val_accuracy: 0.5750

Epoch 00174: val_accuracy did not improve from 0.73750
Epoch 175/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8291 - accuracy: 0.7495 - v
al_loss: 1.4604 - val_accuracy: 0.5500

Epoch 00175: val_accuracy did not improve from 0.73750
Epoch 176/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7903 - accuracy: 0.7622 - v
al_loss: 1.4230 - val_accuracy: 0.5625

Epoch 00176: val_accuracy did not improve from 0.73750
Epoch 177/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7112 - accuracy: 0.7713 - v
al_loss: 1.3743 - val_accuracy: 0.5875

Epoch 00177: val_accuracy did not improve from 0.73750
Epoch 178/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7372 - accuracy: 0.7762 - v
al_loss: 1.3873 - val_accuracy: 0.6000

Epoch 00178: val_accuracy did not improve from 0.73750
Epoch 179/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7732 - accuracy: 0.7461 - v
al_loss: 1.4033 - val_accuracy: 0.6125

Epoch 00179: val_accuracy did not improve from 0.73750
Epoch 180/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7140 - accuracy: 0.8129 - v
al_loss: 1.3655 - val_accuracy: 0.6125

Epoch 00180: val_accuracy did not improve from 0.73750
Epoch 181/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7880 - accuracy: 0.7514 - v
al_loss: 1.4263 - val_accuracy: 0.5875

Epoch 00181: val_accuracy did not improve from 0.73750
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Epoch 00181: val_accuracy did not improve from 0.73750
Epoch 182/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7351 - accuracy: 0.7550 - v
al_loss: 1.3941 - val_accuracy: 0.6250

Epoch 00182: val_accuracy did not improve from 0.73750
Epoch 183/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8401 - accuracy: 0.7183 - v
al_loss: 1.4258 - val_accuracy: 0.5625

Epoch 00183: val_accuracy did not improve from 0.73750
Epoch 184/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8043 - accuracy: 0.7750 - v
al_loss: 1.4363 - val_accuracy: 0.5500

Epoch 00184: val_accuracy did not improve from 0.73750
Epoch 185/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8058 - accuracy: 0.7572 - v
al_loss: 1.4299 - val_accuracy: 0.5750

Epoch 00185: val_accuracy did not improve from 0.73750
Epoch 186/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8750 - accuracy: 0.7072 - v
al_loss: 1.3728 - val_accuracy: 0.6125

Epoch 00186: val_accuracy did not improve from 0.73750
Epoch 187/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7538 - accuracy: 0.7441 - v
al_loss: 1.3811 - val_accuracy: 0.6125

Epoch 00187: val_accuracy did not improve from 0.73750
Epoch 188/300
9/9 [==============================] - 0s 57ms/step - loss: 0.7713 - accuracy: 0.7544 - v
al_loss: 1.4012 - val_accuracy: 0.6000

Epoch 00188: val_accuracy did not improve from 0.73750
Epoch 189/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7468 - accuracy: 0.7869 - v
al_loss: 1.4250 - val_accuracy: 0.6000

Epoch 00189: val_accuracy did not improve from 0.73750
Epoch 190/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7677 - accuracy: 0.7682 - v
al_loss: 1.5387 - val_accuracy: 0.5375

Epoch 00190: val_accuracy did not improve from 0.73750
Epoch 191/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7490 - accuracy: 0.7533 - v
al_loss: 1.5521 - val_accuracy: 0.5625

Epoch 00191: val_accuracy did not improve from 0.73750
Epoch 192/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7899 - accuracy: 0.6994 - v
al_loss: 1.4447 - val_accuracy: 0.5750

Epoch 00192: val_accuracy did not improve from 0.73750
Epoch 193/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7604 - accuracy: 0.7733 - v
al_loss: 1.4523 - val_accuracy: 0.5625

Epoch 00193: val_accuracy did not improve from 0.73750
Epoch 194/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8047 - accuracy: 0.7784 - v
al_loss: 1.4525 - val_accuracy: 0.6000

Epoch 00194: val_accuracy did not improve from 0.73750
Epoch 195/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7347 - accuracy: 0.7947 - v
al_loss: 1.4070 - val_accuracy: 0.6000

Epoch 00195: val_accuracy did not improve from 0.73750
Epoch 196/300
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9/9 [==============================] - 0s 40ms/step - loss: 0.6898 - accuracy: 0.7807 - v
al_loss: 1.3802 - val_accuracy: 0.5625

Epoch 00196: val_accuracy did not improve from 0.73750
Epoch 197/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7315 - accuracy: 0.7938 - v
al_loss: 1.4114 - val_accuracy: 0.6000

Epoch 00197: val_accuracy did not improve from 0.73750
Epoch 198/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6957 - accuracy: 0.7725 - v
al_loss: 1.4541 - val_accuracy: 0.5625

Epoch 00198: val_accuracy did not improve from 0.73750
Epoch 199/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6769 - accuracy: 0.7953 - v
al_loss: 1.4971 - val_accuracy: 0.5875

Epoch 00199: val_accuracy did not improve from 0.73750
Epoch 200/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7649 - accuracy: 0.7310 - v
al_loss: 1.4950 - val_accuracy: 0.5875

Epoch 00200: val_accuracy did not improve from 0.73750
Epoch 201/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7207 - accuracy: 0.7933 - v
al_loss: 1.4331 - val_accuracy: 0.5750

Epoch 00201: val_accuracy did not improve from 0.73750
Epoch 202/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7040 - accuracy: 0.8064 - v
al_loss: 1.3970 - val_accuracy: 0.5875

Epoch 00202: val_accuracy did not improve from 0.73750
Epoch 203/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7974 - accuracy: 0.7336 - v
al_loss: 1.4631 - val_accuracy: 0.5625

Epoch 00203: val_accuracy did not improve from 0.73750
Epoch 204/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7287 - accuracy: 0.7881 - v
al_loss: 1.5140 - val_accuracy: 0.5750

Epoch 00204: val_accuracy did not improve from 0.73750
Epoch 205/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6294 - accuracy: 0.8271 - v
al_loss: 1.5093 - val_accuracy: 0.5750

Epoch 00205: val_accuracy did not improve from 0.73750
Epoch 206/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7059 - accuracy: 0.8080 - v
al_loss: 1.4945 - val_accuracy: 0.5625

Epoch 00206: val_accuracy did not improve from 0.73750
Epoch 207/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6794 - accuracy: 0.7741 - v
al_loss: 1.3961 - val_accuracy: 0.6000

Epoch 00207: val_accuracy did not improve from 0.73750
Epoch 208/300
9/9 [==============================] - 0s 39ms/step - loss: 0.6873 - accuracy: 0.7843 - v
al_loss: 1.3590 - val_accuracy: 0.6375

Epoch 00208: val_accuracy did not improve from 0.73750
Epoch 209/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6642 - accuracy: 0.8018 - v
al_loss: 1.4354 - val_accuracy: 0.5375

Epoch 00209: val_accuracy did not improve from 0.73750
Epoch 210/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7458 - accuracy: 0.7662 - v
al_loss: 1.4315 - val_accuracy: 0.5375
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Epoch 00210: val_accuracy did not improve from 0.73750
Epoch 211/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7087 - accuracy: 0.8118 - v
al_loss: 1.4194 - val_accuracy: 0.5750

Epoch 00211: val_accuracy did not improve from 0.73750
Epoch 212/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6552 - accuracy: 0.8156 - v
al_loss: 1.4306 - val_accuracy: 0.5875

Epoch 00212: val_accuracy did not improve from 0.73750
Epoch 213/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7009 - accuracy: 0.7784 - v
al_loss: 1.3784 - val_accuracy: 0.6000

Epoch 00213: val_accuracy did not improve from 0.73750
Epoch 214/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6505 - accuracy: 0.8219 - v
al_loss: 1.3454 - val_accuracy: 0.6125

Epoch 00214: val_accuracy did not improve from 0.73750
Epoch 215/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7331 - accuracy: 0.7752 - v
al_loss: 1.2832 - val_accuracy: 0.6125

Epoch 00215: val_accuracy did not improve from 0.73750
Epoch 216/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6625 - accuracy: 0.8190 - v
al_loss: 1.3438 - val_accuracy: 0.6000

Epoch 00216: val_accuracy did not improve from 0.73750
Epoch 217/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6793 - accuracy: 0.8253 - v
al_loss: 1.3375 - val_accuracy: 0.6000

Epoch 00217: val_accuracy did not improve from 0.73750
Epoch 218/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6924 - accuracy: 0.7994 - v
al_loss: 1.3406 - val_accuracy: 0.6125

Epoch 00218: val_accuracy did not improve from 0.73750
Epoch 219/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6205 - accuracy: 0.8542 - v
al_loss: 1.4228 - val_accuracy: 0.5875

Epoch 00219: val_accuracy did not improve from 0.73750
Epoch 220/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6415 - accuracy: 0.7722 - v
al_loss: 1.3806 - val_accuracy: 0.6250

Epoch 00220: val_accuracy did not improve from 0.73750
Epoch 221/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6577 - accuracy: 0.7865 - v
al_loss: 1.4146 - val_accuracy: 0.6250

Epoch 00221: val_accuracy did not improve from 0.73750
Epoch 222/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6047 - accuracy: 0.8550 - v
al_loss: 1.3831 - val_accuracy: 0.6500

Epoch 00222: val_accuracy did not improve from 0.73750
Epoch 223/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5830 - accuracy: 0.8294 - v
al_loss: 1.4139 - val_accuracy: 0.6125

Epoch 00223: val_accuracy did not improve from 0.73750
Epoch 224/300
9/9 [==============================] - 0s 56ms/step - loss: 0.6806 - accuracy: 0.7961 - v
al_loss: 1.3850 - val_accuracy: 0.6250

Epoch 00224: val_accuracy did not improve from 0.73750
Epoch 225/300
```

```
Epoch 225/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5890 - accuracy: 0.8253 - v
al_loss: 1.3868 - val_accuracy: 0.6125

Epoch 00225: val_accuracy did not improve from 0.73750
Epoch 226/300
9/9 [==============================] - 0s 43ms/step - loss: 0.6731 - accuracy: 0.7727 - v
al_loss: 1.3554 - val_accuracy: 0.6375

Epoch 00226: val_accuracy did not improve from 0.73750
Epoch 227/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5334 - accuracy: 0.8702 - v
al_loss: 1.3105 - val_accuracy: 0.6125

Epoch 00227: val_accuracy did not improve from 0.73750
Epoch 228/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6315 - accuracy: 0.8232 - v
al_loss: 1.3023 - val_accuracy: 0.6125

Epoch 00228: val_accuracy did not improve from 0.73750
Epoch 229/300
9/9 [==============================] - 0s 39ms/step - loss: 0.6376 - accuracy: 0.7865 - v
al_loss: 1.3470 - val_accuracy: 0.5875

Epoch 00229: val_accuracy did not improve from 0.73750
Epoch 230/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6291 - accuracy: 0.7877 - v
al_loss: 1.3820 - val_accuracy: 0.5750

Epoch 00230: val_accuracy did not improve from 0.73750
Epoch 231/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5732 - accuracy: 0.8542 - v
al_loss: 1.3392 - val_accuracy: 0.5750

Epoch 00231: val_accuracy did not improve from 0.73750
Epoch 232/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6580 - accuracy: 0.7987 - v
al_loss: 1.3550 - val_accuracy: 0.6000

Epoch 00232: val_accuracy did not improve from 0.73750
Epoch 233/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6806 - accuracy: 0.7603 - v
al_loss: 1.3729 - val_accuracy: 0.5875

Epoch 00233: val_accuracy did not improve from 0.73750
Epoch 234/300
9/9 [==============================] - 0s 40ms/step - loss: 0.7057 - accuracy: 0.7928 - v
al_loss: 1.3936 - val_accuracy: 0.6125

Epoch 00234: val_accuracy did not improve from 0.73750
Epoch 235/300
9/9 [==============================] - 0s 43ms/step - loss: 0.6497 - accuracy: 0.8023 - v
al_loss: 1.3867 - val_accuracy: 0.6125

Epoch 00235: val_accuracy did not improve from 0.73750
Epoch 236/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5907 - accuracy: 0.8288 - v
al_loss: 1.3943 - val_accuracy: 0.6000

Epoch 00236: val_accuracy did not improve from 0.73750
Epoch 237/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5286 - accuracy: 0.8198 - v
al_loss: 1.4146 - val_accuracy: 0.6000

Epoch 00237: val_accuracy did not improve from 0.73750
Epoch 238/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5889 - accuracy: 0.8271 - v
al_loss: 1.3849 - val_accuracy: 0.6000

Epoch 00238: val_accuracy did not improve from 0.73750
Epoch 239/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5751 - accuracy: 0.8485 - v
```

```
al_loss: 1.4109 - val_accuracy: 0.6000

Epoch 00239: val_accuracy did not improve from 0.73750
Epoch 240/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6391 - accuracy: 0.8329 - v
al_loss: 1.3881 - val_accuracy: 0.6000

Epoch 00240: val_accuracy did not improve from 0.73750
Epoch 241/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6433 - accuracy: 0.7870 - v
al_loss: 1.4071 - val_accuracy: 0.6250

Epoch 00241: val_accuracy did not improve from 0.73750
Epoch 242/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6243 - accuracy: 0.7998 - v
al_loss: 1.3958 - val_accuracy: 0.6250

Epoch 00242: val_accuracy did not improve from 0.73750
Epoch 243/300
9/9 [==============================] - 0s 39ms/step - loss: 0.6410 - accuracy: 0.7840 - v
al_loss: 1.3291 - val_accuracy: 0.6250

Epoch 00243: val_accuracy did not improve from 0.73750
Epoch 244/300
9/9 [==============================] - 0s 39ms/step - loss: 0.5748 - accuracy: 0.8405 - v
al_loss: 1.3169 - val_accuracy: 0.6500

Epoch 00244: val_accuracy did not improve from 0.73750
Epoch 245/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6441 - accuracy: 0.8051 - v
al_loss: 1.3484 - val_accuracy: 0.6125

Epoch 00245: val_accuracy did not improve from 0.73750
Epoch 246/300
9/9 [==============================] - 0s 39ms/step - loss: 0.5573 - accuracy: 0.8580 - v
al_loss: 1.3783 - val_accuracy: 0.5875

Epoch 00246: val_accuracy did not improve from 0.73750
Epoch 247/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5629 - accuracy: 0.8377 - v
al_loss: 1.3599 - val_accuracy: 0.6125

Epoch 00247: val_accuracy did not improve from 0.73750
Epoch 248/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6094 - accuracy: 0.8106 - v
al_loss: 1.3953 - val_accuracy: 0.5625

Epoch 00248: val_accuracy did not improve from 0.73750
Epoch 249/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5699 - accuracy: 0.8086 - v
al_loss: 1.3979 - val_accuracy: 0.5500

Epoch 00249: val_accuracy did not improve from 0.73750
Epoch 250/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6047 - accuracy: 0.8192 - v
al_loss: 1.3566 - val_accuracy: 0.5750

Epoch 00250: val_accuracy did not improve from 0.73750
Epoch 251/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5837 - accuracy: 0.8375 - v
al_loss: 1.4278 - val_accuracy: 0.5750

Epoch 00251: val_accuracy did not improve from 0.73750
Epoch 252/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5378 - accuracy: 0.8421 - v
al_loss: 1.4211 - val_accuracy: 0.5750

Epoch 00252: val_accuracy did not improve from 0.73750
Epoch 253/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7269 - accuracy: 0.8142 - v
al_loss: 1.5231 - val_accuracy: 0.5875

Epoch 00253: val_accuracy did not improve from 0.73750
```

```
Epoch 00253: val_accuracy did not improve from 0.73750
Epoch 254/300
9/9 [==============================] - 0s 41ms/step - loss: 0.8222 - accuracy: 0.7040 - v
al_loss: 1.4336 - val_accuracy: 0.6000

Epoch 00254: val_accuracy did not improve from 0.73750
Epoch 255/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7437 - accuracy: 0.7680 - v
al_loss: 1.4155 - val_accuracy: 0.5375

Epoch 00255: val_accuracy did not improve from 0.73750
Epoch 256/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6640 - accuracy: 0.7751 - v
al_loss: 1.4030 - val_accuracy: 0.5375

Epoch 00256: val_accuracy did not improve from 0.73750
Epoch 257/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6638 - accuracy: 0.7917 - v
al_loss: 1.4662 - val_accuracy: 0.5250

Epoch 00257: val_accuracy did not improve from 0.73750
Epoch 258/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5734 - accuracy: 0.8802 - v
al_loss: 1.3943 - val_accuracy: 0.5875

Epoch 00258: val_accuracy did not improve from 0.73750
Epoch 259/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5376 - accuracy: 0.8933 - v
al_loss: 1.3818 - val_accuracy: 0.5750

Epoch 00259: val_accuracy did not improve from 0.73750
Epoch 260/300
9/9 [==============================] - 0s 39ms/step - loss: 0.6629 - accuracy: 0.8095 - v
al_loss: 1.3823 - val_accuracy: 0.5625

Epoch 00260: val_accuracy did not improve from 0.73750
Epoch 261/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6090 - accuracy: 0.8030 - v
al_loss: 1.3711 - val_accuracy: 0.5625

Epoch 00261: val_accuracy did not improve from 0.73750
Epoch 262/300
9/9 [==============================] - 0s 41ms/step - loss: 0.6546 - accuracy: 0.8075 - v
al_loss: 1.3832 - val_accuracy: 0.5750

Epoch 00262: val_accuracy did not improve from 0.73750
Epoch 263/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6452 - accuracy: 0.8094 - v
al_loss: 1.4214 - val_accuracy: 0.5500

Epoch 00263: val_accuracy did not improve from 0.73750
Epoch 264/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5713 - accuracy: 0.8453 - v
al_loss: 1.4204 - val_accuracy: 0.5250

Epoch 00264: val_accuracy did not improve from 0.73750
Epoch 265/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5851 - accuracy: 0.8373 - v
al_loss: 1.4743 - val_accuracy: 0.5375

Epoch 00265: val_accuracy did not improve from 0.73750
Epoch 266/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5305 - accuracy: 0.8558 - v
al_loss: 1.4762 - val_accuracy: 0.5375

Epoch 00266: val_accuracy did not improve from 0.73750
Epoch 267/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5915 - accuracy: 0.8550 - v
al_loss: 1.4142 - val_accuracy: 0.5625

Epoch 00267: val_accuracy did not improve from 0.73750
Epoch 268/300
```

```
9/9 [==============================] - 0s 40ms/step - loss: 0.5955 - accuracy: 0.8215 - v
al_loss: 1.3823 - val_accuracy: 0.5750

Epoch 00268: val_accuracy did not improve from 0.73750
Epoch 269/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5756 - accuracy: 0.8306 - v
al_loss: 1.4549 - val_accuracy: 0.5625

Epoch 00269: val_accuracy did not improve from 0.73750
Epoch 270/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5331 - accuracy: 0.8344 - v
al_loss: 1.4520 - val_accuracy: 0.5625

Epoch 00270: val_accuracy did not improve from 0.73750
Epoch 271/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5952 - accuracy: 0.8251 - v
al_loss: 1.3972 - val_accuracy: 0.5875

Epoch 00271: val_accuracy did not improve from 0.73750
Epoch 272/300
9/9 [==============================] - 0s 41ms/step - loss: 0.7666 - accuracy: 0.7941 - v
al_loss: 1.6511 - val_accuracy: 0.5625

Epoch 00272: val_accuracy did not improve from 0.73750
Epoch 273/300
9/9 [==============================] - 0s 42ms/step - loss: 0.7474 - accuracy: 0.7898 - v
al_loss: 1.5763 - val_accuracy: 0.5375

Epoch 00273: val_accuracy did not improve from 0.73750
Epoch 274/300
9/9 [==============================] - 0s 40ms/step - loss: 0.8081 - accuracy: 0.7503 - v
al_loss: 1.4071 - val_accuracy: 0.6125

Epoch 00274: val_accuracy did not improve from 0.73750
Epoch 275/300
9/9 [==============================] - 0s 39ms/step - loss: 0.7063 - accuracy: 0.7769 - v
al_loss: 1.3471 - val_accuracy: 0.5875

Epoch 00275: val_accuracy did not improve from 0.73750
Epoch 276/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5609 - accuracy: 0.8782 - v
al_loss: 1.4338 - val_accuracy: 0.5750

Epoch 00276: val_accuracy did not improve from 0.73750
Epoch 277/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6413 - accuracy: 0.8163 - v
al_loss: 1.4149 - val_accuracy: 0.6000

Epoch 00277: val_accuracy did not improve from 0.73750
Epoch 278/300
9/9 [==============================] - 0s 56ms/step - loss: 0.6754 - accuracy: 0.8139 - v
al_loss: 1.3614 - val_accuracy: 0.6250

Epoch 00278: val_accuracy did not improve from 0.73750
Epoch 279/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6043 - accuracy: 0.7952 - v
al_loss: 1.3899 - val_accuracy: 0.5875

Epoch 00279: val_accuracy did not improve from 0.73750
Epoch 280/300
9/9 [==============================] - 0s 40ms/step - loss: 0.6222 - accuracy: 0.8465 - v
al_loss: 1.3907 - val_accuracy: 0.5500

Epoch 00280: val_accuracy did not improve from 0.73750
Epoch 281/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5752 - accuracy: 0.8539 - v
al_loss: 1.3347 - val_accuracy: 0.6000

Epoch 00281: val_accuracy did not improve from 0.73750
Epoch 282/300
9/9 [==============================] - 0s 43ms/step - loss: 0.5351 - accuracy: 0.8330 - v
al_loss: 1.3364 - val_accuracy: 0.6000
```

```
Epoch 00282: val_accuracy did not improve from 0.73750
Epoch 283/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5856 - accuracy: 0.8421 - v
al_loss: 1.3756 - val_accuracy: 0.5875

Epoch 00283: val_accuracy did not improve from 0.73750
Epoch 284/300
9/9 [==============================] - 0s 41ms/step - loss: 0.4880 - accuracy: 0.8890 - v
al_loss: 1.3795 - val_accuracy: 0.5750

Epoch 00284: val_accuracy did not improve from 0.73750
Epoch 285/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5081 - accuracy: 0.8717 - v
al_loss: 1.4011 - val_accuracy: 0.6125

Epoch 00285: val_accuracy did not improve from 0.73750
Epoch 286/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5710 - accuracy: 0.8743 - v
al_loss: 1.3699 - val_accuracy: 0.6375

Epoch 00286: val_accuracy did not improve from 0.73750
Epoch 287/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5555 - accuracy: 0.8592 - v
al_loss: 1.4393 - val_accuracy: 0.5875

Epoch 00287: val_accuracy did not improve from 0.73750
Epoch 288/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5756 - accuracy: 0.8527 - v
al_loss: 1.3668 - val_accuracy: 0.6250

Epoch 00288: val_accuracy did not improve from 0.73750
Epoch 289/300
9/9 [==============================] - 0s 41ms/step - loss: 0.4730 - accuracy: 0.8837 - v
al_loss: 1.3883 - val_accuracy: 0.6125

Epoch 00289: val_accuracy did not improve from 0.73750
Epoch 290/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5109 - accuracy: 0.8447 - v
al_loss: 1.4788 - val_accuracy: 0.5875

Epoch 00290: val_accuracy did not improve from 0.73750
Epoch 291/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5027 - accuracy: 0.8791 - v
al_loss: 1.4391 - val_accuracy: 0.5750

Epoch 00291: val_accuracy did not improve from 0.73750
Epoch 292/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5291 - accuracy: 0.8601 - v
al_loss: 1.5210 - val_accuracy: 0.5250

Epoch 00292: val_accuracy did not improve from 0.73750
Epoch 293/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6239 - accuracy: 0.8038 - v
al_loss: 1.4430 - val_accuracy: 0.5500

Epoch 00293: val_accuracy did not improve from 0.73750
Epoch 294/300
9/9 [==============================] - 0s 40ms/step - loss: 0.5745 - accuracy: 0.8305 - v
al_loss: 1.3769 - val_accuracy: 0.6000

Epoch 00294: val_accuracy did not improve from 0.73750
Epoch 295/300
9/9 [==============================] - 0s 42ms/step - loss: 0.6043 - accuracy: 0.8376 - v
al_loss: 1.4263 - val_accuracy: 0.5500

Epoch 00295: val_accuracy did not improve from 0.73750
Epoch 296/300
9/9 [==============================] - 0s 43ms/step - loss: 0.5922 - accuracy: 0.8250 - v
al_loss: 1.4208 - val_accuracy: 0.5500

Epoch 00296: val_accuracy did not improve from 0.73750
```

```
Epoch 297/300
9/9 [==============================] - 0s 43ms/step - loss: 0.4903 - accuracy: 0.8254 - v
al_loss: 1.3744 - val_accuracy: 0.5625

Epoch 00297: val_accuracy did not improve from 0.73750
Epoch 298/300
9/9 [==============================] - 0s 41ms/step - loss: 0.4702 - accuracy: 0.8828 - v
al_loss: 1.5170 - val_accuracy: 0.5625

Epoch 00298: val_accuracy did not improve from 0.73750
Epoch 299/300
9/9 [==============================] - 0s 41ms/step - loss: 0.5538 - accuracy: 0.8495 - v
al_loss: 1.4177 - val_accuracy: 0.5750

Epoch 00299: val_accuracy did not improve from 0.73750
Epoch 300/300
9/9 [==============================] - 0s 42ms/step - loss: 0.5307 - accuracy: 0.8620 - v
al_loss: 1.4368 - val_accuracy: 0.5750

Epoch 00300: val_accuracy did not improve from 0.73750
```

Plot the training history and evaluate the model. Discuss your results.

In [ ]:

```
plt.figure(figsize=(16,5))

# Accuracy
plt.subplot(1,2,1)
plt.plot(history_hybrid.history['accuracy'])
plt.plot(history_hybrid.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'val'])

# Loss
plt.subplot(1,2,2)
plt.plot(history_hybrid.history['loss'])
plt.plot(history_hybrid.history['val_loss'])
plt.title('Model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'val'])

# best validation accuracy
best_acc = np.max(history_hybrid.history['val_accuracy'])
print('Best validation accuracy: {0:5.1f} % '.format(best_acc*100))
```

```
Best validation accuracy:  65.0 %
```

In [ ]:

```
from sklearn.metrics import accuracy_score
```

```
y_pred = np.argmax(model_hybrid.predict(X_test_rss), axis=-1)
print(y_pred)
print(y_test)
print("Accuracy score: {0:5.1f} % ".format(100*accuracy_score(y_test, y_pred)))
```

```
[5 8 6 7 0 2 0 3 5 9 9 3 4 9 8 8 4 2 9 6 6 0 1 9 0 5 6 7 5 7 5 3 9 8 2 8 8
 7 0 1]
[1 8 6 7 6 2 3 3 2 9 1 3 4 7 8 2 1 2 4 0 6 0 1 4 0 1 6 3 5 7 8 7 9 8 7 8 5
 7 0 1]
Accuracy score:  57.5 %
```

Accuracy is similar to the model of exercise 6. However we can see from both the accuracy and loss plots our model training is smoother.