

# Assignment 3: Heartbeat Sounds - Kaggle Competition

## Team Members

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In [1]:

```
from google.colab import drive
import os
import glob
import pandas as pd
import numpy as np
import itertools
import matplotlib.pyplot as plt
import seaborn as sns
import IPython.display as ipd
from scipy.io import wavfile
import librosa
import librosa.display
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report, accuracy_score, confusion_matrix
from sklearn.preprocessing import LabelEncoder
from sklearn.utils import shuffle
from sklearn.utils import compute_class_weight
import keras
from keras.callbacks import ModelCheckpoint
from keras.models import load_model
from keras.models import Sequential
from keras.layers import Dense, Dropout, Activation, Flatten, LSTM, Bidirectional
from keras.layers import Convolution2D, Conv2D, Conv1D, MaxPooling2D, GlobalAveragePooling2D, MaxPooling1D, GlobalAveragePooling1D
from keras.utils import to_categorical
from keras.callbacks import EarlyStopping
from sklearn.metrics import roc_curve, auc
from itertools import cycle
```

In [2]:

```
drive.mount('/gdrive', force_remount = True)
!ln -s "/gdrive/MyDrive/HeartBeats/set_a" "/content/set_a"
!ln -s "/gdrive/MyDrive/HeartBeats/set_b" "/content/set_b"
!ln -s "/gdrive/MyDrive/HeartBeats/set_a_timing.csv" "/content/set_a_timing.csv"
!ln -s "/gdrive/MyDrive/HeartBeats/set_a.csv" "/content/set_a.csv"
!ln -s "/gdrive/MyDrive/HeartBeats/set_b.csv" "/content/set_b.csv"
setaa_path = "/content/set_a.csv"
setbb_path = "/content/set_b.csv"
seta_path = "/content/set_a"
setb_path = "/content/set_b"
```

Mounted at /gdrive

## Data Exploratory Analysis

The dataset is primarily audio-based containing the heartbeat sounds stored as WAV files that record either normal or abnormal heartbeats.

Dataset A Timings:

- Contains audio segmentation data, giving time locations of the S1 (lub) and S2 (dub) sounds within the Normal audio files of set A.

Dataset A:

- Collected from the general public via the iStethoscope Pro iPhone app.
- Contains 124 labelled sound clips from four classes: *normal*, *murmur*, *extra heart sound*, and *artifact*.
- Contains 52 unlabeled sound clips.

Dataset B:

- Collected from a clinical trial in hospitals using the digital stethoscope DigiScope.
- Contains 461 labelled sound clips from three classes: *normal*, *murmur*, *extrasystole*.\*
- Contains 71 unlabeled sound clips.

First File: `set_a_timing.csv`

contains gold-standard timing information for the "normal" recordings from Set A.

In [3]:

```
set_a_timing_df = pd.read_csv("set_a_timing.csv")
set_a_timing_df.head(-1)
```

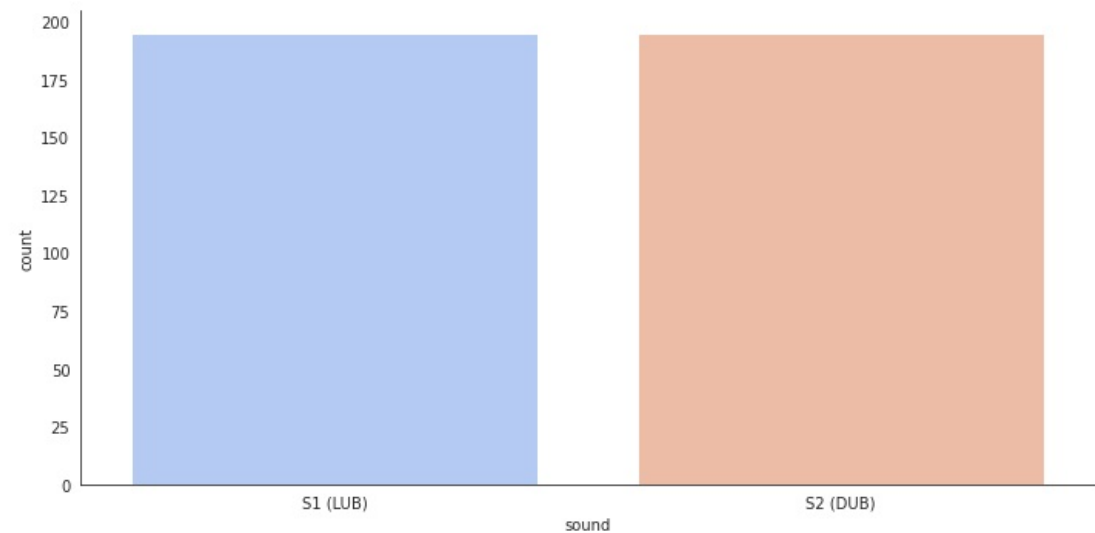
Out[3]:

	fname	cycle	sound	location
0	set_a/normal__201102081321.wav	1	S1	10021
1	set_a/normal__201102081321.wav	1	S2	20759
2	set_a/normal__201102081321.wav	2	S1	35075
3	set_a/normal__201102081321.wav	2	S2	47244
4	set_a/normal__201102081321.wav	3	S1	62992
...	...	...	...	...
384	set_a/normal__201108011118.wav	10	S1	272527
385	set_a/normal__201108011118.wav	10	S2	284673
386	set_a/normal__201108011118.wav	11	S1	300863
387	set_a/normal__201108011118.wav	11	S2	314279
388	set_a/normal__201108011118.wav	12	S1	330980

389 rows × 4 columns

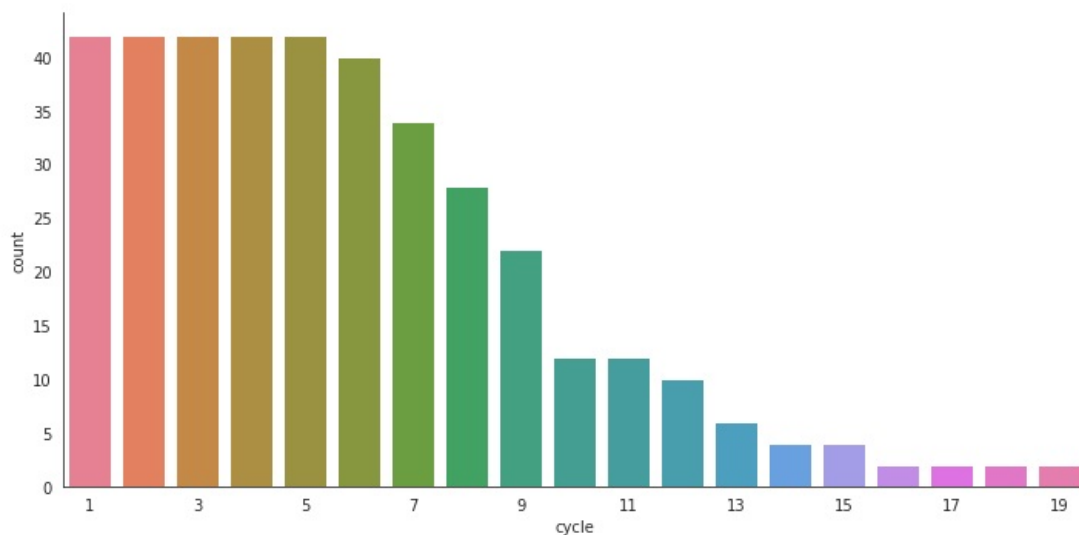
In [4]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=set_a_timing_df, x="sound", aspect=2,
                    kind="count", palette='coolwarm')
    g.set_xticklabels(["S1 (LUB)", "S2 (DUB)"])
```



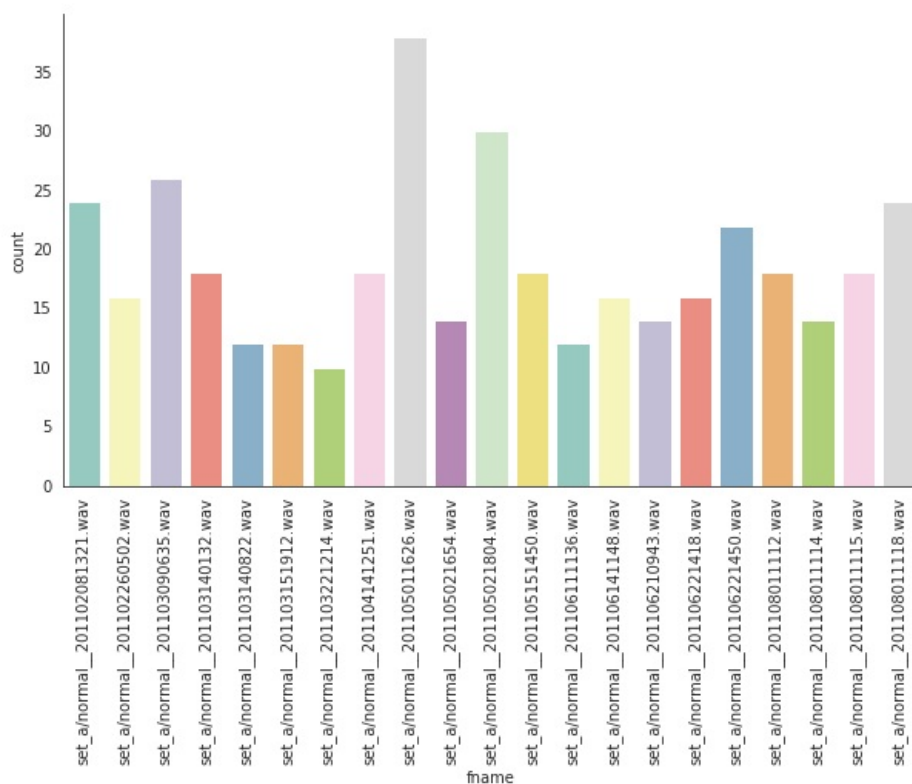
In [5]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=set_a_timing_df, x="cycle", aspect=2,
                    kind="count", palette='husl')
    g.set_xticklabels(step=2)
```

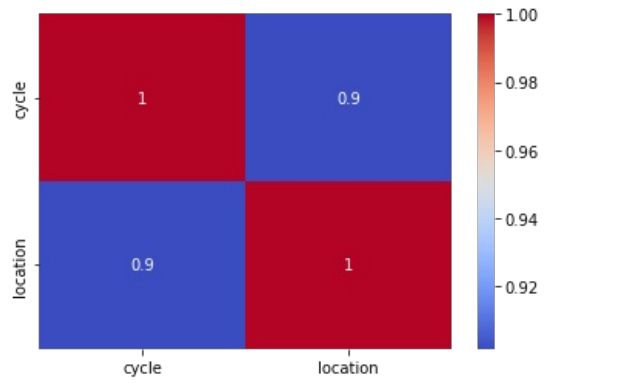


In [6]:

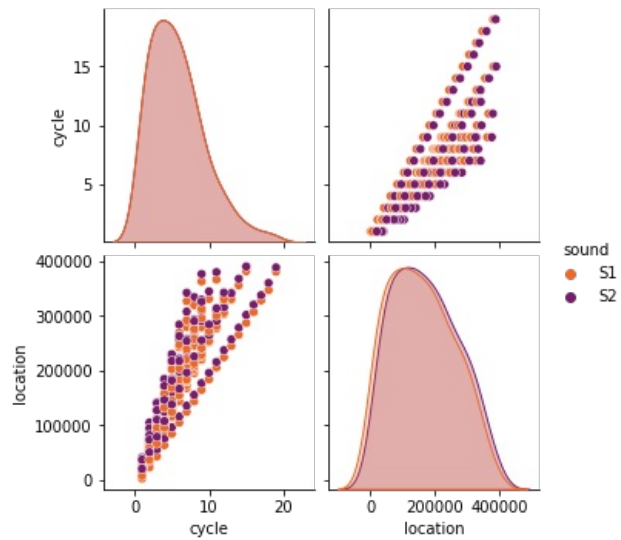
```
with sns.axes_style('white'):
    g = sns.catplot(data=set_a_timing_df, x="fname", aspect=2,
                    kind="count", palette='Set3')
    g.set_xticklabels(set_a_timing_df.fname.unique())
    g.set_xticklabels(rotation=90)
```



```
In [7]:
dataplot = sns.heatmap(set_a_timing_df.corr(), cmap="coolwarm", annot=True)
plt.show()
```



```
In [8]:
sns.pairplot(set_a_timing_df, diag_kind="kde", hue="sound", palette="inferno_r")
plt.show()
```



**Second File: set\_a.csv**

Labels and metadata for heart beats collected from the general public via the iStethoscope Pro iPhone app.

```
In [9]:
set_a_df = pd.read_csv("set_a.csv")
set_a_df.head(-1)
```

Out[9]:

	dataset	fname	label	sublabel
0	a	set_a/artifact__201012172012.wav	artifact	NaN
1	a	set_a/artifact__201105040918.wav	artifact	NaN
2	a	set_a/artifact__201105041959.wav	artifact	NaN
3	a	set_a/artifact__201105051017.wav	artifact	NaN
4	a	set_a/artifact__201105060108.wav	artifact	NaN
...	...	...	...	...
170	a	set_a/_201108222234.wav	NaN	NaN
171	a	set_a/_201108222241.wav	NaN	NaN
172	a	set_a/_201108222244.wav	NaN	NaN
173	a	set_a/_201108222247.wav	NaN	NaN
174	a	set_a/_201108222254.wav	NaN	NaN

175 rows × 4 columns

In [10]:

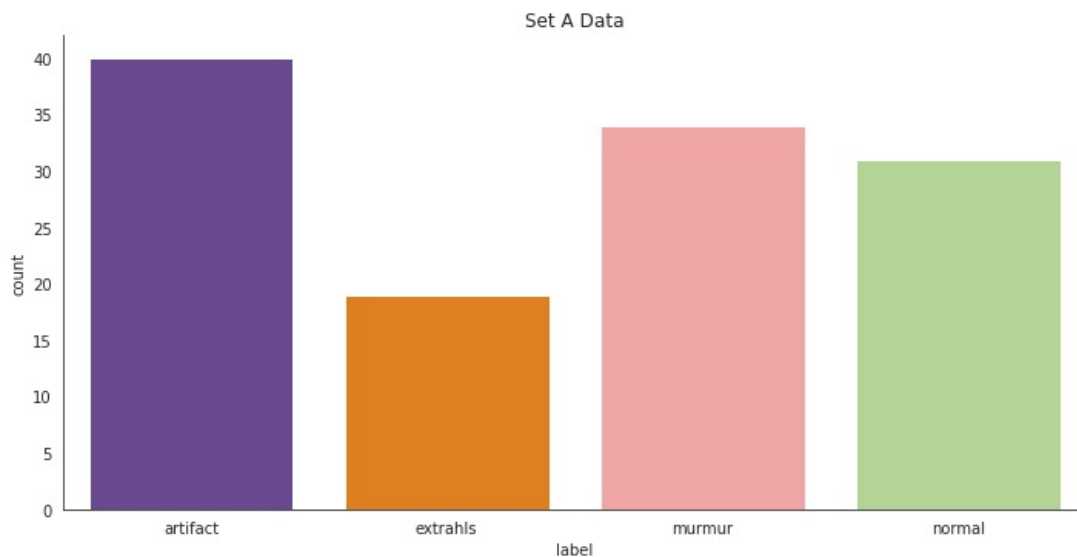
```
set_a_df["label"].value_counts()
```

Out[10]:

```
artifact    40
murmur      34
normal      31
extrahls    19
Name: label, dtype: int64
```

In [11]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=set_a_df, x="label", aspect=2,
                    kind="count", palette='Paired_r')
    plt.title("Set A Data")
```

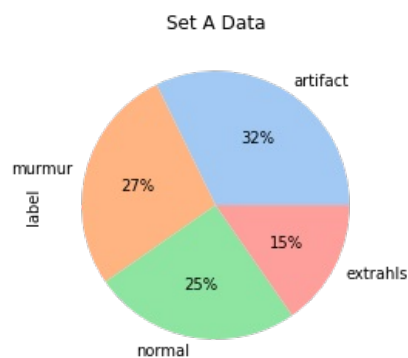


In [12]:

```
set_a_df['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct = '%.0f%%')
plt.title("Set A Data")
```

Out[12]:

Text(0.5, 1.0, 'Set A Data')



### Third File: set\_b.csv

Labels and metadata for heart beats collected from a clinical trial in hospitals using a digital stethoscope DigiScope.

In [12]:

```
set_b_df = pd.read_csv("set_b.csv")
set_b_df.head(-1)
```

Out[12]:

	dataset	fname	label	sublabel
0	b	set_b/Btraining_extrastole_127_1306764300147_C...	extrastole	NaN
1	b	set_b/Btraining_extrastole_128_1306344005749_A...	extrastole	NaN
2	b	set_b/Btraining_extrastole_130_1306347376079_D...	extrastole	NaN
3	b	set_b/Btraining_extrastole_134_1306428161797_C...	extrastole	NaN
4	b	set_b/Btraining_extrastole_138_1306762146980_B...	extrastole	NaN
...	...	...	...	...
650	b	set_b/Btraining_normal_Btraining_noisynormal_2...	normal	noisynormal
651	b	set_b/Btraining_normal_Btraining_noisynormal_2...	normal	noisynormal
652	b	set_b/Btraining_normal_Btraining_noisynormal_2...	normal	noisynormal
653	b	set_b/Btraining_normal_Btraining_noisynormal_2...	normal	noisynormal
654	b	set_b/Btraining_normal_Btraining_noisynormal_2...	normal	noisynormal

655 rows × 4 columns

In [13]:

```
set_b_df["label"].value_counts()
```

Out[13]:

```
normal      320
murmur       95
extrastole   46
Name: label, dtype: int64
```

In [14]:

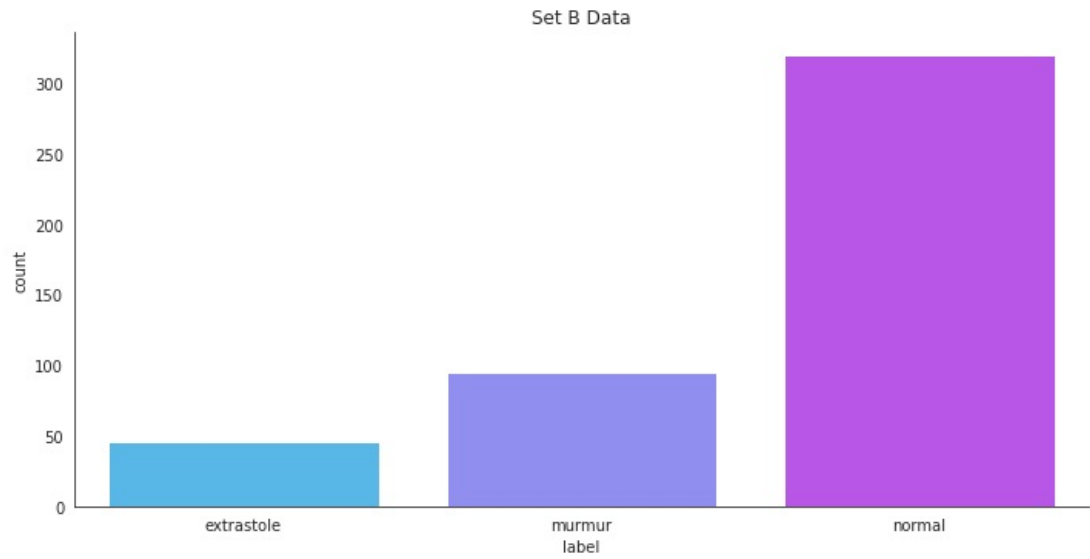
```
set_b_df["sublabel"].value_counts()
```

Out[14]:

```
noisynormal    120
noisymurmur     29
Name: sublabel, dtype: int64
```

In [15]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=set_b_df, x="label", aspect=2,
                    kind="count", palette='cool')
    plt.title("Set B Data")
```

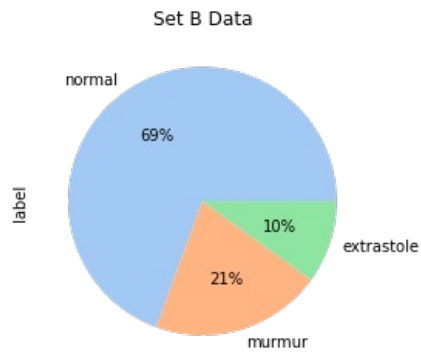


In [16]:

```
set_b_df['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0f%%')
plt.title("Set B Data")
```

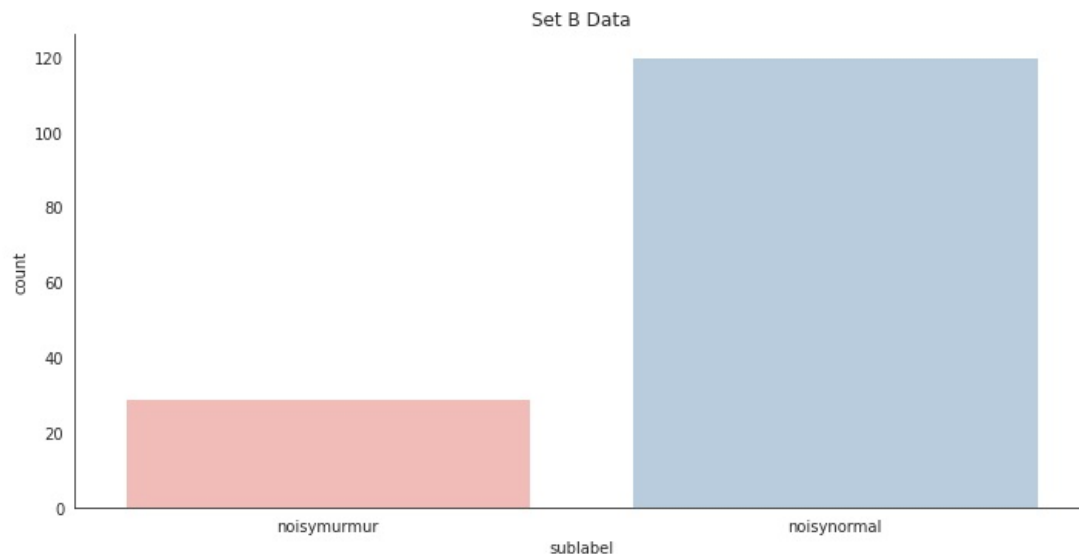
Out[16]:

Text(0.5, 1.0, 'Set B Data')



In [17]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=set_b_df, x="sublabel", aspect=2,
                    kind="count", palette="Pastell1")
    plt.title("Set B Data")
```

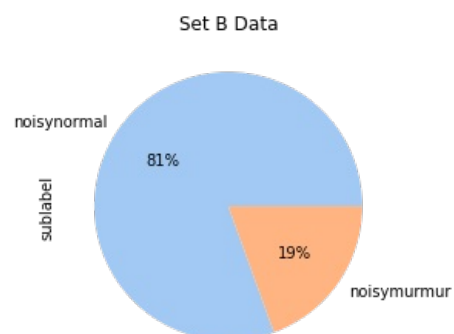


In [18]:

```
set_b_df['sublabel'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0f%%')
plt.title("Set B Data")
```

Out[18]:

Text(0.5, 1.0, 'Set B Data')



Concatenating both sets A & B together.

In [19]:

```
ab = [set_a_df, set_b_df]
set_ab_df = pd.concat(ab)
set_ab_df = set_ab_df.reset_index(drop=False)
set_ab_df.head(-1)
```

Out[19]:

	index	dataset		fname	label	sublabel
	0	0	a	set_a/artifact__201012172012.wav	artifact	NaN
	1	1	a	set_a/artifact__201105040918.wav	artifact	NaN
	2	2	a	set_a/artifact__201105041959.wav	artifact	NaN
	3	3	a	set_a/artifact__201105051017.wav	artifact	NaN
	4	4	a	set_a/artifact__201105060108.wav	artifact	NaN
...	...	...		...	...	...
826	650	b	set_b/Btraining_normal_Btraining_noisynormal_2...		normal	noisynormal
827	651	b	set_b/Btraining_normal_Btraining_noisynormal_2...		normal	noisynormal
828	652	b	set_b/Btraining_normal_Btraining_noisynormal_2...		normal	noisynormal
829	653	b	set_b/Btraining_normal_Btraining_noisynormal_2...		normal	noisynormal
830	654	b	set_b/Btraining_normal_Btraining_noisynormal_2...		normal	noisynormal

831 rows × 5 columns

In [20]:

```
set_ab_df.describe()
```

Out[20]:

	index
count	832.000000
mean	276.730769
std	196.149418
min	0.000000
25%	103.750000
50%	239.500000
75%	447.250000
max	655.000000

In [21]:

```
set_ab_df["label"].value_counts()
```

Out[21]:

```
normal      351
murmur      129
extrastole   46
artifact     40
extrahls     19
Name: label, dtype: int64
```

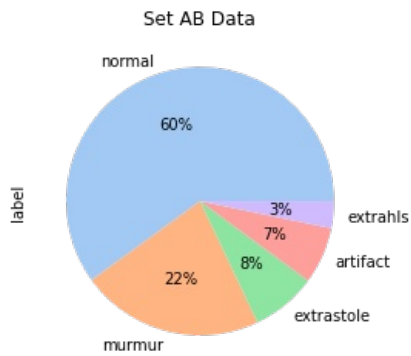


In [22]:

```
set_ab_df['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0.0f%%')
plt.title("Set AB Data")
```

Out[22]:

Text(0.5, 1.0, 'Set AB Data')



In [23]:

```
set_ab_df["sublabel"].value_counts()
```

Out[23]:

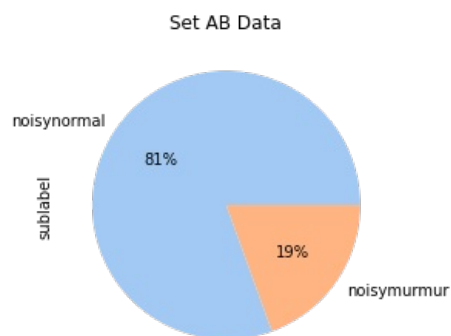
```
noisynormal    120
noisymurmur     29
Name: sublabel, dtype: int64
```

In [24]:

```
set_ab_df['sublabel'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0.0f%%')
plt.title("Set AB Data")
```

Out[24]:

Text(0.5, 1.0, 'Set AB Data')



Keeping in mind that there are **unlabeled** instances in both sets **A** and **B**.

In [25]:

```
labels = set_ab_df.label.unique()
print(f"Number of classes in both sets A & B = {len(labels)}, which are:\n{labels}")
```

Number of classes in both sets A & B = 6, which are:  
['artifact' 'extrahls' 'murmur' 'normal' nan 'extrastole']

Sets **a** and **b** distribution:

In [26]:

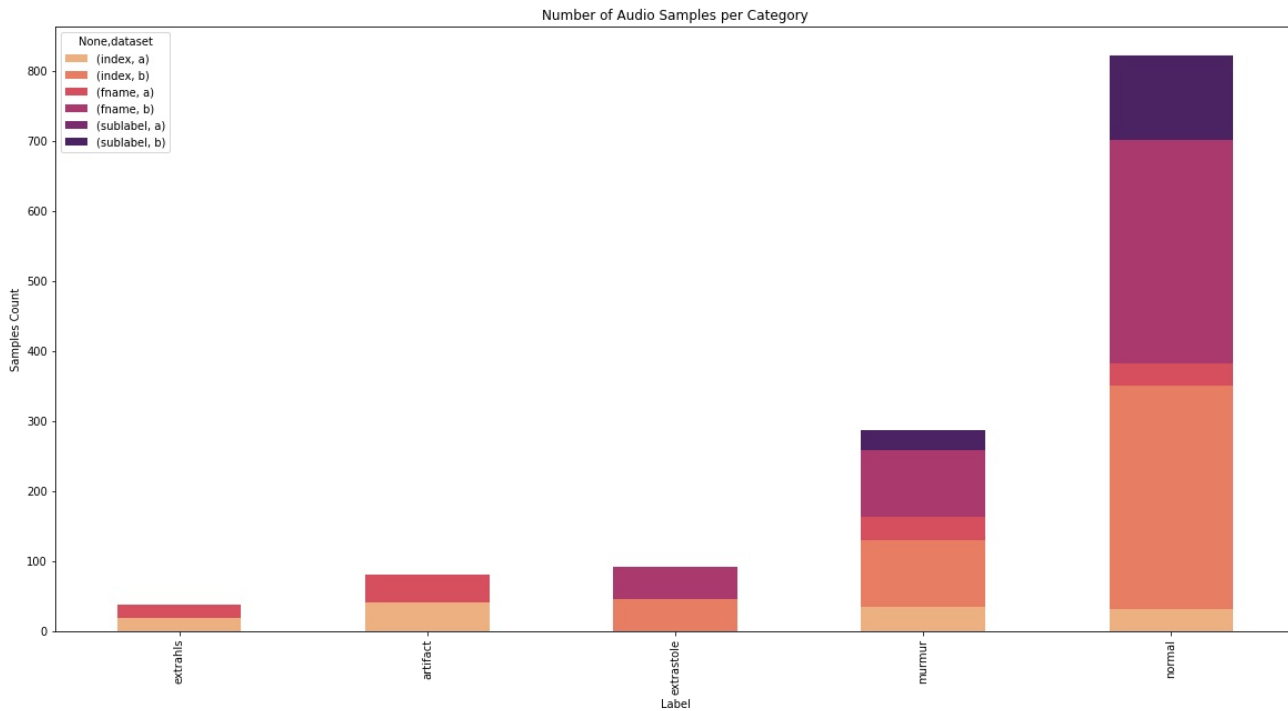
```
print('Min samples per category = ', min(set_ab_df.label.value_counts()))
print('Max samples per category = ', max(set_ab_df.label.value_counts()))
```

Min samples per category = 19  
Max samples per category = 351

In [27]:

```
category_group = set_ab_df.groupby(['label', 'dataset']).count()
plot = category_group.unstack().reindex(category_group.unstack().sum(axis=1).sort_values().index)\
    .plot(kind='bar', stacked=True, title="Number of Audio Samples per Category", figsize=(20,10), cmap="flare")

plot.set_xlabel("Label")
plot.set_ylabel("Samples Count");
```



## Audio Files Analysis

In [28]:

```
DF = []
files = []

for root, dirnames, filenames in os.walk(seta_path):
    for file_name in filenames:
        files.append(os.path.join(root, file_name))

for root, dirnames, filenames in os.walk(setb_path):
    for file_name in filenames:
        files.append(os.path.join(root, file_name))

for filename in files:
    label = os.path.basename(filename).split("_")[0]
    duration = librosa.get_duration(filename=filename)
    DF.append({"filename": filename, "label": label, "duration (seconds)": duration})

dataframe = pd.DataFrame(DF)

cond_counts = dataframe['label'].value_counts()
min_duration = dataframe.groupby('label')['duration (seconds)'].min()
max_duration = dataframe.groupby('label')['duration (seconds)'].max()
mean_duration = dataframe.groupby('label')['duration (seconds)'].max()
total_duration = dataframe.groupby('label')['duration (seconds)'].sum()

audio_duration_dict = {'min duration' : min_duration, 'max duration': max_duration, 'mean duration':mean_duration
,
                        'total duration':total_duration, 'number of samples': cond_counts}
audio_duration_summary = pd.DataFrame(audio_duration_dict)
display('Auditory Duration Summary in seconds')
pd.DataFrame(audio_duration_dict)
```

'Auditory Duration Summary in seconds'

Out[28]:

	min duration	max duration	mean duration	total duration	number of samples
<b>Aunlabelledtest</b>	1.754875	9.000000	9.000000	422.725102	52
<b>Bunlabelledtest</b>	1.027500	24.44875	24.44875	1309.889500	195
<b>artifact</b>	9.000000	9.000000	9.000000	360.000000	40
<b>extrahls</b>	0.936372	9.000000	9.000000	130.572494	19
<b>extrastole</b>	1.874500	13.38075	13.38075	269.470000	46
<b>murmur</b>	0.856750	24.16000	24.16000	1002.851552	129
<b>normal</b>	0.763250	27.86700	27.86700	2217.682312	351

The above analysis indicates that there is class imbalance in both the number of samples per label and the mean duration per label. This class imbalance will be problematic later when we train the model which lead us to compute class weights later.

## Sample by Category:

We can visualize the audio signals of the recordings using oscillograms and spectrograms.

### **Oscillogram:**

- It is a measure of a sound wave's Amplitude vs Time.

### **Melspectrogram:**

- It represents an acoustic time-frequency representation of a sound.
- It is basically a spectrogram with the Mel Scale as its y-axis.

This Mel Scale is constructed such that sounds are equal distance from each other on the Mel Scale.

### **MFCC (Mel Frequency Cepstral Components):**

- It is representation of the short-term power spectrum of a sound, based on a linear cosine transform of a log power spectrum on a nonlinear mel scale of frequency.
- MFCCs are commonly used as a feature type in automatic speech recognition.

We chose to use this to perform this transformation, as FCCs capture features from audio data that more closely resembles how human beings perceive loudness and pitch.

In [29]:

```
def plot_mfcc_spect(filewave):
    y, sr = librosa.load(filewave)
    S = librosa.feature.melspectrogram(y, sr=sr, n_mels=128)
    log_S = librosa.amplitude_to_db(S)
    plt.figure(figsize=(12,4))
    librosa.display.specshow(log_S, sr=sr, x_axis='time', y_axis='mel')
    plt.title('mel power spectrogram')
    plt.colorbar(format='%+02.0f dB')
    plt.tight_layout()
    mfcc = librosa.feature.mfcc(S=log_S, n_mfcc=13)
    delta_mfcc = librosa.feature.delta(mfcc)
    plt.figure(figsize=(12, 6))
    plt.subplot(3,1,1)
    librosa.display.specshow(mfcc)
    plt.ylabel('MFCC')
    plt.colorbar()
    plt.tight_layout()
```

### **Normal**

In [30]:

```
normal_example = seta_path + "/normal__201102201230.wav"
ipd.Audio(normal_example)
```

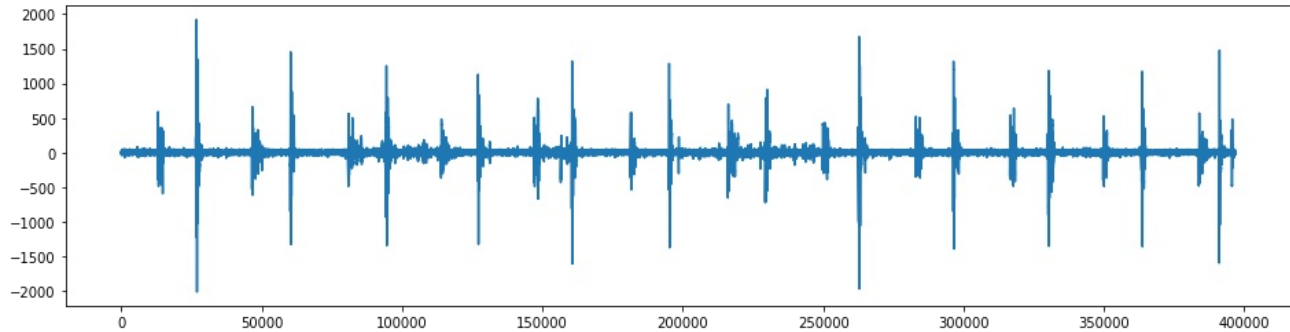
Out[30]:

Your browser does not support the audio element.

In [31]:

```
rate, data = wavfile.read(normal_example)
print("Sampling rate = ", rate)
print("Total samples = ", len(data))
print(data)
plt.figure(figsize=(16, 4))
plt.plot(data, '-', )
plt.show()
```

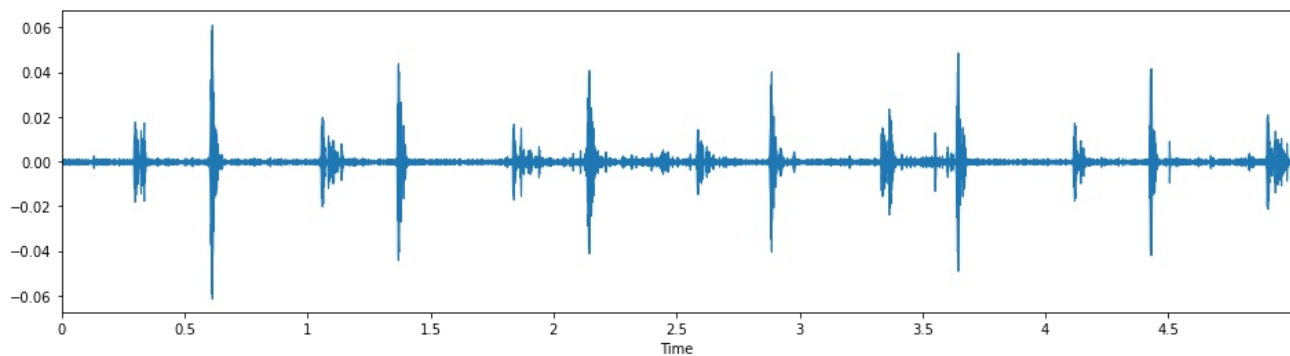
Sampling rate = 44100  
Total samples = 396900  
[10 11 5 ... 1 3 3]



In [32]:

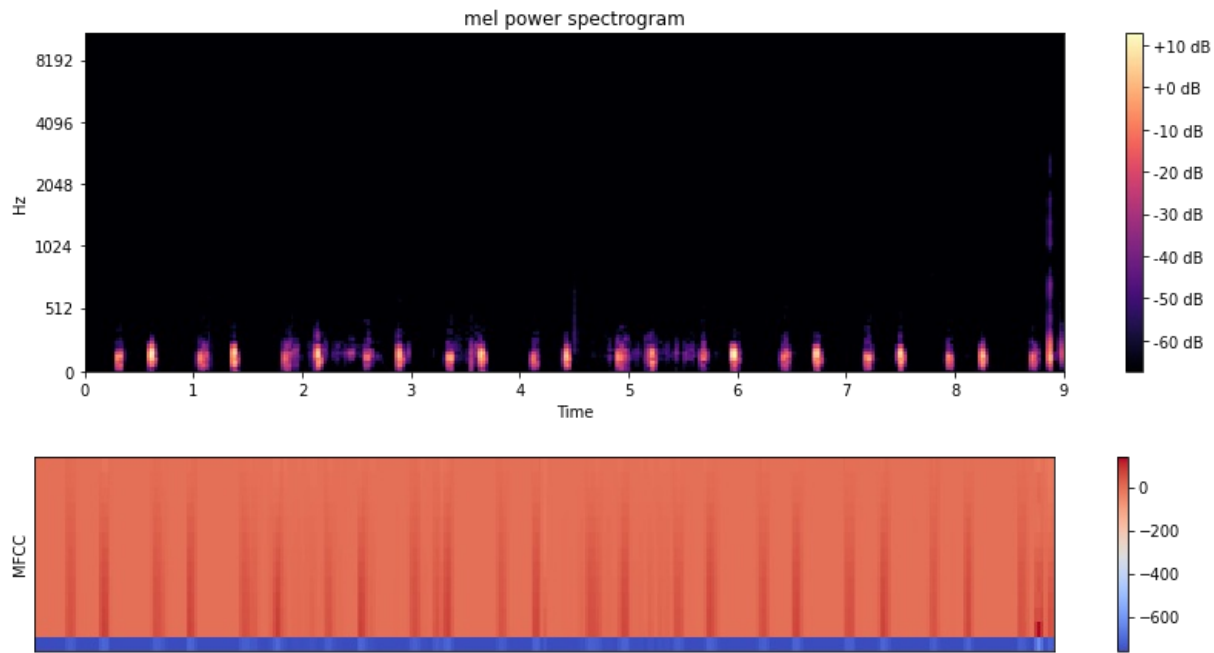
```
y, sr = librosa.load(normal_example, duration = 5) #default sampling rate is 22 HZ
dur=librosa.get_duration(y)
print ("duration:", dur)
print(y.shape, sr)
# librosa plot
plt.figure(figsize=(16, 4))
librosa.display.waveplot(y, sr=sr)
plt.show()
```

duration: 5.0  
(110250,) 22050



In [33]:

```
plot_mfcc_spect(normal_example)
```



## ***Murmur***

In [34]:

```
murmur_example = seta_path + "/murmur__201108222255.wav"  
ipd.Audio(murmur_example)
```

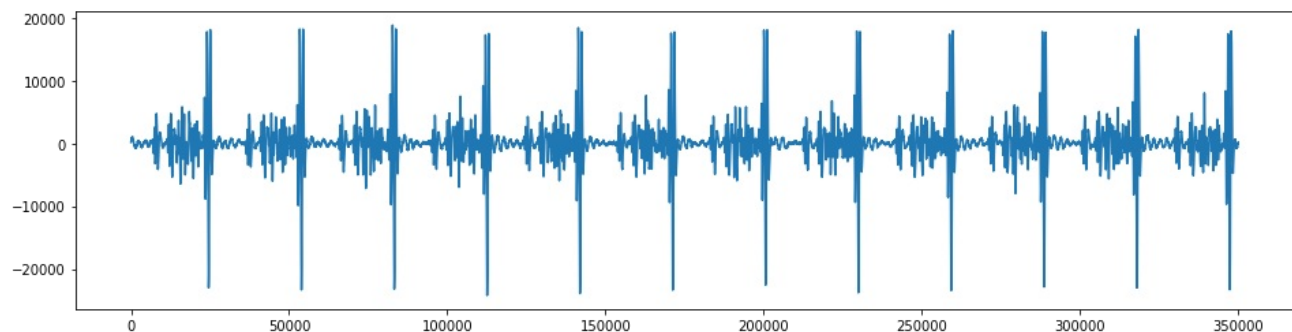
Out[34]:

Your browser does not support the audio element.

In [35]:

```
rate, data = wavfile.read(murmur_example)  
print("Sampling rate = ", rate)  
print("Total samples = ", len(data))  
print(data)  
plt.figure(figsize=(16, 4))  
plt.plot(data, '-', )  
plt.show()
```

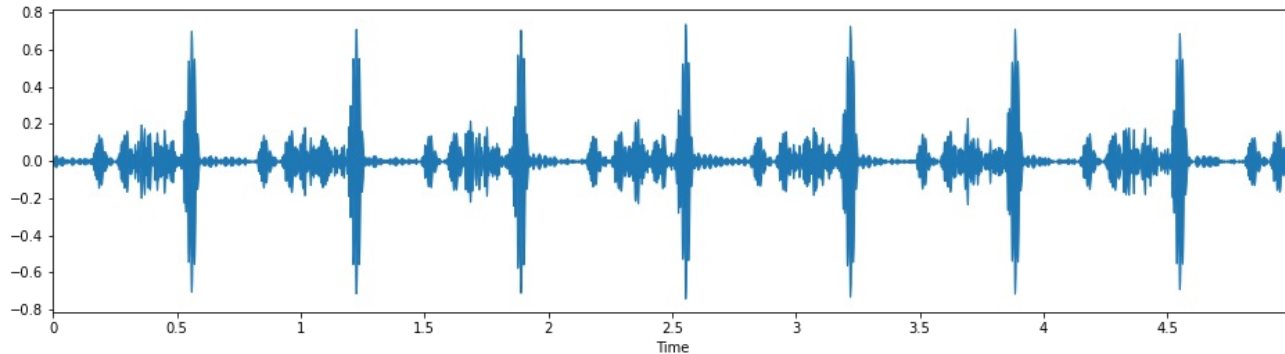
```
Sampling rate = 44100  
Total samples = 349958  
[180 192 200 ... 108 115 0]
```



In [36]:

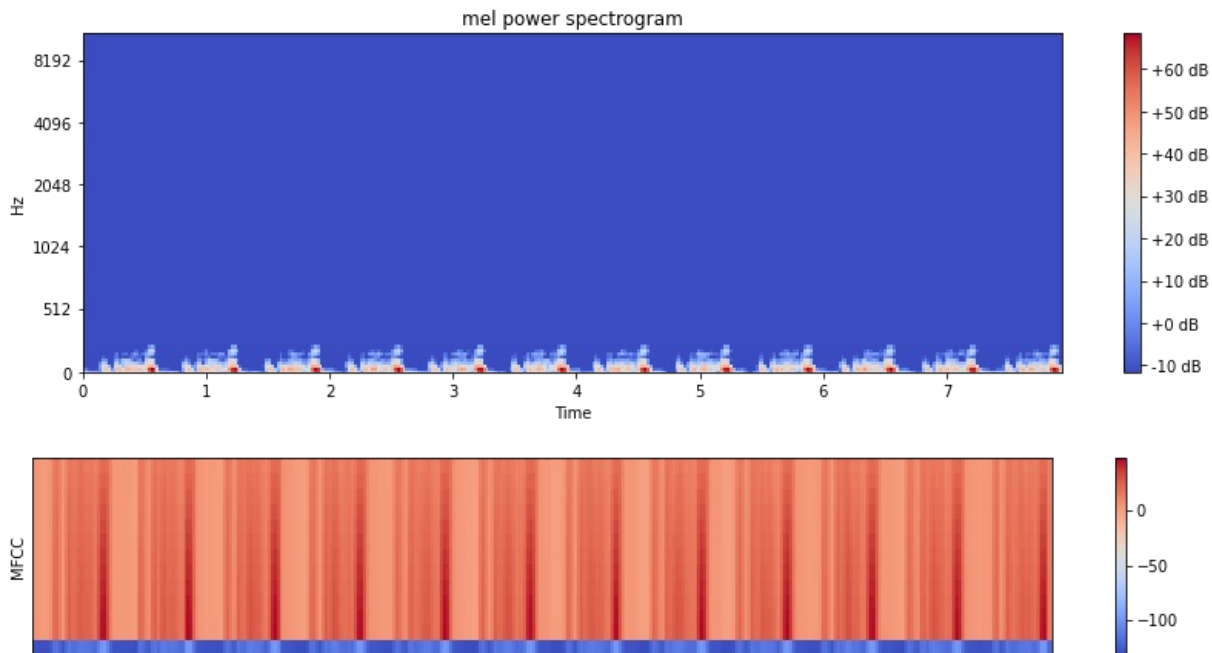
```
y, sr = librosa.load(murmur_example, duration = 5)  #default sampling rate is 22 KHZ
dur = librosa.get_duration(y)
print("duration:", dur)
print(y.shape, sr)
# librosa plot
plt.figure(figsize=(16, 4))
librosa.display.waveplot(y, sr=sr)
plt.show()
```

duration: 5.0  
(110250,) 22050



In [37]:

```
plot_mfcc_spect(murmur_example)
```



## Extrasystole

In [38]:

```
extrasystole_example = setb_path + "/extrastole_128_1306344005749_A.wav"
ipd.Audio(extrasystole_example)
```

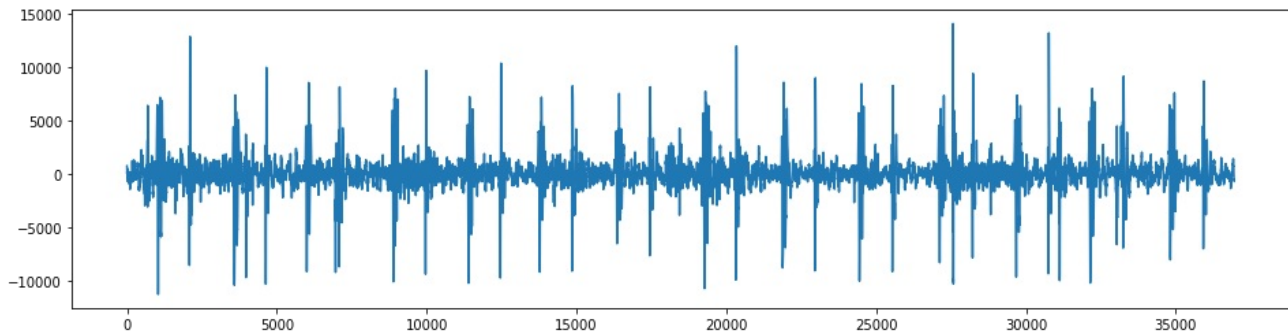
Out[38]:

Your browser does not support the audio element.

In [39]:

```
rate, data = wavfile.read(extrasystole_example)
print("Sampling rate = ", rate)
print("Total samples = ", len(data))
print(data)
plt.figure(figsize=(16, 4))
plt.plot(data, '-', )
plt.show()
```

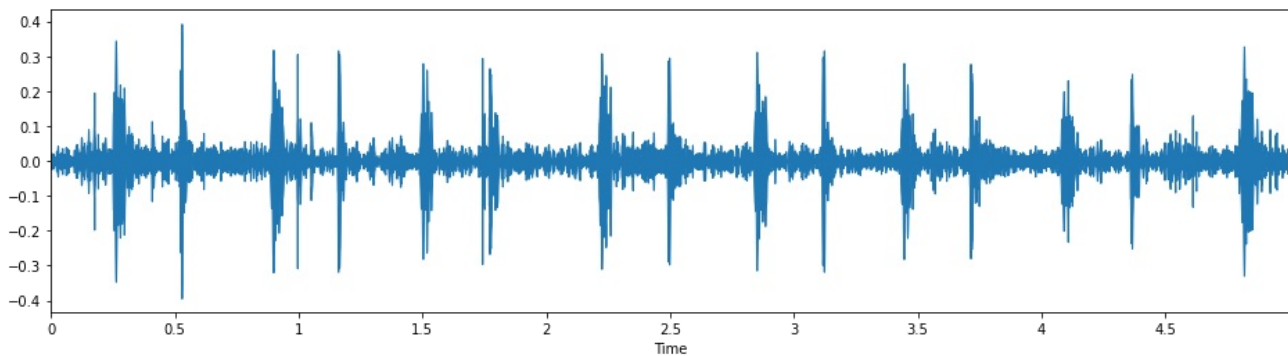
```
Sampling rate = 4000
Total samples = 36946
[ 747  485  363 ... -657 -679 -693]
```



In [40]:

```
y, sr = librosa.load(extrasystole_example, duration = 5)  #default sampling rate is 22 HZ
dur=librosa.get_duration(y)
print ("duration:", dur)
print(y.shape, sr)
# librosa plot
plt.figure(figsize=(16, 4))
librosa.display.waveplot(y, sr=sr)
plt.show()
```

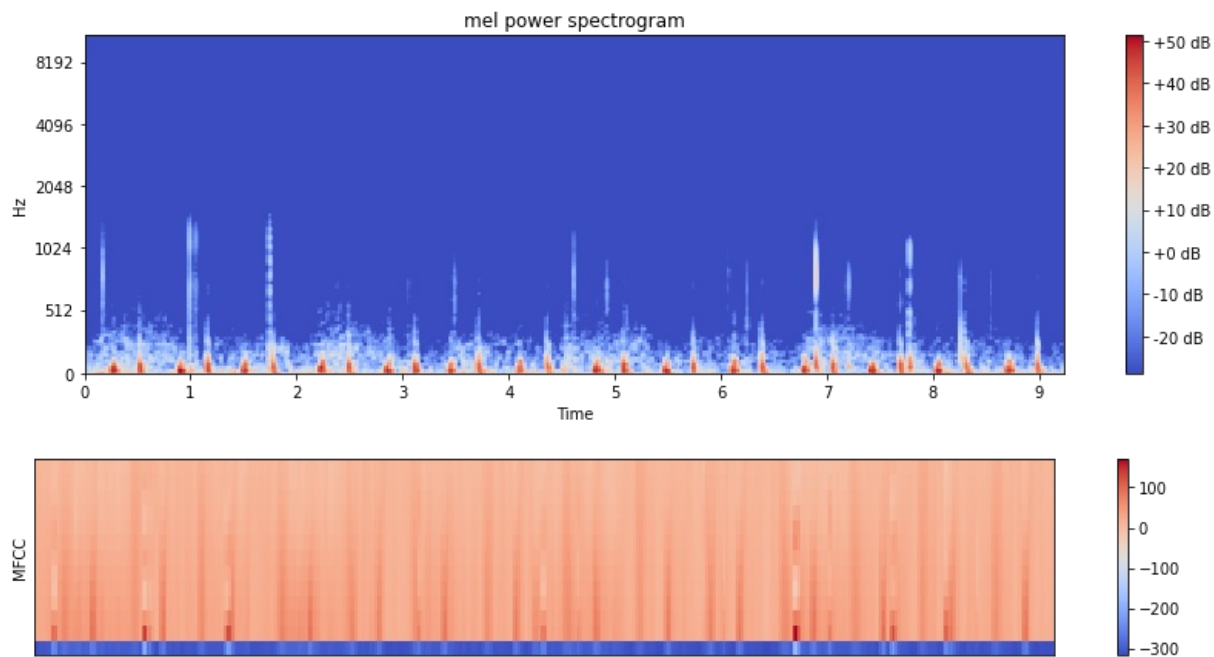
```
duration: 5.0
(110250,) 22050
```





In [41]:

```
plot_mfcc_spect(extrasystole_example)
```



## Artifact

In [42]:

```
artifcat_example = seta_path + "/artifact_201012172012.wav"  
ipd.Audio(artifcat_example)
```

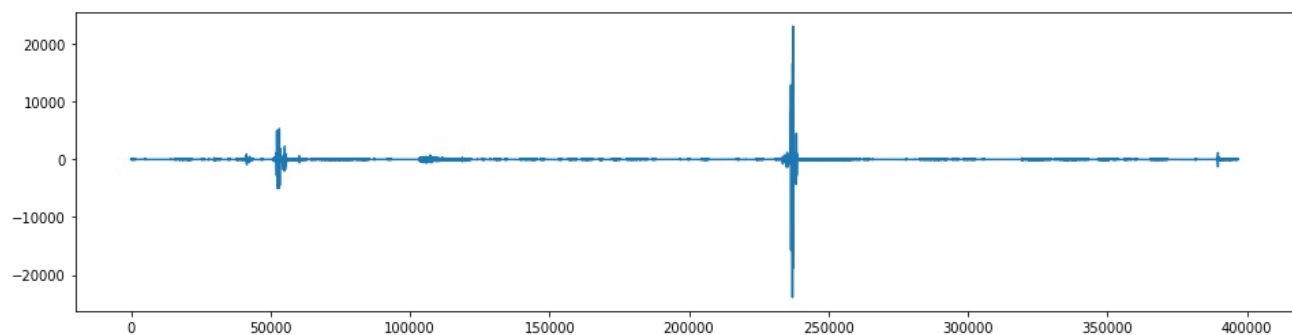
Out[42]:

Your browser does not support the audio element.

In [43]:

```
rate, data = wavfile.read(artifcat_example)  
print("Sampling rate = ", rate)  
print("Total samples = ", len(data))  
print(data)  
plt.figure(figsize=(16, 4))  
plt.plot(data, '- ', )  
plt.show()
```

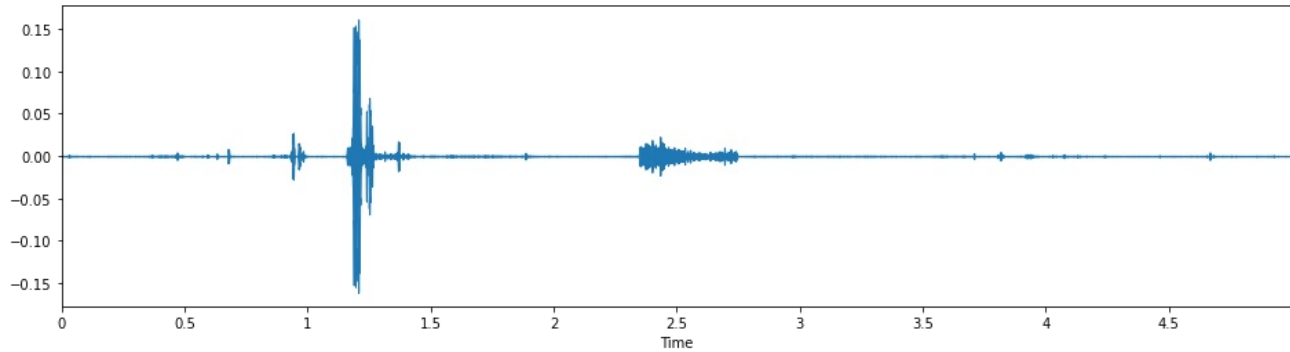
Sampling rate = 44100  
Total samples = 396900  
[ 1 -3 -1 ... 0 1 0]



In [44]:

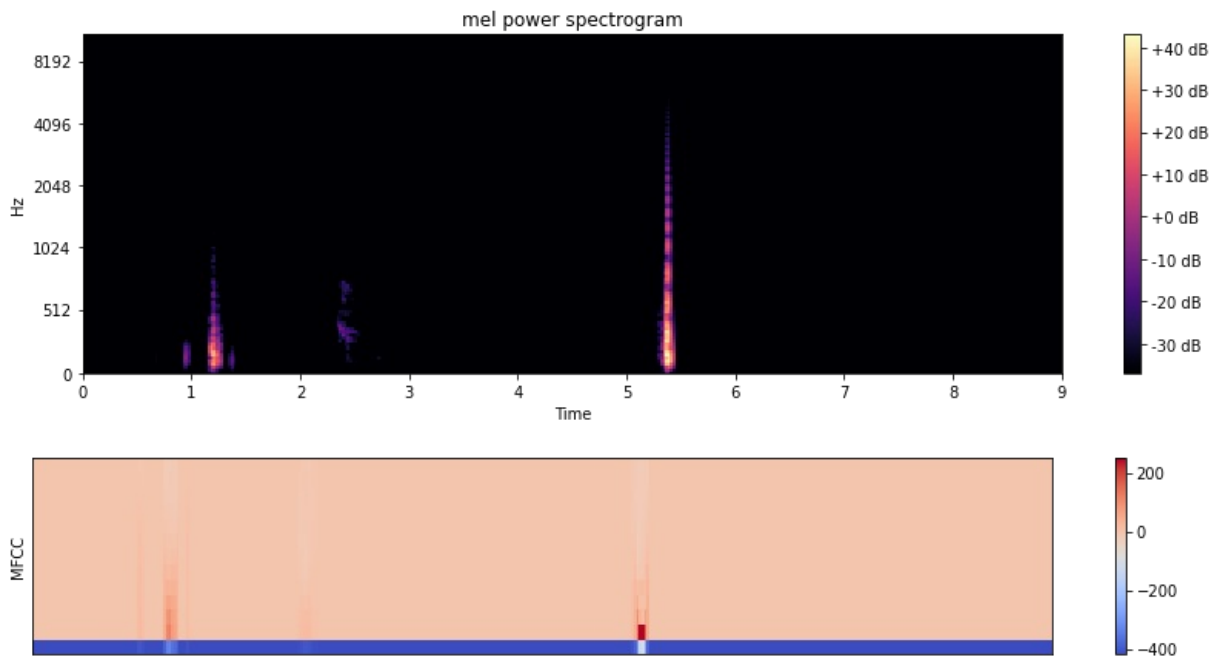
```
y, sr = librosa.load(artifcat_example, duration = 5)  #default sampling rate is 22 KHZ
dur=librosa.get_duration(y)
print ("duration:", dur)
print(y.shape, sr)
# librosa plot
plt.figure(figsize=(16, 4))
librosa.display.waveplot(y, sr=sr)
plt.show()
```

duration: 5.0  
(110250,) 22050



In [45]:

```
plot_mfcc_spect(artifcat_example)
```



## Extra Heart Sound

In [46]:

```
extrahls_example = seta_path + "/extrahls__201101160808.wav"
ipd.Audio(extrahls_example)
```

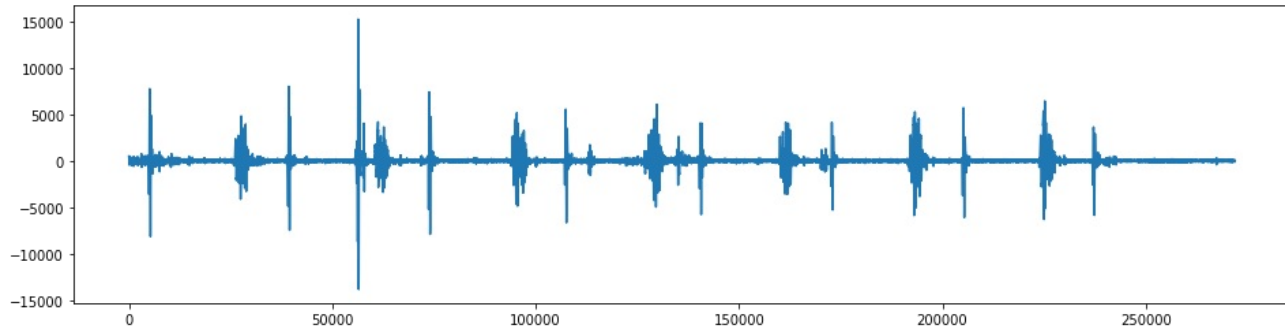
Out[46]:

Your browser does not support the audio element.

In [47]:

```
rate, data = wavfile.read(extrahls_example)
print("Sampling rate = ", rate)
print("Total samples = ", len(data))
print(data)
plt.figure(figsize=(16, 4))
plt.plot(data, '-', )
plt.show()
```

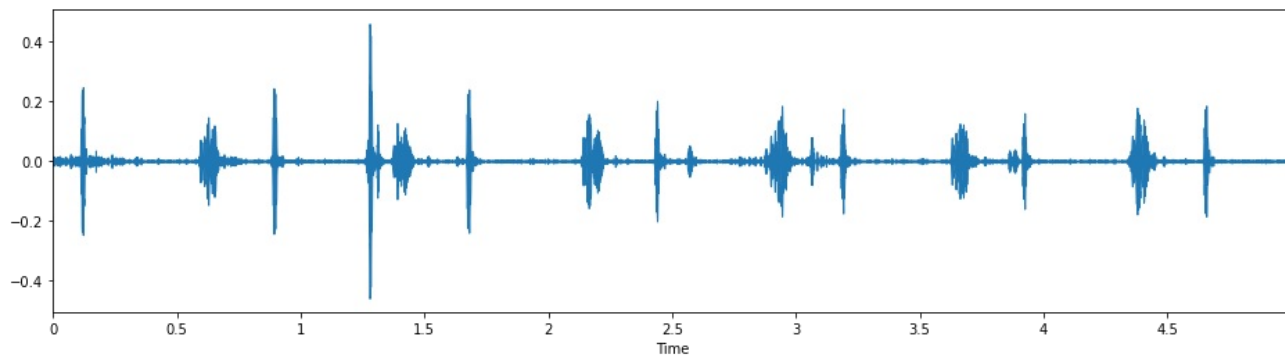
```
Sampling rate = 44100
Total samples = 271970
[475 462 442 ...  5 -7 -16]
```



In [48]:

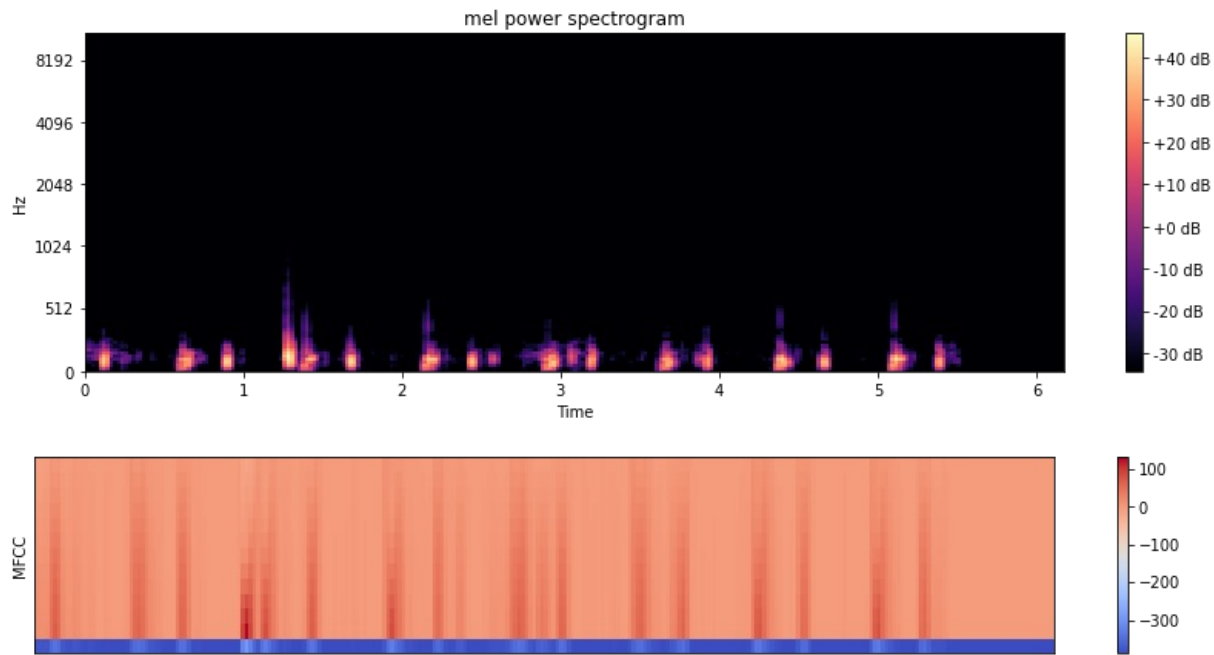
```
y, sr = librosa.load(extrahls_example, duration = 5)  #default sampling rate is 22 HZ
dur=librosa.get_duration(y)
print ("duration:", dur)
print(y.shape, sr)
# librosa plot
plt.figure(figsize=(16, 4))
librosa.display.waveplot(y, sr=sr)
plt.show()
```

```
duration: 5.0
(110250,) 22050
```



In [49]:

```
plot_mfcc_spect(extrahls_example)
```



## Second Task: Classification

### Data Preprocessing:

#### For Preprocessing:

1. Unlabelled data and artifact-labelled data will be excluded.
2. We are going to exclude audio files that have a duration less than 3 seconds as they do not contain enough datapoints to accurately classify the heartbeats.
3. We sliced the heartbeat sounds into fixed-length segments of length 3 seconds to increase the size of the dataset by slicing large files into multiple smaller files while still retaining the original labels.

In [52]:

```
D = []
files = []

for root, dirnames, filenames in os.walk(seta_path):
    for file_name in filenames:
        files.append(os.path.join(root, file_name))

for root, dirnames, filenames in os.walk(setb_path):
    for file_name in filenames:
        files.append(os.path.join(root, file_name))

for filename in files:
    label = os.path.basename(filename).split("_")[0]
    duration = librosa.get_duration(filename=filename)
    # dividing the audio into partitions of 3 seconds
    # ignoring audio files with duration < 3 seconds
    if duration >= 3:
        no_of_itations = int((duration - 3)/2) + 1
        if label not in ["Aunlabelledtest", "Bunlabelledtest", "artifact"]:
            for i in range(no_of_itations):
                offset = 2*i + 1
                D.append({"filename": filename, "label": label, "offset": offset})

df = pd.DataFrame(D)
df.head(-1)
```

Out[52]:

	filename	label	offset
0	/content/set_a/extrahls__201103170134.wav	extrahls	1
1	/content/set_a/extrahls__201103170134.wav	extrahls	3
2	/content/set_a/extrahls__201103170134.wav	extrahls	5
3	/content/set_a/extrahls__201101152255.wav	extrahls	1
4	/content/set_a/extrahls__201101152255.wav	extrahls	3
...	...	...	...
1275	/content/set_b/normal_noisynormal_146_13067787...	normal	9
1276	/content/set_b/normal_noisynormal_146_13067787...	normal	11
1277	/content/set_b/normal_noisynormal_146_13067787...	normal	13
1278	/content/set_b/normal_noisynormal_146_13067787...	normal	15
1279	/content/set_b/normal_noisynormal_146_13067787...	normal	17

1280 rows × 3 columns

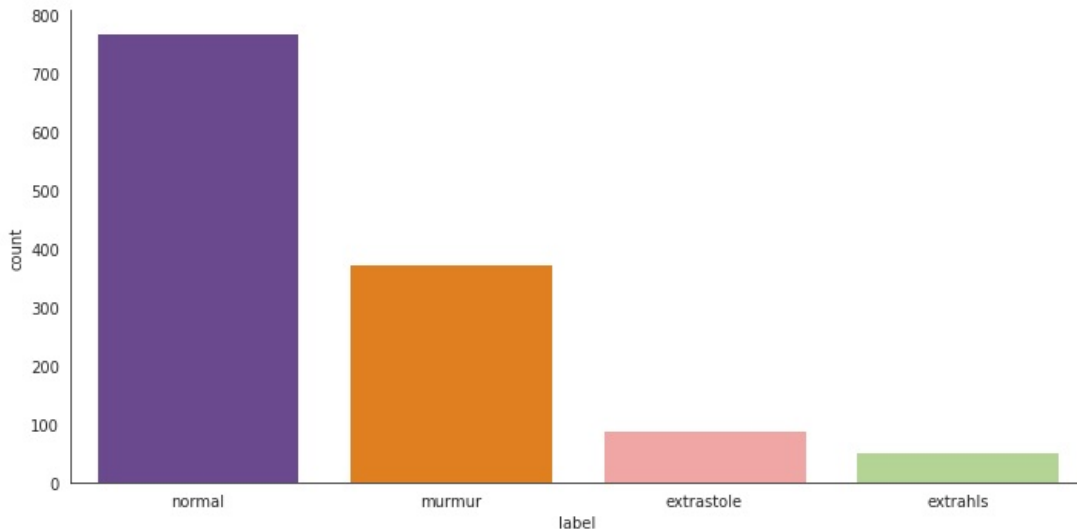
In [53]:

```
# shuffling for randomness
df = shuffle(df, random_state=42)
```

Visuialising clean data that will be used

In [54]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=df, x="label", aspect=2,
                    kind="count", palette='Paired_r')
```

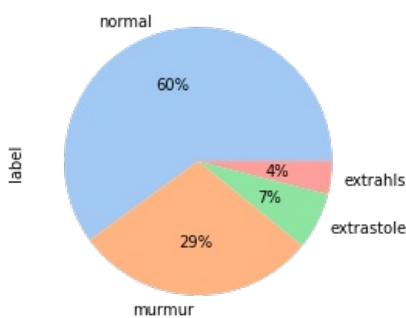


In [55]:

```
df['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0f%%')
```

Out[55]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x7f43dd9ee580>



## Helper Functions:

### Feature Extraction:

**MFCCs are commonly derived as follows:**

1. Take the Fourier transform of (a windowed excerpt of) a signal.
2. Map the powers of the spectrum obtained above onto the mel scale, using triangular overlapping windows or alternatively, cosine overlapping windows.
3. Take the logs of the powers at each of the mel frequencies.
4. Take the discrete cosine transform of the list of mel log powers, as if it were a signal.
5. The MFCCs are the amplitudes of the resulting spectrum.

Extracting Features for MLP:

In [56]:

```
def extracting_features(filename, offset):
    # loading the audio file
    Y, sample_rate = librosa.load(filename, offset=offset, duration=3, res_type='kaiser_fast')
    # extracting features from the audio
    mfcc = np.mean(librosa.feature.mfcc(y=Y, sr=sample_rate, n_mfcc=40).T, axis=0)
    feature = np.array(mfcc).reshape([-1,1])
    return mfcc
```

In [57]:

```
def extract_features_helper(data):
    X = []
    for i in tqdm(range(len(data))):
        filename = data['filename'].iloc[i]
        offset = data.offset.iloc[i]
        X.append(np.array(extracting_features(filename, offset)))
    return X
```

Extracting Features for CNN:

In [58]:

```
from tqdm import tqdm
def extract_features(data):
    X = []
    for i in tqdm(range(len(data))):
        filename = data['filename'].iloc[i]
        offset = data.offset.iloc[i]
        try:
            y, sr = librosa.load(filename, offset=offset, duration=3, res_type='kaiser_fast')
            mfccs = librosa.feature.mfcc(y=y, sr=sr, n_mfcc=40)
            pad_width = 130 - mfccs.shape[1]
            mfccs = np.pad(mfccs, pad_width=((0, 0), (0, pad_width)), mode='constant')
            X.append(mfccs)
        except Exception as e:
            print("Error encountered while parsing file: ", file_name)
            return None

    return X
```

Plotting the Training and Validation Accuracies and losses :

In [59]:

```
def plotfn(history):
    # Loss Curves
    plt.figure(figsize=[14,10])
    plt.subplot(211)
    plt.plot(history.history['loss'], '#d62728', linewidth=3.0)
    plt.plot(history.history['val_loss'], '#1f77b4', linewidth=3.0)
    plt.legend(['Training loss', 'Validation Loss'], fontsize=18)
    plt.xlabel('Epochs ', fontsize=16)
    plt.ylabel('Loss', fontsize=16)
    plt.title('Loss Curves', fontsize=16)

    # Accuracy Curves
    plt.figure(figsize=[14,10])
    plt.subplot(212)
    plt.plot(history.history['accuracy'], '#d62728', linewidth=3.0)
    plt.plot(history.history['val_accuracy'], '#1f77b4', linewidth=3.0)
    plt.legend(['Training Accuracy', 'Validation Accuracy'], fontsize=18)
    plt.xlabel('Epochs ', fontsize=16)
    plt.ylabel('Accuracy', fontsize=16)
    plt.title('Accuracy Curves', fontsize=16)
```

Evaluation (Accuracy and Loss):

In [60]:

```
def evaluation_train_val(model, x, y, x_va, y_va, results, index):
    score1 = model.evaluate(x, y, verbose=0)
    print("Training Accuracy: ", score1[1])
    print("Training Loss: ", score1[0])
    score2 = model.evaluate(x_va, y_va, verbose=0)
    print("Validation Accuracy: ", score2[1])
    print("Validation Loss: ", score2[0])
    results.loc[index, ['Train Acc', 'Train Loss', 'Val Acc', 'Val Loss']] = [score1[1], score1[0], score2[1], score2[0]]
```

In [61]:

```
def evaluation_test(model,x,y, results, index):
    scores = model.evaluate(x, y, verbose=1)
    print('Test accuracy:', scores[1])
    print('Test loss:', scores[0])
    results.loc[index,['Test Acc','Test Loss']] = [scores[1],scores[0]]
```

**Prediction (F1 and ROC):**

In [94]:

```
def predictfn(model, test_data, label_data):
    predictions = model.predict(test_data, verbose=1)
    y_true, y_pred = [],[]
    classes = encoder.classes_
    for idx, prediction in enumerate(predictions):
        y_true.append(classes[np.argmax(label_data[idx])])
        y_pred.append(classes[np.argmax(prediction)])
        report = classification_report(y_pred, y_true, output_dict=True,zero_division=1)
    print(classification_report(y_pred, y_true,zero_division=1))
    return predictions,y_pred , y_true, report['weighted avg']['f1-score']
```

In [62]:

```
def sample_predict(model_name, i):
    # load model
    model = load_model(model_name)
    classify_file = test.iloc[i]
    # change x_test name to any other name
    x_testing = []
    if model_name == "heartbeat_classifierMLP.h5":
        x_testing = extracting_features(classify_file['filename'], classify_file['offset'])
        x_testing = np.asarray(x_testing)
        x_tester = x_testing.reshape(1,-1)
        pred = model.predict(x_tester,verbose=1)
    else:
        y, sr = librosa.load(classify_file['filename'], offset=classify_file['offset'], duration=3, res_type='kaiser_fast')
        mfccs = librosa.feature.mfcc(y=y, sr=sr, n_mfcc=40)
        pad_width = 130 - mfccs.shape[1]
        mfccs = np.pad(mfccs, pad_width=((0, 0), (0, pad_width)), mode='constant')
        x_testing.append(mfccs)
        x_testing = np.asarray(x_testing)
        x_testing = x_testing.reshape(x_testing.shape[0], x_testing.shape[1], x_testing.shape[2], 1)
        pred = model.predict(x_testing,verbose=1)
    print("Label Prediction Probabilities:",pred)
    print("-----")
    print("Label:")
    x = np.argmax(pred, axis=1)
    if x == 0:
        print("Extrahls heartbeat")
        print("confidence:",pred[0][0])
    elif x == 1:
        print("Extrasystole heartbeat")
        print("confidence:",pred[0][1])
    elif x == 2:
        print("Murmur heartbeat")
        print("confidence:",pred[0][2])
    elif x == 3:
        print("Normal heartbeat")
        print("confidence:",pred[0][3])
```



In [63]:

```
def plot_ROC(y , predict):
    fpr = dict()
    tpr = dict()
    roc_auc = dict()
    for i in range(4):
        fpr[i], tpr[i], _ = roc_curve(y[:, i], predict[:, i])
        roc_auc[i] = auc(fpr[i], tpr[i])

    #macro average
    all_fpr = np.unique(np.concatenate([fpr[i] for i in range(4)]))
    mean_tpr = np.zeros_like(all_fpr)
    for i in range(4):
        mean_tpr += np.interp(all_fpr, fpr[i], tpr[i])
    mean_tpr /= 4
    fpr["macro"] = all_fpr
    tpr["macro"] = mean_tpr
    roc_auc["macro"] = auc(fpr["macro"], tpr["macro"])

    plt.plot(fpr["macro"], tpr["macro"],
             label='macro-average ROC curve (area = {0:0.2f})'
               ''.format(roc_auc["macro"]),
             color='navy', linestyle=':', linewidth=4)

    colors = cycle(['aqua', 'darkorange', 'cornflowerblue','green'])
    for i, color in zip(range(4), colors):
        plt.plot(fpr[i], tpr[i], color=color, lw=2, label='ROC curve of class {0} (area = {1:0.2f})'
                  ''.format(i, roc_auc[i]))

    plt.plot([0, 1], [0, 1], 'k--', lw=2)
    plt.xlim([0.0, 1.0])
    plt.ylim([0.0, 1.05])
    plt.xlabel('False Positive Rate')
    plt.ylabel('True Positive Rate')
    plt.legend(loc="lower right")
    plt.show()
    return roc_auc["macro"]
```

#### Model creation, compiling, and fitting:

In [64]:

```
def Conv2Dmodel(model,dropout):
    model.add(Conv2D(16,(3, 3), padding = 'same', input_shape=(x_train.shape[1],x_train.shape[2],x_train.shape[3]
), activation='relu'))
    model.add(MaxPooling2D())
    model.add(Dropout(dropout))

    model.add(Conv2D(32, (3, 3), padding = 'same',activation='relu'))
    model.add(MaxPooling2D())
    model.add(Dropout(dropout))

    model.add(Conv2D(64, (3, 3),padding = 'same', activation='relu'))
    model.add(MaxPooling2D())
    model.add(Dropout(dropout))

    model.add(Conv2D(128, (3, 3),padding = 'same', activation='relu'))
    model.add(MaxPooling2D())
    # model.add(Dropout(dropout))
    model.add(GlobalAveragePooling2D())

    model.add(Dense(len(encoder.classes_), activation='softmax'))
    model.summary()
```

#### NOTE:

Adding checkpoints after each epoch that saves the weights of the epoch with the highest validation accuracy. (This will help in overfitting problems)

In [65]:

```
def compile_fit(model, lossfn='categorical_crossentropy', LR=0.0001, early_stopping=0):
    adam = keras.optimizers.Adam(learning_rate=LR)
    model.compile(loss=lossfn, metrics=['accuracy'], optimizer='adam')
    custom_early_stopping = EarlyStopping(
        monitor='val_accuracy',
        patience=50,
        min_delta=0.0001,
        mode='max')
    filepath="/content/weights.best.hdf5"
    checkpoint = ModelCheckpoint(filepath, monitor='val_accuracy', verbose=1, save_best_only=True, mode='max')
    if early_stopping == 0:
        history = model.fit(x_train, y_train,
                            batch_size=128,
                            epochs=300,
                            validation_data=(x_val, y_val),
                            class_weight=classWeights,
                            callbacks=[checkpoint],
                            shuffle=True)
    model.load_weights("/content/weights.best.hdf5")
    adam = keras.optimizers.Adam(learning_rate=LR)
    model.compile(loss='categorical_crossentropy', metrics=['accuracy'], optimizer='adam')
    print("Created model and loaded weights from file")
    return history, model
```

## Data Splitting

Performing a splitting with ratio 70:15:15 for training, testing, and validation respectively and fixing this split for all experiments.

In [66]:

```
# splitting to get test partition
train_1, test = train_test_split(df, test_size=0.15, random_state=42)
# splitting to get validation and training partition (0.15/0.85)
train, val = train_test_split(train_1, test_size=0.17647059, random_state=42)
```

In [67]:

```
print(f"Training Data Size: {len(train)}")
print(f"Validation Data Size: {len(val)}")
print(f"Testing Data Size: {len(test)}")
```

```
Training Data Size: 895
Validation Data Size: 193
Testing Data Size: 193
```

## Training Data

In [68]:

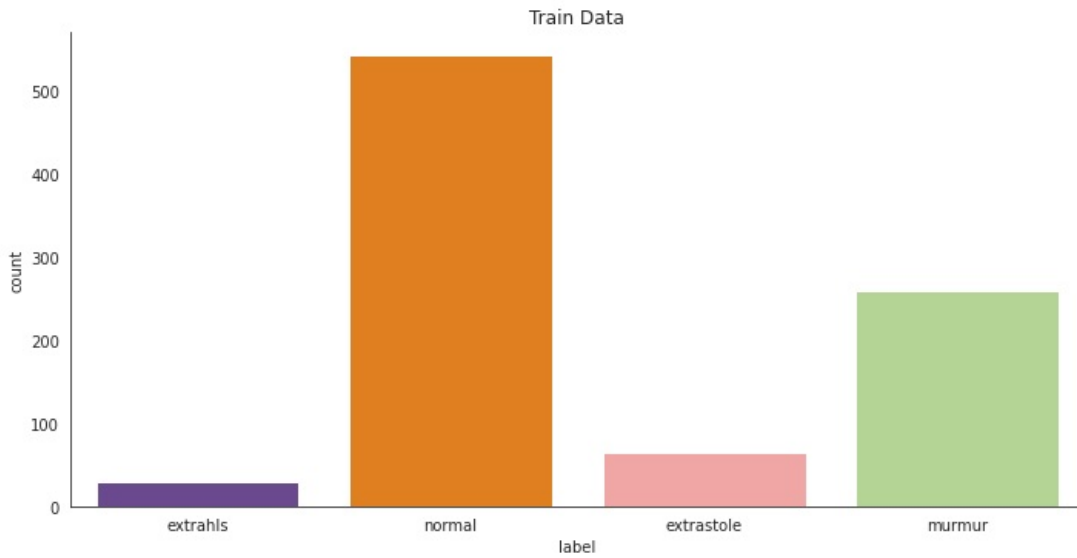
```
train.label.value_counts()
```

Out[68]:

```
normal      542
murmur      259
extrastole   64
extrahls     30
Name: label, dtype: int64
```

In [69]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=train, x="label", aspect=2,
                    kind="count", palette='Paired_r')
    plt.title("Train Data")
```

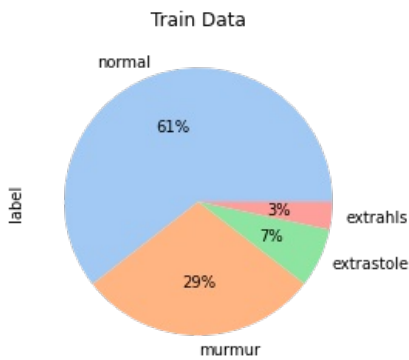


In [70]:

```
train['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0.0f%%')
plt.title("Train Data")
```

Out[70]:

Text(0.5, 1.0, 'Train Data')



## Validation Data

In [71]:

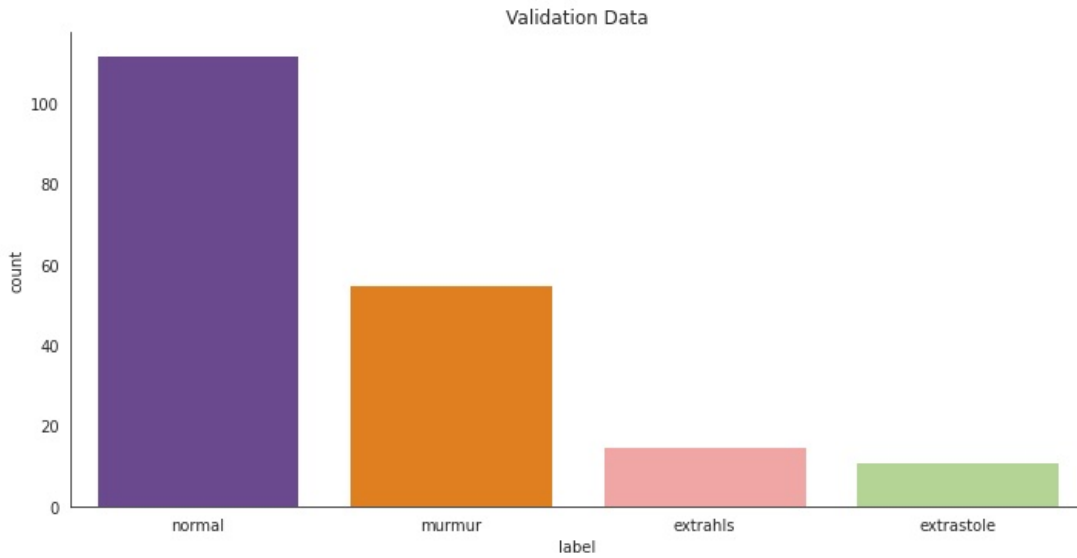
```
val.label.value_counts()
```

Out[71]:

```
normal      112
murmur       55
extrahls     15
extrastole   11
Name: label, dtype: int64
```

In [72]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=val, x="label", aspect=2,
                    kind="count", palette='Paired_r')
    plt.title("Validation Data")
```

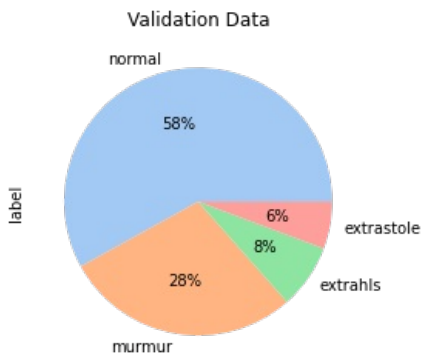


In [73]:

```
val['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0.0f%%')
plt.title("Validation Data")
```

Out[73]:

Text(0.5, 1.0, 'Validation Data')



## Testing Data

In [74]:

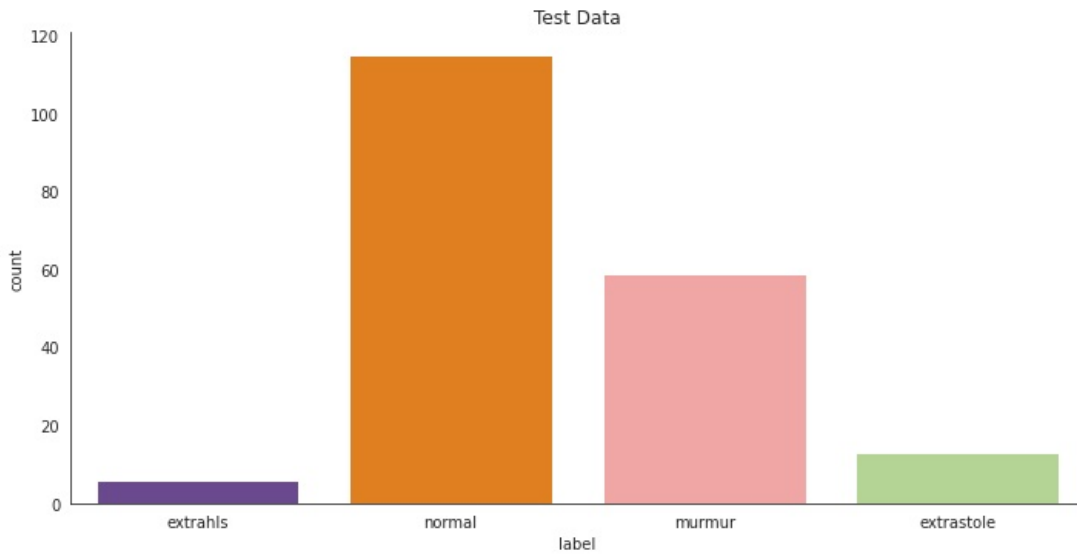
```
test.label.value_counts()
```

Out[74]:

```
normal      115
murmur       59
extrastole   13
extrahls      6
Name: label, dtype: int64
```

In [75]:

```
with sns.axes_style('white'):
    g = sns.catplot(data=test, x="label", aspect=2,
                    kind="count", palette='Paired_r')
    plt.title("Test Data")
```

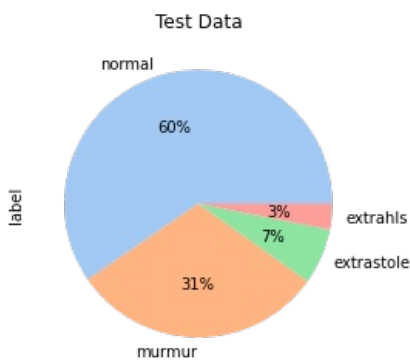


In [76]:

```
test['label'].value_counts(normalize=True).plot(kind='pie', colors = sns.color_palette('pastel')[0:5], autopct='%0f%')
plt.title("Test Data")
```

Out[76]:

Text(0.5, 1.0, 'Test Data')



## Extract Features:

In [77]:

```
x_train = extract_features(train)
x_test = extract_features(test)
x_val = extract_features(val)
```

```
100%|██████████| 895/895 [01:16<00:00, 11.70it/s]
100%|██████████| 193/193 [00:12<00:00, 15.41it/s]
100%|██████████| 193/193 [00:18<00:00, 10.39it/s]
```

In [78]:

```
x_train = np.array(x_train)
x_test = np.array(x_test)
x_val = np.array(x_val)
print("X train:", x_train.shape)
print("X test:", x_test.shape)
print("X validation:", x_val.shape)
```

```
X train: (895, 40, 130)
X test: (193, 40, 130)
X validation: (193, 40, 130)
```

## Encoding the labels (0~3)

In [79]:

```
# get labels and encode them
encoder = LabelEncoder()
encoder.fit(val.label)
y_train = encoder.transform(train.label)
y_test = encoder.transform(test.label)
y_val = encoder.transform(val.label)
```

**Labels:**

- 0: Extrasls
- 1: Extrasystole
- 2: Murmur
- 3: Normal

In [80]:

```
y_train = to_categorical(y_train)
y_val = to_categorical(y_val)
# set aside for testing
y_test = to_categorical(y_test)
```

In [81]:

```
x_train = x_train.reshape(x_train.shape[0], x_train.shape[1], x_train.shape[2], 1)
x_val = x_val.reshape(x_val.shape[0], x_val.shape[1], x_val.shape[2], 1)
# set aside for testing
x_test = x_test.reshape(x_test.shape[0], x_test.shape[1], x_test.shape[2], 1)
```

In [82]:

```
print("X train:", x_train.shape)
print("Y train:", y_train.shape)
print("X val:", x_val.shape)
print("Y val:", y_val.shape)
# set aside for testing
print("X test:", x_test.shape)
print("Y test:", y_test.shape)
```

```
X train: (895, 40, 130, 1)
Y train: (895, 4)
X val: (193, 40, 130, 1)
Y val: (193, 4)
X test: (193, 40, 130, 1)
Y test: (193, 4)
```

**NOTE:** Due to class imbalances, we computed the class weights

In [83]:

```
# Compute class weights
classWeights = compute_class_weight(
    class_weight = 'balanced',
    classes = np.unique(train.label),
    y = train.label)
classWeights = dict(enumerate(classWeights))
```

In [84]:

```
print(classWeights)
```

```
{0: 7.458333333333333, 1: 3.49609375, 2: 0.8638996138996139, 3: 0.4128228782287823}
```

## Create a Dataframe for the results

```
In [88]:
results = pd.DataFrame(columns=['Architecture', 'LR', 'Dropout', 'Loss Fn', 'Train Acc', 'Train Loss', 'Val Acc', 'Val Loss', 'Test Acc', 'Test Loss', 'Val f1', 'Test f1', 'Average ROC'],
index = 0
results

Out[88]:
```

Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
--------------	----	---------	---------	-----------	------------	---------	----------	----------	-----------	--------	---------	-------------

Suitable Loss Functions for Multi-class Classification:

- 1. Categorical Cross-Entropy Loss Function
- 2. Poisson Loss Function
- 3. Kullback-Leibler Divergence Loss Function(KL Divergence)

CNN Experiment 1:

Loss Function used:

- Categorical Cross Entropy:
- The crossentropy loss between the labels and the predictions is calculated.

```
In [86]:
model = Sequential()
Conv2Dmodel(model, 0.2)
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 40, 130, 16)	160
max_pooling2d (MaxPooling2D)	(None, 20, 65, 16)	0
dropout (Dropout)	(None, 20, 65, 16)	0
conv2d_1 (Conv2D)	(None, 20, 65, 32)	4640
max_pooling2d_1 (MaxPooling2D)	(None, 10, 32, 32)	0
dropout_1 (Dropout)	(None, 10, 32, 32)	0
conv2d_2 (Conv2D)	(None, 10, 32, 64)	18496
max_pooling2d_2 (MaxPooling2D)	(None, 5, 16, 64)	0
dropout_2 (Dropout)	(None, 5, 16, 64)	0
conv2d_3 (Conv2D)	(None, 5, 16, 128)	73856
max_pooling2d_3 (MaxPooling2D)	(None, 2, 8, 128)	0
global_average_pooling2d (GlobalAveragePooling2D)	(None, 128)	0
dense (Dense)	(None, 4)	516
Total params: 97,668		
Trainable params: 97,668		
Non-trainable params: 0		

```
In [87]:
history, model = compile_fit(model)

Epoch 1/300
```

```
Epoch 1/300
7/7 [=====] - ETA: 0s - loss: 10.2553 - accuracy: 0.2492
Epoch 1: val_accuracy improved from -inf to 0.12435, saving model to /content/weights.best.hdf5
7/7 [=====] - 7s 885ms/step - loss: 10.2553 - accuracy: 0.2492 - val_loss:
4.8849 - val_accuracy: 0.1244
Epoch 2/300
7/7 [=====] - ETA: 0s - loss: 2.5720 - accuracy: 0.2358
Epoch 2: val_accuracy improved from 0.12435 to 0.58031, saving model to /content/weights.best.hdf5
7/7 [=====] - 6s 825ms/step - loss: 2.5720 - accuracy: 0.2358 - val_loss: 0
.9388 - val_accuracy: 0.5803
Epoch 3/300
7/7 [=====] - ETA: 0s - loss: 1.5484 - accuracy: 0.4816
Epoch 3: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 802ms/step - loss: 1.5484 - accuracy: 0.4816 - val_loss: 1
.2723 - val_accuracy: 0.3420
Epoch 4/300
7/7 [=====] - ETA: 0s - loss: 1.1165 - accuracy: 0.1609
Epoch 4: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 802ms/step - loss: 1.1165 - accuracy: 0.1609 - val_loss: 1
.3655 - val_accuracy: 0.2694
Epoch 5/300
7/7 [=====] - ETA: 0s - loss: 0.9730 - accuracy: 0.2559
Epoch 5: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 774ms/step - loss: 0.9730 - accuracy: 0.2559 - val_loss: 1
.1629 - val_accuracy: 0.4301
Epoch 6/300
7/7 [=====] - ETA: 0s - loss: 0.9325 - accuracy: 0.5587
Epoch 6: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 807ms/step - loss: 0.9325 - accuracy: 0.5587 - val_loss: 1
.1037 - val_accuracy: 0.5440
Epoch 7/300
7/7 [=====] - ETA: 0s - loss: 0.8739 - accuracy: 0.4726
Epoch 7: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 767ms/step - loss: 0.8739 - accuracy: 0.4726 - val_loss: 1
.1638 - val_accuracy: 0.4197
Epoch 8/300
7/7 [=====] - ETA: 0s - loss: 0.8711 - accuracy: 0.3486
Epoch 8: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 945ms/step - loss: 0.8711 - accuracy: 0.3486 - val_loss: 1
.0980 - val_accuracy: 0.4611
Epoch 9/300
7/7 [=====] - ETA: 0s - loss: 0.8428 - accuracy: 0.4793
Epoch 9: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 760ms/step - loss: 0.8428 - accuracy: 0.4793 - val_loss: 1
.0583 - val_accuracy: 0.5026
Epoch 10/300
7/7 [=====] - ETA: 0s - loss: 0.8202 - accuracy: 0.4581
Epoch 10: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 786ms/step - loss: 0.8202 - accuracy: 0.4581 - val_loss: 1
.0663 - val_accuracy: 0.4663
Epoch 11/300
7/7 [=====] - ETA: 0s - loss: 0.8024 - accuracy: 0.4358
Epoch 11: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 792ms/step - loss: 0.8024 - accuracy: 0.4358 - val_loss: 1
.0120 - val_accuracy: 0.5181
Epoch 12/300
7/7 [=====] - ETA: 0s - loss: 0.7856 - accuracy: 0.5240
Epoch 12: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 817ms/step - loss: 0.7856 - accuracy: 0.5240 - val_loss: 1
.0594 - val_accuracy: 0.4301
Epoch 13/300
7/7 [=====] - ETA: 0s - loss: 0.7943 - accuracy: 0.4335
Epoch 13: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 807ms/step - loss: 0.7943 - accuracy: 0.4335 - val_loss: 0
.9967 - val_accuracy: 0.4974
Epoch 14/300
7/7 [=====] - ETA: 0s - loss: 0.7596 - accuracy: 0.4916
Epoch 14: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 808ms/step - loss: 0.7596 - accuracy: 0.4916 - val_loss: 1
.0377 - val_accuracy: 0.4456
Epoch 15/300
7/7 [=====] - ETA: 0s - loss: 0.7541 - accuracy: 0.5441
Epoch 15: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 762ms/step - loss: 0.7541 - accuracy: 0.5441 - val_loss: 1
.0306 - val_accuracy: 0.4611
Epoch 16/300
7/7 [=====] - ETA: 0s - loss: 0.7466 - accuracy: 0.4212
Epoch 16: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 770ms/step - loss: 0.7466 - accuracy: 0.4212 - val_loss: 0
.9440 - val_accuracy: 0.5544
Epoch 17/300
7/7 [=====] - ETA: 0s - loss: 0.7674 - accuracy: 0.5508
Epoch 17: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 807ms/step - loss: 0.7674 - accuracy: 0.5508 - val_loss: 1
```



```
.0413 - val_accuracy: 0.4352
Epoch 18/300
7/7 [=====] - ETA: 0s - loss: 0.7386 - accuracy: 0.4279
Epoch 18: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 804ms/step - loss: 0.7386 - accuracy: 0.4279 - val_loss: 0
.9094 - val_accuracy: 0.5751
Epoch 19/300
7/7 [=====] - ETA: 0s - loss: 0.7414 - accuracy: 0.5430
Epoch 19: val_accuracy did not improve from 0.58031
7/7 [=====] - 5s 780ms/step - loss: 0.7414 - accuracy: 0.5430 - val_loss: 0
.9775 - val_accuracy: 0.5078
Epoch 20/300
7/7 [=====] - ETA: 0s - loss: 0.7197 - accuracy: 0.4682
Epoch 20: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 792ms/step - loss: 0.7197 - accuracy: 0.4682 - val_loss: 0
.9451 - val_accuracy: 0.5181
Epoch 21/300
7/7 [=====] - ETA: 0s - loss: 0.7071 - accuracy: 0.5073
Epoch 21: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 806ms/step - loss: 0.7071 - accuracy: 0.5073 - val_loss: 0
.9146 - val_accuracy: 0.5337
Epoch 22/300
7/7 [=====] - ETA: 0s - loss: 0.7340 - accuracy: 0.5307
Epoch 22: val_accuracy did not improve from 0.58031
7/7 [=====] - 6s 796ms/step - loss: 0.7340 - accuracy: 0.5307 - val_loss: 0
.9814 - val_accuracy: 0.4715
Epoch 23/300
7/7 [=====] - ETA: 0s - loss: 0.7331 - accuracy: 0.4201
Epoch 23: val_accuracy improved from 0.58031 to 0.61658, saving model to /content/weights.best.hdf5
7/7 [=====] - 7s 981ms/step - loss: 0.7331 - accuracy: 0.4201 - val_loss: 0
.8558 - val_accuracy: 0.6166
Epoch 24/300
7/7 [=====] - ETA: 0s - loss: 0.6993 - accuracy: 0.6101
Epoch 24: val_accuracy did not improve from 0.61658
7/7 [=====] - 6s 839ms/step - loss: 0.6993 - accuracy: 0.6101 - val_loss: 0
.9673 - val_accuracy: 0.4870
Epoch 25/300
7/7 [=====] - ETA: 0s - loss: 0.6987 - accuracy: 0.4771
Epoch 25: val_accuracy did not improve from 0.61658
7/7 [=====] - 6s 795ms/step - loss: 0.6987 - accuracy: 0.4771 - val_loss: 0
.9014 - val_accuracy: 0.5440
Epoch 26/300
7/7 [=====] - ETA: 0s - loss: 0.6762 - accuracy: 0.5251
Epoch 26: val_accuracy did not improve from 0.61658
7/7 [=====] - 5s 771ms/step - loss: 0.6762 - accuracy: 0.5251 - val_loss: 0
.9215 - val_accuracy: 0.5130
Epoch 27/300
7/7 [=====] - ETA: 0s - loss: 0.6817 - accuracy: 0.5151
Epoch 27: val_accuracy did not improve from 0.61658
7/7 [=====] - 5s 776ms/step - loss: 0.6817 - accuracy: 0.5151 - val_loss: 0
.8640 - val_accuracy: 0.5855
Epoch 28/300
7/7 [=====] - ETA: 0s - loss: 0.7087 - accuracy: 0.4804
Epoch 28: val_accuracy improved from 0.61658 to 0.62176, saving model to /content/weights.best.hdf5
7/7 [=====] - 5s 794ms/step - loss: 0.7087 - accuracy: 0.4804 - val_loss: 0
.8148 - val_accuracy: 0.6218
Epoch 29/300
7/7 [=====] - ETA: 0s - loss: 0.6892 - accuracy: 0.5575
Epoch 29: val_accuracy did not improve from 0.62176
7/7 [=====] - 5s 783ms/step - loss: 0.6892 - accuracy: 0.5575 - val_loss: 0
.9476 - val_accuracy: 0.4922
Epoch 30/300
7/7 [=====] - ETA: 0s - loss: 0.6805 - accuracy: 0.5095
Epoch 30: val_accuracy did not improve from 0.62176
7/7 [=====] - 5s 781ms/step - loss: 0.6805 - accuracy: 0.5095 - val_loss: 0
.8451 - val_accuracy: 0.6010
Epoch 31/300
7/7 [=====] - ETA: 0s - loss: 0.6762 - accuracy: 0.5330
Epoch 31: val_accuracy did not improve from 0.62176
7/7 [=====] - 6s 813ms/step - loss: 0.6762 - accuracy: 0.5330 - val_loss: 0
.8853 - val_accuracy: 0.5440
Epoch 32/300
7/7 [=====] - ETA: 0s - loss: 0.6571 - accuracy: 0.5598
Epoch 32: val_accuracy did not improve from 0.62176
7/7 [=====] - 6s 802ms/step - loss: 0.6571 - accuracy: 0.5598 - val_loss: 0
.8302 - val_accuracy: 0.6062
Epoch 33/300
7/7 [=====] - ETA: 0s - loss: 0.6449 - accuracy: 0.5453
Epoch 33: val_accuracy improved from 0.62176 to 0.62694, saving model to /content/weights.best.hdf5
7/7 [=====] - 6s 810ms/step - loss: 0.6449 - accuracy: 0.5453 - val_loss: 0
.8019 - val_accuracy: 0.6269
Epoch 34/300
7/7 [=====] - ETA: 0s - loss: 0.6313 - accuracy: 0.5698
```

Epoch 34: val\_accuracy did not improve from 0.62694  
7/7 [=====] - 6s 809ms/step - loss: 0.6313 - accuracy: 0.5698 - val\_loss: 0.8120 - val\_accuracy: 0.6166  
Epoch 35/300  
7/7 [=====] - ETA: 0s - loss: 0.6261 - accuracy: 0.5508  
Epoch 35: val\_accuracy improved from 0.62694 to 0.64249, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 787ms/step - loss: 0.6261 - accuracy: 0.5508 - val\_loss: 0.7423 - val\_accuracy: 0.6425  
Epoch 36/300  
7/7 [=====] - ETA: 0s - loss: 0.6359 - accuracy: 0.5642  
Epoch 36: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 5s 790ms/step - loss: 0.6359 - accuracy: 0.5642 - val\_loss: 0.8223 - val\_accuracy: 0.5907  
Epoch 37/300  
7/7 [=====] - ETA: 0s - loss: 0.6319 - accuracy: 0.5799  
Epoch 37: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 798ms/step - loss: 0.6319 - accuracy: 0.5799 - val\_loss: 0.8318 - val\_accuracy: 0.5907  
Epoch 38/300  
7/7 [=====] - ETA: 0s - loss: 0.6548 - accuracy: 0.5240  
Epoch 38: val\_accuracy improved from 0.64249 to 0.71503, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 814ms/step - loss: 0.6548 - accuracy: 0.5240 - val\_loss: 0.7069 - val\_accuracy: 0.7150  
Epoch 39/300  
7/7 [=====] - ETA: 0s - loss: 0.6639 - accuracy: 0.5832  
Epoch 39: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 800ms/step - loss: 0.6639 - accuracy: 0.5832 - val\_loss: 0.9597 - val\_accuracy: 0.4819  
Epoch 40/300  
7/7 [=====] - ETA: 0s - loss: 0.6782 - accuracy: 0.5263  
Epoch 40: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 784ms/step - loss: 0.6782 - accuracy: 0.5263 - val\_loss: 0.8717 - val\_accuracy: 0.5699  
Epoch 41/300  
7/7 [=====] - ETA: 0s - loss: 0.6492 - accuracy: 0.5073  
Epoch 41: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 781ms/step - loss: 0.6492 - accuracy: 0.5073 - val\_loss: 0.8201 - val\_accuracy: 0.6010  
Epoch 42/300  
7/7 [=====] - ETA: 0s - loss: 0.6141 - accuracy: 0.5922  
Epoch 42: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 795ms/step - loss: 0.6141 - accuracy: 0.5922 - val\_loss: 0.7916 - val\_accuracy: 0.6166  
Epoch 43/300  
7/7 [=====] - ETA: 0s - loss: 0.6230 - accuracy: 0.5598  
Epoch 43: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 808ms/step - loss: 0.6230 - accuracy: 0.5598 - val\_loss: 0.7879 - val\_accuracy: 0.6010  
Epoch 44/300  
7/7 [=====] - ETA: 0s - loss: 0.6424 - accuracy: 0.5888  
Epoch 44: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 801ms/step - loss: 0.6424 - accuracy: 0.5888 - val\_loss: 0.7960 - val\_accuracy: 0.6477  
Epoch 45/300  
7/7 [=====] - ETA: 0s - loss: 0.6045 - accuracy: 0.5486  
Epoch 45: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 817ms/step - loss: 0.6045 - accuracy: 0.5486 - val\_loss: 0.7252 - val\_accuracy: 0.6736  
Epoch 46/300  
7/7 [=====] - ETA: 0s - loss: 0.5864 - accuracy: 0.6313  
Epoch 46: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 808ms/step - loss: 0.5864 - accuracy: 0.6313 - val\_loss: 0.8146 - val\_accuracy: 0.6114  
Epoch 47/300  
7/7 [=====] - ETA: 0s - loss: 0.6212 - accuracy: 0.5855  
Epoch 47: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 772ms/step - loss: 0.6212 - accuracy: 0.5855 - val\_loss: 0.7658 - val\_accuracy: 0.6321  
Epoch 48/300  
7/7 [=====] - ETA: 0s - loss: 0.6408 - accuracy: 0.5765  
Epoch 48: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 780ms/step - loss: 0.6408 - accuracy: 0.5765 - val\_loss: 0.8012 - val\_accuracy: 0.6218  
Epoch 49/300  
7/7 [=====] - ETA: 0s - loss: 0.5974 - accuracy: 0.6089  
Epoch 49: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 787ms/step - loss: 0.5974 - accuracy: 0.6089 - val\_loss: 0.7296 - val\_accuracy: 0.6269  
Epoch 50/300  
7/7 [=====] - ETA: 0s - loss: 0.5661 - accuracy: 0.5944  
Epoch 50: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 797ms/step - loss: 0.5661 - accuracy: 0.5944 - val\_loss: 0.7910 - val\_accuracy: 0.6373

Epoch 51/300  
7/7 [=====] - ETA: 0s - loss: 0.5703 - accuracy: 0.6101  
Epoch 51: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 800ms/step - loss: 0.5703 - accuracy: 0.6101 - val\_loss: 0.6846 - val\_accuracy: 0.6528  
Epoch 52/300  
7/7 [=====] - ETA: 0s - loss: 0.5771 - accuracy: 0.6201  
Epoch 52: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 787ms/step - loss: 0.5771 - accuracy: 0.6201 - val\_loss: 0.7144 - val\_accuracy: 0.6684  
Epoch 53/300  
7/7 [=====] - ETA: 0s - loss: 0.5609 - accuracy: 0.6201  
Epoch 53: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 801ms/step - loss: 0.5609 - accuracy: 0.6201 - val\_loss: 0.6871 - val\_accuracy: 0.6528  
Epoch 54/300  
7/7 [=====] - ETA: 0s - loss: 0.5667 - accuracy: 0.6145  
Epoch 54: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 768ms/step - loss: 0.5667 - accuracy: 0.6145 - val\_loss: 0.7593 - val\_accuracy: 0.6373  
Epoch 55/300  
7/7 [=====] - ETA: 0s - loss: 0.5564 - accuracy: 0.6302  
Epoch 55: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 793ms/step - loss: 0.5564 - accuracy: 0.6302 - val\_loss: 0.6763 - val\_accuracy: 0.6736  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.5606 - accuracy: 0.6279  
Epoch 56: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 799ms/step - loss: 0.5606 - accuracy: 0.6279 - val\_loss: 0.6743 - val\_accuracy: 0.6943  
Epoch 57/300  
7/7 [=====] - ETA: 0s - loss: 0.5809 - accuracy: 0.6324  
Epoch 57: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 794ms/step - loss: 0.5809 - accuracy: 0.6324 - val\_loss: 0.7695 - val\_accuracy: 0.6218  
Epoch 58/300  
7/7 [=====] - ETA: 0s - loss: 0.5758 - accuracy: 0.6235  
Epoch 58: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 800ms/step - loss: 0.5758 - accuracy: 0.6235 - val\_loss: 0.7201 - val\_accuracy: 0.6321  
Epoch 59/300  
7/7 [=====] - ETA: 0s - loss: 0.5295 - accuracy: 0.6223  
Epoch 59: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 787ms/step - loss: 0.5295 - accuracy: 0.6223 - val\_loss: 0.7718 - val\_accuracy: 0.6166  
Epoch 60/300  
7/7 [=====] - ETA: 0s - loss: 0.5577 - accuracy: 0.6425  
Epoch 60: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 5s 780ms/step - loss: 0.5577 - accuracy: 0.6425 - val\_loss: 0.7025 - val\_accuracy: 0.6580  
Epoch 61/300  
7/7 [=====] - ETA: 0s - loss: 0.5482 - accuracy: 0.6436  
Epoch 61: val\_accuracy improved from 0.71503 to 0.72021, saving model to /content/weights.best.hdf5  
7/7 [=====] - 8s 1s/step - loss: 0.5482 - accuracy: 0.6436 - val\_loss: 0.6389 - val\_accuracy: 0.7202  
Epoch 62/300  
7/7 [=====] - ETA: 0s - loss: 0.5219 - accuracy: 0.6302  
Epoch 62: val\_accuracy improved from 0.72021 to 0.73057, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 774ms/step - loss: 0.5219 - accuracy: 0.6302 - val\_loss: 0.6254 - val\_accuracy: 0.7306  
Epoch 63/300  
7/7 [=====] - ETA: 0s - loss: 0.5170 - accuracy: 0.6771  
Epoch 63: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 5s 795ms/step - loss: 0.5170 - accuracy: 0.6771 - val\_loss: 0.7046 - val\_accuracy: 0.6736  
Epoch 64/300  
7/7 [=====] - ETA: 0s - loss: 0.5223 - accuracy: 0.6626  
Epoch 64: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 793ms/step - loss: 0.5223 - accuracy: 0.6626 - val\_loss: 0.6989 - val\_accuracy: 0.6788  
Epoch 65/300  
7/7 [=====] - ETA: 0s - loss: 0.5523 - accuracy: 0.6413  
Epoch 65: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 811ms/step - loss: 0.5523 - accuracy: 0.6413 - val\_loss: 0.6122 - val\_accuracy: 0.7047  
Epoch 66/300  
7/7 [=====] - ETA: 0s - loss: 0.5598 - accuracy: 0.6223  
Epoch 66: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 808ms/step - loss: 0.5598 - accuracy: 0.6223 - val\_loss: 0.6950 - val\_accuracy: 0.6632  
Epoch 67/300  
7/7 [=====] - ETA: 0s - loss: 0.5532 - accuracy: 0.6447  
Epoch 67: val\_accuracy did not improve from 0.73057

7/7 [=====] - 6s 813ms/step - loss: 0.5532 - accuracy: 0.6447 - val\_loss: 0.7539 - val\_accuracy: 0.6269  
Epoch 68/300  
7/7 [=====] - ETA: 0s - loss: 0.5312 - accuracy: 0.6547  
Epoch 68: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 813ms/step - loss: 0.5312 - accuracy: 0.6547 - val\_loss: 0.7614 - val\_accuracy: 0.6684  
Epoch 69/300  
7/7 [=====] - ETA: 0s - loss: 0.5170 - accuracy: 0.6525  
Epoch 69: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 815ms/step - loss: 0.5170 - accuracy: 0.6525 - val\_loss: 0.6102 - val\_accuracy: 0.6943  
Epoch 70/300  
7/7 [=====] - ETA: 0s - loss: 0.4964 - accuracy: 0.6536  
Epoch 70: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 5s 773ms/step - loss: 0.4964 - accuracy: 0.6536 - val\_loss: 0.5945 - val\_accuracy: 0.7202  
Epoch 71/300  
7/7 [=====] - ETA: 0s - loss: 0.5059 - accuracy: 0.6827  
Epoch 71: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 5s 776ms/step - loss: 0.5059 - accuracy: 0.6827 - val\_loss: 0.6194 - val\_accuracy: 0.7047  
Epoch 72/300  
7/7 [=====] - ETA: 0s - loss: 0.4839 - accuracy: 0.7006  
Epoch 72: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 809ms/step - loss: 0.4839 - accuracy: 0.7006 - val\_loss: 0.6068 - val\_accuracy: 0.7150  
Epoch 73/300  
7/7 [=====] - ETA: 0s - loss: 0.4793 - accuracy: 0.6693  
Epoch 73: val\_accuracy did not improve from 0.73057  
7/7 [=====] - 6s 805ms/step - loss: 0.4793 - accuracy: 0.6693 - val\_loss: 0.6458 - val\_accuracy: 0.6943  
Epoch 74/300  
7/7 [=====] - ETA: 0s - loss: 0.4600 - accuracy: 0.6827  
Epoch 74: val\_accuracy improved from 0.73057 to 0.77202, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 785ms/step - loss: 0.4600 - accuracy: 0.6827 - val\_loss: 0.5243 - val\_accuracy: 0.7720  
Epoch 75/300  
7/7 [=====] - ETA: 0s - loss: 0.4912 - accuracy: 0.6804  
Epoch 75: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 810ms/step - loss: 0.4912 - accuracy: 0.6804 - val\_loss: 0.7127 - val\_accuracy: 0.6528  
Epoch 76/300  
7/7 [=====] - ETA: 0s - loss: 0.4677 - accuracy: 0.7084  
Epoch 76: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 830ms/step - loss: 0.4677 - accuracy: 0.7084 - val\_loss: 0.6464 - val\_accuracy: 0.7098  
Epoch 77/300  
7/7 [=====] - ETA: 0s - loss: 0.5206 - accuracy: 0.6715  
Epoch 77: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 798ms/step - loss: 0.5206 - accuracy: 0.6715 - val\_loss: 0.6742 - val\_accuracy: 0.7409  
Epoch 78/300  
7/7 [=====] - ETA: 0s - loss: 0.4971 - accuracy: 0.6469  
Epoch 78: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 818ms/step - loss: 0.4971 - accuracy: 0.6469 - val\_loss: 0.5783 - val\_accuracy: 0.7202  
Epoch 79/300  
7/7 [=====] - ETA: 0s - loss: 0.4976 - accuracy: 0.6983  
Epoch 79: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 807ms/step - loss: 0.4976 - accuracy: 0.6983 - val\_loss: 0.6499 - val\_accuracy: 0.6943  
Epoch 80/300  
7/7 [=====] - ETA: 0s - loss: 0.4523 - accuracy: 0.7263  
Epoch 80: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 805ms/step - loss: 0.4523 - accuracy: 0.7263 - val\_loss: 0.5972 - val\_accuracy: 0.7409  
Epoch 81/300  
7/7 [=====] - ETA: 0s - loss: 0.4455 - accuracy: 0.6983  
Epoch 81: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 5s 759ms/step - loss: 0.4455 - accuracy: 0.6983 - val\_loss: 0.6101 - val\_accuracy: 0.7202  
Epoch 82/300  
7/7 [=====] - ETA: 0s - loss: 0.4521 - accuracy: 0.6905  
Epoch 82: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 811ms/step - loss: 0.4521 - accuracy: 0.6905 - val\_loss: 0.5533 - val\_accuracy: 0.7668  
Epoch 83/300  
7/7 [=====] - ETA: 0s - loss: 0.5134 - accuracy: 0.6760  
Epoch 83: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 807ms/step - loss: 0.5134 - accuracy: 0.6760 - val\_loss: 0.6445 - val\_accuracy: 0.7202  
Epoch 84/300

7/7 [=====] - ETA: 0s - loss: 0.4564 - accuracy: 0.7006  
Epoch 84: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 847ms/step - loss: 0.4564 - accuracy: 0.7006 - val\_loss: 0.6244 - val\_accuracy: 0.7409  
Epoch 85/300  
7/7 [=====] - ETA: 0s - loss: 0.4444 - accuracy: 0.7028  
Epoch 85: val\_accuracy improved from 0.77202 to 0.80311, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 816ms/step - loss: 0.4444 - accuracy: 0.7028 - val\_loss: 0.5081 - val\_accuracy: 0.8031  
Epoch 86/300  
7/7 [=====] - ETA: 0s - loss: 0.4260 - accuracy: 0.7274  
Epoch 86: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.4260 - accuracy: 0.7274 - val\_loss: 0.5395 - val\_accuracy: 0.7565  
Epoch 87/300  
7/7 [=====] - ETA: 0s - loss: 0.4450 - accuracy: 0.7263  
Epoch 87: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 792ms/step - loss: 0.4450 - accuracy: 0.7263 - val\_loss: 0.6353 - val\_accuracy: 0.7409  
Epoch 88/300  
7/7 [=====] - ETA: 0s - loss: 0.4481 - accuracy: 0.7453  
Epoch 88: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 780ms/step - loss: 0.4481 - accuracy: 0.7453 - val\_loss: 0.6818 - val\_accuracy: 0.7098  
Epoch 89/300  
7/7 [=====] - ETA: 0s - loss: 0.4544 - accuracy: 0.6816  
Epoch 89: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 786ms/step - loss: 0.4544 - accuracy: 0.6816 - val\_loss: 0.5729 - val\_accuracy: 0.7876  
Epoch 90/300  
7/7 [=====] - ETA: 0s - loss: 0.4392 - accuracy: 0.7263  
Epoch 90: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 791ms/step - loss: 0.4392 - accuracy: 0.7263 - val\_loss: 0.7468 - val\_accuracy: 0.6218  
Epoch 91/300  
7/7 [=====] - ETA: 0s - loss: 0.4789 - accuracy: 0.6994  
Epoch 91: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 818ms/step - loss: 0.4789 - accuracy: 0.6994 - val\_loss: 0.7111 - val\_accuracy: 0.6580  
Epoch 92/300  
7/7 [=====] - ETA: 0s - loss: 0.4378 - accuracy: 0.6939  
Epoch 92: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 806ms/step - loss: 0.4378 - accuracy: 0.6939 - val\_loss: 0.4995 - val\_accuracy: 0.7927  
Epoch 93/300  
7/7 [=====] - ETA: 0s - loss: 0.4385 - accuracy: 0.7017  
Epoch 93: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 809ms/step - loss: 0.4385 - accuracy: 0.7017 - val\_loss: 0.6579 - val\_accuracy: 0.7150  
Epoch 94/300  
7/7 [=====] - ETA: 0s - loss: 0.4184 - accuracy: 0.7084  
Epoch 94: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.4184 - accuracy: 0.7084 - val\_loss: 0.4871 - val\_accuracy: 0.8031  
Epoch 95/300  
7/7 [=====] - ETA: 0s - loss: 0.4046 - accuracy: 0.7207  
Epoch 95: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 806ms/step - loss: 0.4046 - accuracy: 0.7207 - val\_loss: 0.5551 - val\_accuracy: 0.7668  
Epoch 96/300  
7/7 [=====] - ETA: 0s - loss: 0.4085 - accuracy: 0.7318  
Epoch 96: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 811ms/step - loss: 0.4085 - accuracy: 0.7318 - val\_loss: 0.5073 - val\_accuracy: 0.7720  
Epoch 97/300  
7/7 [=====] - ETA: 0s - loss: 0.4024 - accuracy: 0.7553  
Epoch 97: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 798ms/step - loss: 0.4024 - accuracy: 0.7553 - val\_loss: 0.6194 - val\_accuracy: 0.7306  
Epoch 98/300  
7/7 [=====] - ETA: 0s - loss: 0.4249 - accuracy: 0.7173  
Epoch 98: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 8s 1s/step - loss: 0.4249 - accuracy: 0.7173 - val\_loss: 0.5305 - val\_accuracy: 0.7876  
Epoch 99/300  
7/7 [=====] - ETA: 0s - loss: 0.4339 - accuracy: 0.7296  
Epoch 99: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 789ms/step - loss: 0.4339 - accuracy: 0.7296 - val\_loss: 0.5197 - val\_accuracy: 0.7565  
Epoch 100/300  
7/7 [=====] - ETA: 0s - loss: 0.3906 - accuracy: 0.7207  
Epoch 100: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 770ms/step - loss: 0.3906 - accuracy: 0.7207 - val\_loss: 0

.6039 - val\_accuracy: 0.6995  
Epoch 101/300  
7/7 [=====] - ETA: 0s - loss: 0.4732 - accuracy: 0.7128  
Epoch 101: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 777ms/step - loss: 0.4732 - accuracy: 0.7128 - val\_loss: 0  
.8351 - val\_accuracy: 0.5648  
Epoch 102/300  
7/7 [=====] - ETA: 0s - loss: 0.4463 - accuracy: 0.7408  
Epoch 102: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 797ms/step - loss: 0.4463 - accuracy: 0.7408 - val\_loss: 0  
.5722 - val\_accuracy: 0.7565  
Epoch 103/300  
7/7 [=====] - ETA: 0s - loss: 0.3854 - accuracy: 0.7385  
Epoch 103: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 795ms/step - loss: 0.3854 - accuracy: 0.7385 - val\_loss: 0  
.5023 - val\_accuracy: 0.7772  
Epoch 104/300  
7/7 [=====] - ETA: 0s - loss: 0.4321 - accuracy: 0.7196  
Epoch 104: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 805ms/step - loss: 0.4321 - accuracy: 0.7196 - val\_loss: 0  
.5697 - val\_accuracy: 0.7617  
Epoch 105/300  
7/7 [=====] - ETA: 0s - loss: 0.3850 - accuracy: 0.7620  
Epoch 105: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 794ms/step - loss: 0.3850 - accuracy: 0.7620 - val\_loss: 0  
.6112 - val\_accuracy: 0.7409  
Epoch 106/300  
7/7 [=====] - ETA: 0s - loss: 0.4052 - accuracy: 0.7397  
Epoch 106: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 799ms/step - loss: 0.4052 - accuracy: 0.7397 - val\_loss: 0  
.6322 - val\_accuracy: 0.7254  
Epoch 107/300  
7/7 [=====] - ETA: 0s - loss: 0.3663 - accuracy: 0.7564  
Epoch 107: val\_accuracy improved from 0.80311 to 0.81347, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 786ms/step - loss: 0.3663 - accuracy: 0.7564 - val\_loss: 0  
.4655 - val\_accuracy: 0.8135  
Epoch 108/300  
7/7 [=====] - ETA: 0s - loss: 0.3771 - accuracy: 0.7374  
Epoch 108: val\_accuracy did not improve from 0.81347  
7/7 [=====] - 6s 812ms/step - loss: 0.3771 - accuracy: 0.7374 - val\_loss: 0  
.5034 - val\_accuracy: 0.8031  
Epoch 109/300  
7/7 [=====] - ETA: 0s - loss: 0.4004 - accuracy: 0.7419  
Epoch 109: val\_accuracy did not improve from 0.81347  
7/7 [=====] - 6s 800ms/step - loss: 0.4004 - accuracy: 0.7419 - val\_loss: 0  
.4887 - val\_accuracy: 0.7876  
Epoch 110/300  
7/7 [=====] - ETA: 0s - loss: 0.4006 - accuracy: 0.7408  
Epoch 110: val\_accuracy did not improve from 0.81347  
7/7 [=====] - 6s 808ms/step - loss: 0.4006 - accuracy: 0.7408 - val\_loss: 0  
.5681 - val\_accuracy: 0.7617  
Epoch 111/300  
7/7 [=====] - ETA: 0s - loss: 0.3761 - accuracy: 0.7564  
Epoch 111: val\_accuracy improved from 0.81347 to 0.83420, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 812ms/step - loss: 0.3761 - accuracy: 0.7564 - val\_loss: 0  
.4214 - val\_accuracy: 0.8342  
Epoch 112/300  
7/7 [=====] - ETA: 0s - loss: 0.3262 - accuracy: 0.8000  
Epoch 112: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 798ms/step - loss: 0.3262 - accuracy: 0.8000 - val\_loss: 0  
.4845 - val\_accuracy: 0.7876  
Epoch 113/300  
7/7 [=====] - ETA: 0s - loss: 0.3478 - accuracy: 0.7888  
Epoch 113: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 806ms/step - loss: 0.3478 - accuracy: 0.7888 - val\_loss: 0  
.4857 - val\_accuracy: 0.7876  
Epoch 114/300  
7/7 [=====] - ETA: 0s - loss: 0.3412 - accuracy: 0.7821  
Epoch 114: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 782ms/step - loss: 0.3412 - accuracy: 0.7821 - val\_loss: 0  
.5532 - val\_accuracy: 0.7720  
Epoch 115/300  
7/7 [=====] - ETA: 0s - loss: 0.3459 - accuracy: 0.7899  
Epoch 115: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 763ms/step - loss: 0.3459 - accuracy: 0.7899 - val\_loss: 0  
.4614 - val\_accuracy: 0.7979  
Epoch 116/300  
7/7 [=====] - ETA: 0s - loss: 0.3548 - accuracy: 0.7743  
Epoch 116: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 787ms/step - loss: 0.3548 - accuracy: 0.7743 - val\_loss: 0  
.5213 - val\_accuracy: 0.8083  
Epoch 117/300  
7/7 [=====] - ETA: 0s - loss: 0.3194 - accuracy: 0.7844

Epoch 117: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 793ms/step - loss: 0.3194 - accuracy: 0.7844 - val\_loss: 0.4819 - val\_accuracy: 0.7979  
Epoch 118/300  
7/7 [=====] - ETA: 0s - loss: 0.3424 - accuracy: 0.7754  
Epoch 118: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 772ms/step - loss: 0.3424 - accuracy: 0.7754 - val\_loss: 0.5000 - val\_accuracy: 0.7927  
Epoch 119/300  
7/7 [=====] - ETA: 0s - loss: 0.3671 - accuracy: 0.7620  
Epoch 119: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 813ms/step - loss: 0.3671 - accuracy: 0.7620 - val\_loss: 0.5049 - val\_accuracy: 0.7617  
Epoch 120/300  
7/7 [=====] - ETA: 0s - loss: 0.3463 - accuracy: 0.7866  
Epoch 120: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 766ms/step - loss: 0.3463 - accuracy: 0.7866 - val\_loss: 0.5869 - val\_accuracy: 0.7565  
Epoch 121/300  
7/7 [=====] - ETA: 0s - loss: 0.3512 - accuracy: 0.7676  
Epoch 121: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 769ms/step - loss: 0.3512 - accuracy: 0.7676 - val\_loss: 0.4880 - val\_accuracy: 0.7824  
Epoch 122/300  
7/7 [=====] - ETA: 0s - loss: 0.3284 - accuracy: 0.7799  
Epoch 122: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 777ms/step - loss: 0.3284 - accuracy: 0.7799 - val\_loss: 0.4148 - val\_accuracy: 0.8238  
Epoch 123/300  
7/7 [=====] - ETA: 0s - loss: 0.3164 - accuracy: 0.7966  
Epoch 123: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 793ms/step - loss: 0.3164 - accuracy: 0.7966 - val\_loss: 0.4650 - val\_accuracy: 0.8187  
Epoch 124/300  
7/7 [=====] - ETA: 0s - loss: 0.3140 - accuracy: 0.8045  
Epoch 124: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 783ms/step - loss: 0.3140 - accuracy: 0.8045 - val\_loss: 0.5437 - val\_accuracy: 0.7565  
Epoch 125/300  
7/7 [=====] - ETA: 0s - loss: 0.3441 - accuracy: 0.7944  
Epoch 125: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 781ms/step - loss: 0.3441 - accuracy: 0.7944 - val\_loss: 0.4449 - val\_accuracy: 0.8238  
Epoch 126/300  
7/7 [=====] - ETA: 0s - loss: 0.3597 - accuracy: 0.7777  
Epoch 126: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 778ms/step - loss: 0.3597 - accuracy: 0.7777 - val\_loss: 0.4330 - val\_accuracy: 0.7927  
Epoch 127/300  
7/7 [=====] - ETA: 0s - loss: 0.3387 - accuracy: 0.7732  
Epoch 127: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 776ms/step - loss: 0.3387 - accuracy: 0.7732 - val\_loss: 0.4927 - val\_accuracy: 0.7876  
Epoch 128/300  
7/7 [=====] - ETA: 0s - loss: 0.3295 - accuracy: 0.7911  
Epoch 128: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 780ms/step - loss: 0.3295 - accuracy: 0.7911 - val\_loss: 0.4619 - val\_accuracy: 0.8187  
Epoch 129/300  
7/7 [=====] - ETA: 0s - loss: 0.3133 - accuracy: 0.7788  
Epoch 129: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 796ms/step - loss: 0.3133 - accuracy: 0.7788 - val\_loss: 0.4038 - val\_accuracy: 0.8187  
Epoch 130/300  
7/7 [=====] - ETA: 0s - loss: 0.3620 - accuracy: 0.7966  
Epoch 130: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 802ms/step - loss: 0.3620 - accuracy: 0.7966 - val\_loss: 0.4124 - val\_accuracy: 0.8342  
Epoch 131/300  
7/7 [=====] - ETA: 0s - loss: 0.3313 - accuracy: 0.8011  
Epoch 131: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 814ms/step - loss: 0.3313 - accuracy: 0.8011 - val\_loss: 0.4965 - val\_accuracy: 0.7668  
Epoch 132/300  
7/7 [=====] - ETA: 0s - loss: 0.2757 - accuracy: 0.8302  
Epoch 132: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 808ms/step - loss: 0.2757 - accuracy: 0.8302 - val\_loss: 0.4530 - val\_accuracy: 0.7927  
Epoch 133/300  
7/7 [=====] - ETA: 0s - loss: 0.2867 - accuracy: 0.8112  
Epoch 133: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 770ms/step - loss: 0.2867 - accuracy: 0.8112 - val\_loss: 0.4220 - val\_accuracy: 0.8238

Epoch 134/300  
7/7 [=====] - ETA: 0s - loss: 0.3036 - accuracy: 0.8067  
Epoch 134: val\_accuracy improved from 0.83420 to 0.84456, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 777ms/step - loss: 0.3036 - accuracy: 0.8067 - val\_loss: 0.3765 - val\_accuracy: 0.8446  
Epoch 135/300  
7/7 [=====] - ETA: 0s - loss: 0.2992 - accuracy: 0.8045  
Epoch 135: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 8s 1s/step - loss: 0.2992 - accuracy: 0.8045 - val\_loss: 0.4631 - val\_accuracy: 0.8083  
Epoch 136/300  
7/7 [=====] - ETA: 0s - loss: 0.2812 - accuracy: 0.8045  
Epoch 136: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 803ms/step - loss: 0.2812 - accuracy: 0.8045 - val\_loss: 0.4392 - val\_accuracy: 0.7979  
Epoch 137/300  
7/7 [=====] - ETA: 0s - loss: 0.2675 - accuracy: 0.8268  
Epoch 137: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 5s 789ms/step - loss: 0.2675 - accuracy: 0.8268 - val\_loss: 0.4405 - val\_accuracy: 0.8187  
Epoch 138/300  
7/7 [=====] - ETA: 0s - loss: 0.2561 - accuracy: 0.8324  
Epoch 138: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 808ms/step - loss: 0.2561 - accuracy: 0.8324 - val\_loss: 0.4666 - val\_accuracy: 0.7927  
Epoch 139/300  
7/7 [=====] - ETA: 0s - loss: 0.2574 - accuracy: 0.8257  
Epoch 139: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 5s 774ms/step - loss: 0.2574 - accuracy: 0.8257 - val\_loss: 0.4432 - val\_accuracy: 0.8031  
Epoch 140/300  
7/7 [=====] - ETA: 0s - loss: 0.2795 - accuracy: 0.8302  
Epoch 140: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 800ms/step - loss: 0.2795 - accuracy: 0.8302 - val\_loss: 0.3942 - val\_accuracy: 0.8290  
Epoch 141/300  
7/7 [=====] - ETA: 0s - loss: 0.2878 - accuracy: 0.8291  
Epoch 141: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 821ms/step - loss: 0.2878 - accuracy: 0.8291 - val\_loss: 0.4209 - val\_accuracy: 0.8187  
Epoch 142/300  
7/7 [=====] - ETA: 0s - loss: 0.2853 - accuracy: 0.8223  
Epoch 142: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 801ms/step - loss: 0.2853 - accuracy: 0.8223 - val\_loss: 0.3890 - val\_accuracy: 0.8238  
Epoch 143/300  
7/7 [=====] - ETA: 0s - loss: 0.2573 - accuracy: 0.8223  
Epoch 143: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 5s 797ms/step - loss: 0.2573 - accuracy: 0.8223 - val\_loss: 0.4705 - val\_accuracy: 0.8083  
Epoch 144/300  
7/7 [=====] - ETA: 0s - loss: 0.2923 - accuracy: 0.8000  
Epoch 144: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 5s 775ms/step - loss: 0.2923 - accuracy: 0.8000 - val\_loss: 0.4289 - val\_accuracy: 0.8342  
Epoch 145/300  
7/7 [=====] - ETA: 0s - loss: 0.2599 - accuracy: 0.8313  
Epoch 145: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 5s 781ms/step - loss: 0.2599 - accuracy: 0.8313 - val\_loss: 0.4943 - val\_accuracy: 0.7824  
Epoch 146/300  
7/7 [=====] - ETA: 0s - loss: 0.2587 - accuracy: 0.8123  
Epoch 146: val\_accuracy improved from 0.84456 to 0.84974, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 772ms/step - loss: 0.2587 - accuracy: 0.8123 - val\_loss: 0.3860 - val\_accuracy: 0.8497  
Epoch 147/300  
7/7 [=====] - ETA: 0s - loss: 0.2731 - accuracy: 0.8212  
Epoch 147: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 5s 767ms/step - loss: 0.2731 - accuracy: 0.8212 - val\_loss: 0.3839 - val\_accuracy: 0.8446  
Epoch 148/300  
7/7 [=====] - ETA: 0s - loss: 0.2782 - accuracy: 0.8335  
Epoch 148: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 808ms/step - loss: 0.2782 - accuracy: 0.8335 - val\_loss: 0.4458 - val\_accuracy: 0.8238  
Epoch 149/300  
7/7 [=====] - ETA: 0s - loss: 0.2465 - accuracy: 0.8436  
Epoch 149: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 799ms/step - loss: 0.2465 - accuracy: 0.8436 - val\_loss: 0.4494 - val\_accuracy: 0.7565  
Epoch 150/300  
7/7 [=====] - ETA: 0s - loss: 0.2621 - accuracy: 0.8492  
Epoch 150: val\_accuracy did not improve from 0.84974



7/7 [=====] - 6s 817ms/step - loss: 0.2621 - accuracy: 0.8492 - val\_loss: 0.4957 - val\_accuracy: 0.7617  
Epoch 151/300  
7/7 [=====] - ETA: 0s - loss: 0.2732 - accuracy: 0.8145  
Epoch 151: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 837ms/step - loss: 0.2732 - accuracy: 0.8145 - val\_loss: 0.4583 - val\_accuracy: 0.7772  
Epoch 152/300  
7/7 [=====] - ETA: 0s - loss: 0.2471 - accuracy: 0.8346  
Epoch 152: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 812ms/step - loss: 0.2471 - accuracy: 0.8346 - val\_loss: 0.3959 - val\_accuracy: 0.8238  
Epoch 153/300  
7/7 [=====] - ETA: 0s - loss: 0.2239 - accuracy: 0.8436  
Epoch 153: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 828ms/step - loss: 0.2239 - accuracy: 0.8436 - val\_loss: 0.3535 - val\_accuracy: 0.8497  
Epoch 154/300  
7/7 [=====] - ETA: 0s - loss: 0.2286 - accuracy: 0.8503  
Epoch 154: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 802ms/step - loss: 0.2286 - accuracy: 0.8503 - val\_loss: 0.3858 - val\_accuracy: 0.8342  
Epoch 155/300  
7/7 [=====] - ETA: 0s - loss: 0.2196 - accuracy: 0.8559  
Epoch 155: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 805ms/step - loss: 0.2196 - accuracy: 0.8559 - val\_loss: 0.4140 - val\_accuracy: 0.8342  
Epoch 156/300  
7/7 [=====] - ETA: 0s - loss: 0.2341 - accuracy: 0.8592  
Epoch 156: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 5s 761ms/step - loss: 0.2341 - accuracy: 0.8592 - val\_loss: 0.4789 - val\_accuracy: 0.7927  
Epoch 157/300  
7/7 [=====] - ETA: 0s - loss: 0.2113 - accuracy: 0.8559  
Epoch 157: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 826ms/step - loss: 0.2113 - accuracy: 0.8559 - val\_loss: 0.4171 - val\_accuracy: 0.8031  
Epoch 158/300  
7/7 [=====] - ETA: 0s - loss: 0.2148 - accuracy: 0.8603  
Epoch 158: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 816ms/step - loss: 0.2148 - accuracy: 0.8603 - val\_loss: 0.4636 - val\_accuracy: 0.7979  
Epoch 159/300  
7/7 [=====] - ETA: 0s - loss: 0.2553 - accuracy: 0.8324  
Epoch 159: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 847ms/step - loss: 0.2553 - accuracy: 0.8324 - val\_loss: 0.5050 - val\_accuracy: 0.7824  
Epoch 160/300  
7/7 [=====] - ETA: 0s - loss: 0.2559 - accuracy: 0.8369  
Epoch 160: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 11s 2s/step - loss: 0.2559 - accuracy: 0.8369 - val\_loss: 0.4242 - val\_accuracy: 0.8342  
Epoch 161/300  
7/7 [=====] - ETA: 0s - loss: 0.2648 - accuracy: 0.8235  
Epoch 161: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 810ms/step - loss: 0.2648 - accuracy: 0.8235 - val\_loss: 0.4397 - val\_accuracy: 0.8342  
Epoch 162/300  
7/7 [=====] - ETA: 0s - loss: 0.2554 - accuracy: 0.8425  
Epoch 162: val\_accuracy improved from 0.84974 to 0.87047, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 821ms/step - loss: 0.2554 - accuracy: 0.8425 - val\_loss: 0.3259 - val\_accuracy: 0.8705  
Epoch 163/300  
7/7 [=====] - ETA: 0s - loss: 0.2394 - accuracy: 0.8246  
Epoch 163: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 784ms/step - loss: 0.2394 - accuracy: 0.8246 - val\_loss: 0.3048 - val\_accuracy: 0.8705  
Epoch 164/300  
7/7 [=====] - ETA: 0s - loss: 0.2952 - accuracy: 0.8145  
Epoch 164: val\_accuracy improved from 0.87047 to 0.88083, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 807ms/step - loss: 0.2952 - accuracy: 0.8145 - val\_loss: 0.3388 - val\_accuracy: 0.8808  
Epoch 165/300  
7/7 [=====] - ETA: 0s - loss: 0.3092 - accuracy: 0.7966  
Epoch 165: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 793ms/step - loss: 0.3092 - accuracy: 0.7966 - val\_loss: 0.4904 - val\_accuracy: 0.7979  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.2958 - accuracy: 0.8358  
Epoch 166: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 5s 780ms/step - loss: 0.2958 - accuracy: 0.8358 - val\_loss: 0.6144 - val\_accuracy: 0.7358  
Epoch 167/300

7/7 [=====] - ETA: 0s - loss: 0.2876 - accuracy: 0.8302  
Epoch 167: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 796ms/step - loss: 0.2876 - accuracy: 0.8302 - val\_loss: 0.3986 - val\_accuracy: 0.8187  
Epoch 168/300  
7/7 [=====] - ETA: 0s - loss: 0.2275 - accuracy: 0.8257  
Epoch 168: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 5s 795ms/step - loss: 0.2275 - accuracy: 0.8257 - val\_loss: 0.2966 - val\_accuracy: 0.8756  
Epoch 169/300  
7/7 [=====] - ETA: 0s - loss: 0.2377 - accuracy: 0.8480  
Epoch 169: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 809ms/step - loss: 0.2377 - accuracy: 0.8480 - val\_loss: 0.4306 - val\_accuracy: 0.8394  
Epoch 170/300  
7/7 [=====] - ETA: 0s - loss: 0.2354 - accuracy: 0.8447  
Epoch 170: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 808ms/step - loss: 0.2354 - accuracy: 0.8447 - val\_loss: 0.3329 - val\_accuracy: 0.8549  
Epoch 171/300  
7/7 [=====] - ETA: 0s - loss: 0.2407 - accuracy: 0.8458  
Epoch 171: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 7s 1s/step - loss: 0.2407 - accuracy: 0.8458 - val\_loss: 0.3643 - val\_accuracy: 0.8653  
Epoch 172/300  
7/7 [=====] - ETA: 0s - loss: 0.2192 - accuracy: 0.8704  
Epoch 172: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 770ms/step - loss: 0.2192 - accuracy: 0.8704 - val\_loss: 0.3388 - val\_accuracy: 0.8756  
Epoch 173/300  
7/7 [=====] - ETA: 0s - loss: 0.1894 - accuracy: 0.8872  
Epoch 173: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 5s 781ms/step - loss: 0.1894 - accuracy: 0.8872 - val\_loss: 0.4648 - val\_accuracy: 0.8342  
Epoch 174/300  
7/7 [=====] - ETA: 0s - loss: 0.2361 - accuracy: 0.8581  
Epoch 174: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 797ms/step - loss: 0.2361 - accuracy: 0.8581 - val\_loss: 0.4667 - val\_accuracy: 0.7979  
Epoch 175/300  
7/7 [=====] - ETA: 0s - loss: 0.2239 - accuracy: 0.8704  
Epoch 175: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 5s 770ms/step - loss: 0.2239 - accuracy: 0.8704 - val\_loss: 0.3657 - val\_accuracy: 0.8446  
Epoch 176/300  
7/7 [=====] - ETA: 0s - loss: 0.2057 - accuracy: 0.8603  
Epoch 176: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 5s 780ms/step - loss: 0.2057 - accuracy: 0.8603 - val\_loss: 0.4137 - val\_accuracy: 0.7979  
Epoch 177/300  
7/7 [=====] - ETA: 0s - loss: 0.2052 - accuracy: 0.8793  
Epoch 177: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 795ms/step - loss: 0.2052 - accuracy: 0.8793 - val\_loss: 0.6012 - val\_accuracy: 0.7306  
Epoch 178/300  
7/7 [=====] - ETA: 0s - loss: 0.2081 - accuracy: 0.8559  
Epoch 178: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 808ms/step - loss: 0.2081 - accuracy: 0.8559 - val\_loss: 0.4169 - val\_accuracy: 0.8031  
Epoch 179/300  
7/7 [=====] - ETA: 0s - loss: 0.1875 - accuracy: 0.8916  
Epoch 179: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 943ms/step - loss: 0.1875 - accuracy: 0.8916 - val\_loss: 0.4474 - val\_accuracy: 0.7979  
Epoch 180/300  
7/7 [=====] - ETA: 0s - loss: 0.2299 - accuracy: 0.8514  
Epoch 180: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 5s 787ms/step - loss: 0.2299 - accuracy: 0.8514 - val\_loss: 0.5094 - val\_accuracy: 0.7513  
Epoch 181/300  
7/7 [=====] - ETA: 0s - loss: 0.2273 - accuracy: 0.8503  
Epoch 181: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 805ms/step - loss: 0.2273 - accuracy: 0.8503 - val\_loss: 0.4210 - val\_accuracy: 0.8290  
Epoch 182/300  
7/7 [=====] - ETA: 0s - loss: 0.2094 - accuracy: 0.8626  
Epoch 182: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 820ms/step - loss: 0.2094 - accuracy: 0.8626 - val\_loss: 0.2913 - val\_accuracy: 0.8756  
Epoch 183/300  
7/7 [=====] - ETA: 0s - loss: 0.1669 - accuracy: 0.8838  
Epoch 183: val\_accuracy improved from 0.88083 to 0.90155, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 811ms/step - loss: 0.1669 - accuracy: 0.8838 - val\_loss: 0

.2739 - val\_accuracy: 0.9016  
Epoch 184/300  
7/7 [=====] - ETA: 0s - loss: 0.1878 - accuracy: 0.8682  
Epoch 184: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 801ms/step - loss: 0.1878 - accuracy: 0.8682 - val\_loss: 0.3084 - val\_accuracy: 0.8705  
Epoch 185/300  
7/7 [=====] - ETA: 0s - loss: 0.1817 - accuracy: 0.8860  
Epoch 185: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 5s 791ms/step - loss: 0.1817 - accuracy: 0.8860 - val\_loss: 0.3773 - val\_accuracy: 0.8497  
Epoch 186/300  
7/7 [=====] - ETA: 0s - loss: 0.1722 - accuracy: 0.9028  
Epoch 186: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 809ms/step - loss: 0.1722 - accuracy: 0.9028 - val\_loss: 0.3252 - val\_accuracy: 0.8705  
Epoch 187/300  
7/7 [=====] - ETA: 0s - loss: 0.1700 - accuracy: 0.8816  
Epoch 187: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 814ms/step - loss: 0.1700 - accuracy: 0.8816 - val\_loss: 0.3419 - val\_accuracy: 0.8290  
Epoch 188/300  
7/7 [=====] - ETA: 0s - loss: 0.1783 - accuracy: 0.8916  
Epoch 188: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 837ms/step - loss: 0.1783 - accuracy: 0.8916 - val\_loss: 0.3176 - val\_accuracy: 0.8756  
Epoch 189/300  
7/7 [=====] - ETA: 0s - loss: 0.1493 - accuracy: 0.9140  
Epoch 189: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 7s 1s/step - loss: 0.1493 - accuracy: 0.9140 - val\_loss: 0.3393 - val\_accuracy: 0.8549  
Epoch 190/300  
7/7 [=====] - ETA: 0s - loss: 0.1699 - accuracy: 0.8983  
Epoch 190: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 9s 1s/step - loss: 0.1699 - accuracy: 0.8983 - val\_loss: 0.3444 - val\_accuracy: 0.8705  
Epoch 191/300  
7/7 [=====] - ETA: 0s - loss: 0.1727 - accuracy: 0.8916  
Epoch 191: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 808ms/step - loss: 0.1727 - accuracy: 0.8916 - val\_loss: 0.4341 - val\_accuracy: 0.8394  
Epoch 192/300  
7/7 [=====] - ETA: 0s - loss: 0.2230 - accuracy: 0.8581  
Epoch 192: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 5s 776ms/step - loss: 0.2230 - accuracy: 0.8581 - val\_loss: 0.3833 - val\_accuracy: 0.8497  
Epoch 193/300  
7/7 [=====] - ETA: 0s - loss: 0.2005 - accuracy: 0.8771  
Epoch 193: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 5s 777ms/step - loss: 0.2005 - accuracy: 0.8771 - val\_loss: 0.3113 - val\_accuracy: 0.8756  
Epoch 194/300  
7/7 [=====] - ETA: 0s - loss: 0.1735 - accuracy: 0.8849  
Epoch 194: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 795ms/step - loss: 0.1735 - accuracy: 0.8849 - val\_loss: 0.3295 - val\_accuracy: 0.8549  
Epoch 195/300  
7/7 [=====] - ETA: 0s - loss: 0.1268 - accuracy: 0.9196  
Epoch 195: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 814ms/step - loss: 0.1268 - accuracy: 0.9196 - val\_loss: 0.3556 - val\_accuracy: 0.8497  
Epoch 196/300  
7/7 [=====] - ETA: 0s - loss: 0.1377 - accuracy: 0.9218  
Epoch 196: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 5s 789ms/step - loss: 0.1377 - accuracy: 0.9218 - val\_loss: 0.3382 - val\_accuracy: 0.8549  
Epoch 197/300  
7/7 [=====] - ETA: 0s - loss: 0.1358 - accuracy: 0.9196  
Epoch 197: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 802ms/step - loss: 0.1358 - accuracy: 0.9196 - val\_loss: 0.2700 - val\_accuracy: 0.8964  
Epoch 198/300  
7/7 [=====] - ETA: 0s - loss: 0.1569 - accuracy: 0.8961  
Epoch 198: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 5s 792ms/step - loss: 0.1569 - accuracy: 0.8961 - val\_loss: 0.2624 - val\_accuracy: 0.8964  
Epoch 199/300  
7/7 [=====] - ETA: 0s - loss: 0.1930 - accuracy: 0.8804  
Epoch 199: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 794ms/step - loss: 0.1930 - accuracy: 0.8804 - val\_loss: 0.3187 - val\_accuracy: 0.8705  
Epoch 200/300  
7/7 [=====] - ETA: 0s - loss: 0.1888 - accuracy: 0.8838

Epoch 200: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 5s 784ms/step - loss: 0.1888 - accuracy: 0.8838 - val\_loss: 0.4067 - val\_accuracy: 0.8342  
Epoch 201/300  
7/7 [=====] - ETA: 0s - loss: 0.1683 - accuracy: 0.8860  
Epoch 201: val\_accuracy improved from 0.90155 to 0.90674, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 775ms/step - loss: 0.1683 - accuracy: 0.8860 - val\_loss: 0.2699 - val\_accuracy: 0.9067  
Epoch 202/300  
7/7 [=====] - ETA: 0s - loss: 0.1525 - accuracy: 0.8994  
Epoch 202: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 5s 766ms/step - loss: 0.1525 - accuracy: 0.8994 - val\_loss: 0.2844 - val\_accuracy: 0.8964  
Epoch 203/300  
7/7 [=====] - ETA: 0s - loss: 0.1359 - accuracy: 0.9240  
Epoch 203: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 5s 784ms/step - loss: 0.1359 - accuracy: 0.9240 - val\_loss: 0.3850 - val\_accuracy: 0.8549  
Epoch 204/300  
7/7 [=====] - ETA: 0s - loss: 0.1541 - accuracy: 0.9128  
Epoch 204: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 5s 765ms/step - loss: 0.1541 - accuracy: 0.9128 - val\_loss: 0.4240 - val\_accuracy: 0.8135  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.1897 - accuracy: 0.8916  
Epoch 205: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 5s 756ms/step - loss: 0.1897 - accuracy: 0.8916 - val\_loss: 0.5358 - val\_accuracy: 0.7617  
Epoch 206/300  
7/7 [=====] - ETA: 0s - loss: 0.2465 - accuracy: 0.8402  
Epoch 206: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 5s 782ms/step - loss: 0.2465 - accuracy: 0.8402 - val\_loss: 0.5567 - val\_accuracy: 0.7772  
Epoch 207/300  
7/7 [=====] - ETA: 0s - loss: 0.2632 - accuracy: 0.8335  
Epoch 207: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 7s 1s/step - loss: 0.2632 - accuracy: 0.8335 - val\_loss: 0.3379 - val\_accuracy: 0.8964  
Epoch 208/300  
7/7 [=====] - ETA: 0s - loss: 0.2060 - accuracy: 0.8559  
Epoch 208: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 811ms/step - loss: 0.2060 - accuracy: 0.8559 - val\_loss: 0.2686 - val\_accuracy: 0.8912  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.1569 - accuracy: 0.8983  
Epoch 209: val\_accuracy improved from 0.90674 to 0.91192, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 819ms/step - loss: 0.1569 - accuracy: 0.8983 - val\_loss: 0.2831 - val\_accuracy: 0.9119  
Epoch 210/300  
7/7 [=====] - ETA: 0s - loss: 0.1655 - accuracy: 0.8894  
Epoch 210: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 791ms/step - loss: 0.1655 - accuracy: 0.8894 - val\_loss: 0.3358 - val\_accuracy: 0.8653  
Epoch 211/300  
7/7 [=====] - ETA: 0s - loss: 0.1425 - accuracy: 0.9073  
Epoch 211: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 795ms/step - loss: 0.1425 - accuracy: 0.9073 - val\_loss: 0.3446 - val\_accuracy: 0.8808  
Epoch 212/300  
7/7 [=====] - ETA: 0s - loss: 0.1378 - accuracy: 0.9061  
Epoch 212: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 802ms/step - loss: 0.1378 - accuracy: 0.9061 - val\_loss: 0.2411 - val\_accuracy: 0.9016  
Epoch 213/300  
7/7 [=====] - ETA: 0s - loss: 0.1294 - accuracy: 0.9274  
Epoch 213: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 792ms/step - loss: 0.1294 - accuracy: 0.9274 - val\_loss: 0.2419 - val\_accuracy: 0.8964  
Epoch 214/300  
7/7 [=====] - ETA: 0s - loss: 0.1175 - accuracy: 0.9229  
Epoch 214: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 806ms/step - loss: 0.1175 - accuracy: 0.9229 - val\_loss: 0.2860 - val\_accuracy: 0.8860  
Epoch 215/300  
7/7 [=====] - ETA: 0s - loss: 0.1152 - accuracy: 0.9341  
Epoch 215: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 10s 1s/step - loss: 0.1152 - accuracy: 0.9341 - val\_loss: 0.2641 - val\_accuracy: 0.8964  
Epoch 216/300  
7/7 [=====] - ETA: 0s - loss: 0.1152 - accuracy: 0.9385  
Epoch 216: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 13s 2s/step - loss: 0.1152 - accuracy: 0.9385 - val\_loss: 0.2730 - val\_accuracy: 0.8912

Epoch 217/300  
7/7 [=====] - ETA: 0s - loss: 0.1669 - accuracy: 0.9084  
Epoch 217: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 7s 1s/step - loss: 0.1669 - accuracy: 0.9084 - val\_loss: 0.2763 - val\_accuracy: 0.8860  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.1414 - accuracy: 0.9128  
Epoch 218: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 762ms/step - loss: 0.1414 - accuracy: 0.9128 - val\_loss: 0.2758 - val\_accuracy: 0.8964  
Epoch 219/300  
7/7 [=====] - ETA: 0s - loss: 0.1257 - accuracy: 0.9285  
Epoch 219: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 791ms/step - loss: 0.1257 - accuracy: 0.9285 - val\_loss: 0.4059 - val\_accuracy: 0.8446  
Epoch 220/300  
7/7 [=====] - ETA: 0s - loss: 0.1198 - accuracy: 0.9330  
Epoch 220: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 794ms/step - loss: 0.1198 - accuracy: 0.9330 - val\_loss: 0.3471 - val\_accuracy: 0.8653  
Epoch 221/300  
7/7 [=====] - ETA: 0s - loss: 0.1186 - accuracy: 0.9263  
Epoch 221: val\_accuracy improved from 0.91192 to 0.91710, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 811ms/step - loss: 0.1186 - accuracy: 0.9263 - val\_loss: 0.2475 - val\_accuracy: 0.9171  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.1143 - accuracy: 0.9196  
Epoch 222: val\_accuracy did not improve from 0.91710  
7/7 [=====] - 6s 813ms/step - loss: 0.1143 - accuracy: 0.9196 - val\_loss: 0.3327 - val\_accuracy: 0.8549  
Epoch 223/300  
7/7 [=====] - ETA: 0s - loss: 0.1135 - accuracy: 0.9352  
Epoch 223: val\_accuracy did not improve from 0.91710  
7/7 [=====] - 6s 791ms/step - loss: 0.1135 - accuracy: 0.9352 - val\_loss: 0.3309 - val\_accuracy: 0.8860  
Epoch 224/300  
7/7 [=====] - ETA: 0s - loss: 0.1192 - accuracy: 0.9240  
Epoch 224: val\_accuracy did not improve from 0.91710  
7/7 [=====] - 6s 811ms/step - loss: 0.1192 - accuracy: 0.9240 - val\_loss: 0.3826 - val\_accuracy: 0.8394  
Epoch 225/300  
7/7 [=====] - ETA: 0s - loss: 0.1152 - accuracy: 0.9218  
Epoch 225: val\_accuracy did not improve from 0.91710  
7/7 [=====] - 6s 792ms/step - loss: 0.1152 - accuracy: 0.9218 - val\_loss: 0.3291 - val\_accuracy: 0.8653  
Epoch 226/300  
7/7 [=====] - ETA: 0s - loss: 0.1126 - accuracy: 0.9296  
Epoch 226: val\_accuracy did not improve from 0.91710  
7/7 [=====] - 5s 767ms/step - loss: 0.1126 - accuracy: 0.9296 - val\_loss: 0.2974 - val\_accuracy: 0.8964  
Epoch 227/300  
7/7 [=====] - ETA: 0s - loss: 0.1020 - accuracy: 0.9397  
Epoch 227: val\_accuracy improved from 0.91710 to 0.92746, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 810ms/step - loss: 0.1020 - accuracy: 0.9397 - val\_loss: 0.2264 - val\_accuracy: 0.9275  
Epoch 228/300  
7/7 [=====] - ETA: 0s - loss: 0.0810 - accuracy: 0.9486  
Epoch 228: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 6s 808ms/step - loss: 0.0810 - accuracy: 0.9486 - val\_loss: 0.2459 - val\_accuracy: 0.9223  
Epoch 229/300  
7/7 [=====] - ETA: 0s - loss: 0.0976 - accuracy: 0.9330  
Epoch 229: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 6s 816ms/step - loss: 0.0976 - accuracy: 0.9330 - val\_loss: 0.2696 - val\_accuracy: 0.8808  
Epoch 230/300  
7/7 [=====] - ETA: 0s - loss: 0.1383 - accuracy: 0.9296  
Epoch 230: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 6s 814ms/step - loss: 0.1383 - accuracy: 0.9296 - val\_loss: 0.4008 - val\_accuracy: 0.8808  
Epoch 231/300  
7/7 [=====] - ETA: 0s - loss: 0.1833 - accuracy: 0.9106  
Epoch 231: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 6s 804ms/step - loss: 0.1833 - accuracy: 0.9106 - val\_loss: 0.3560 - val\_accuracy: 0.8912  
Epoch 232/300  
7/7 [=====] - ETA: 0s - loss: 0.2124 - accuracy: 0.9128  
Epoch 232: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 5s 776ms/step - loss: 0.2124 - accuracy: 0.9128 - val\_loss: 0.3223 - val\_accuracy: 0.8756  
Epoch 233/300  
7/7 [=====] - ETA: 0s - loss: 0.1465 - accuracy: 0.9307  
Epoch 233: val\_accuracy did not improve from 0.92746

7/7 [=====] - 6s 805ms/step - loss: 0.1465 - accuracy: 0.9307 - val\_loss: 0.3533 - val\_accuracy: 0.8497  
Epoch 234/300  
7/7 [=====] - ETA: 0s - loss: 0.1410 - accuracy: 0.8927  
Epoch 234: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 5s 766ms/step - loss: 0.1410 - accuracy: 0.8927 - val\_loss: 0.2380 - val\_accuracy: 0.9119  
Epoch 235/300  
7/7 [=====] - ETA: 0s - loss: 0.1238 - accuracy: 0.9374  
Epoch 235: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 5s 781ms/step - loss: 0.1238 - accuracy: 0.9374 - val\_loss: 0.2918 - val\_accuracy: 0.8964  
Epoch 236/300  
7/7 [=====] - ETA: 0s - loss: 0.1023 - accuracy: 0.9497  
Epoch 236: val\_accuracy did not improve from 0.92746  
7/7 [=====] - 5s 772ms/step - loss: 0.1023 - accuracy: 0.9497 - val\_loss: 0.3152 - val\_accuracy: 0.9067  
Epoch 237/300  
7/7 [=====] - ETA: 0s - loss: 0.1102 - accuracy: 0.9307  
Epoch 237: val\_accuracy improved from 0.92746 to 0.94819, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 809ms/step - loss: 0.1102 - accuracy: 0.9307 - val\_loss: 0.2115 - val\_accuracy: 0.9482  
Epoch 238/300  
7/7 [=====] - ETA: 0s - loss: 0.0847 - accuracy: 0.9508  
Epoch 238: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 810ms/step - loss: 0.0847 - accuracy: 0.9508 - val\_loss: 0.2354 - val\_accuracy: 0.9171  
Epoch 239/300  
7/7 [=====] - ETA: 0s - loss: 0.1010 - accuracy: 0.9453  
Epoch 239: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 789ms/step - loss: 0.1010 - accuracy: 0.9453 - val\_loss: 0.2658 - val\_accuracy: 0.9119  
Epoch 240/300  
7/7 [=====] - ETA: 0s - loss: 0.1599 - accuracy: 0.9229  
Epoch 240: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 786ms/step - loss: 0.1599 - accuracy: 0.9229 - val\_loss: 0.2918 - val\_accuracy: 0.8964  
Epoch 241/300  
7/7 [=====] - ETA: 0s - loss: 0.1174 - accuracy: 0.9374  
Epoch 241: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 857ms/step - loss: 0.1174 - accuracy: 0.9374 - val\_loss: 0.4497 - val\_accuracy: 0.8187  
Epoch 242/300  
7/7 [=====] - ETA: 0s - loss: 0.1191 - accuracy: 0.9307  
Epoch 242: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 7s 955ms/step - loss: 0.1191 - accuracy: 0.9307 - val\_loss: 0.4876 - val\_accuracy: 0.8187  
Epoch 243/300  
7/7 [=====] - ETA: 0s - loss: 0.1183 - accuracy: 0.9318  
Epoch 243: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 810ms/step - loss: 0.1183 - accuracy: 0.9318 - val\_loss: 0.3133 - val\_accuracy: 0.8808  
Epoch 244/300  
7/7 [=====] - ETA: 0s - loss: 0.1102 - accuracy: 0.9274  
Epoch 244: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 793ms/step - loss: 0.1102 - accuracy: 0.9274 - val\_loss: 0.2529 - val\_accuracy: 0.9016  
Epoch 245/300  
7/7 [=====] - ETA: 0s - loss: 0.0927 - accuracy: 0.9251  
Epoch 245: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 779ms/step - loss: 0.0927 - accuracy: 0.9251 - val\_loss: 0.2074 - val\_accuracy: 0.9378  
Epoch 246/300  
7/7 [=====] - ETA: 0s - loss: 0.1077 - accuracy: 0.9274  
Epoch 246: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 810ms/step - loss: 0.1077 - accuracy: 0.9274 - val\_loss: 0.2871 - val\_accuracy: 0.8860  
Epoch 247/300  
7/7 [=====] - ETA: 0s - loss: 0.0959 - accuracy: 0.9408  
Epoch 247: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 801ms/step - loss: 0.0959 - accuracy: 0.9408 - val\_loss: 0.2252 - val\_accuracy: 0.9275  
Epoch 248/300  
7/7 [=====] - ETA: 0s - loss: 0.0756 - accuracy: 0.9520  
Epoch 248: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 807ms/step - loss: 0.0756 - accuracy: 0.9520 - val\_loss: 0.2845 - val\_accuracy: 0.9016  
Epoch 249/300  
7/7 [=====] - ETA: 0s - loss: 0.0895 - accuracy: 0.9397  
Epoch 249: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 783ms/step - loss: 0.0895 - accuracy: 0.9397 - val\_loss: 0.2988 - val\_accuracy: 0.8964  
Epoch 250/300

7/7 [=====] - ETA: 0s - loss: 0.0749 - accuracy: 0.9575  
Epoch 250: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 781ms/step - loss: 0.0749 - accuracy: 0.9575 - val\_loss: 0  
.2890 - val\_accuracy: 0.8808  
Epoch 251/300  
7/7 [=====] - ETA: 0s - loss: 0.0732 - accuracy: 0.9497  
Epoch 251: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 813ms/step - loss: 0.0732 - accuracy: 0.9497 - val\_loss: 0  
.2382 - val\_accuracy: 0.9067  
Epoch 252/300  
7/7 [=====] - ETA: 0s - loss: 0.0644 - accuracy: 0.9676  
Epoch 252: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 807ms/step - loss: 0.0644 - accuracy: 0.9676 - val\_loss: 0  
.2217 - val\_accuracy: 0.9223  
Epoch 253/300  
7/7 [=====] - ETA: 0s - loss: 0.0719 - accuracy: 0.9620  
Epoch 253: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 803ms/step - loss: 0.0719 - accuracy: 0.9620 - val\_loss: 0  
.3276 - val\_accuracy: 0.8964  
Epoch 254/300  
7/7 [=====] - ETA: 0s - loss: 0.0957 - accuracy: 0.9341  
Epoch 254: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 774ms/step - loss: 0.0957 - accuracy: 0.9341 - val\_loss: 0  
.2752 - val\_accuracy: 0.9067  
Epoch 255/300  
7/7 [=====] - ETA: 0s - loss: 0.0850 - accuracy: 0.9520  
Epoch 255: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 816ms/step - loss: 0.0850 - accuracy: 0.9520 - val\_loss: 0  
.3236 - val\_accuracy: 0.8912  
Epoch 256/300  
7/7 [=====] - ETA: 0s - loss: 0.0981 - accuracy: 0.9430  
Epoch 256: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 806ms/step - loss: 0.0981 - accuracy: 0.9430 - val\_loss: 0  
.2958 - val\_accuracy: 0.8808  
Epoch 257/300  
7/7 [=====] - ETA: 0s - loss: 0.0728 - accuracy: 0.9497  
Epoch 257: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 811ms/step - loss: 0.0728 - accuracy: 0.9497 - val\_loss: 0  
.3111 - val\_accuracy: 0.8912  
Epoch 258/300  
7/7 [=====] - ETA: 0s - loss: 0.0903 - accuracy: 0.9430  
Epoch 258: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 783ms/step - loss: 0.0903 - accuracy: 0.9430 - val\_loss: 0  
.2546 - val\_accuracy: 0.9119  
Epoch 259/300  
7/7 [=====] - ETA: 0s - loss: 0.1431 - accuracy: 0.9006  
Epoch 259: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 776ms/step - loss: 0.1431 - accuracy: 0.9006 - val\_loss: 0  
.2755 - val\_accuracy: 0.8912  
Epoch 260/300  
7/7 [=====] - ETA: 0s - loss: 0.1037 - accuracy: 0.9419  
Epoch 260: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 802ms/step - loss: 0.1037 - accuracy: 0.9419 - val\_loss: 0  
.3736 - val\_accuracy: 0.8964  
Epoch 261/300  
7/7 [=====] - ETA: 0s - loss: 0.0949 - accuracy: 0.9453  
Epoch 261: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 780ms/step - loss: 0.0949 - accuracy: 0.9453 - val\_loss: 0  
.2627 - val\_accuracy: 0.8912  
Epoch 262/300  
7/7 [=====] - ETA: 0s - loss: 0.0746 - accuracy: 0.9598  
Epoch 262: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 797ms/step - loss: 0.0746 - accuracy: 0.9598 - val\_loss: 0  
.2837 - val\_accuracy: 0.9016  
Epoch 263/300  
7/7 [=====] - ETA: 0s - loss: 0.0873 - accuracy: 0.9475  
Epoch 263: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 785ms/step - loss: 0.0873 - accuracy: 0.9475 - val\_loss: 0  
.3165 - val\_accuracy: 0.8912  
Epoch 264/300  
7/7 [=====] - ETA: 0s - loss: 0.1128 - accuracy: 0.9497  
Epoch 264: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 800ms/step - loss: 0.1128 - accuracy: 0.9497 - val\_loss: 0  
.3953 - val\_accuracy: 0.8653  
Epoch 265/300  
7/7 [=====] - ETA: 0s - loss: 0.2709 - accuracy: 0.8994  
Epoch 265: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 795ms/step - loss: 0.2709 - accuracy: 0.8994 - val\_loss: 0  
.3285 - val\_accuracy: 0.9016  
Epoch 266/300  
7/7 [=====] - ETA: 0s - loss: 0.1588 - accuracy: 0.9162  
Epoch 266: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 789ms/step - loss: 0.1588 - accuracy: 0.9162 - val\_loss: 0

.2450 - val\_accuracy: 0.9171  
Epoch 267/300  
7/7 [=====] - ETA: 0s - loss: 0.1231 - accuracy: 0.9318  
Epoch 267: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 798ms/step - loss: 0.1231 - accuracy: 0.9318 - val\_loss: 0  
.2727 - val\_accuracy: 0.8912  
Epoch 268/300  
7/7 [=====] - ETA: 0s - loss: 0.1012 - accuracy: 0.9497  
Epoch 268: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 780ms/step - loss: 0.1012 - accuracy: 0.9497 - val\_loss: 0  
.4091 - val\_accuracy: 0.8653  
Epoch 269/300  
7/7 [=====] - ETA: 0s - loss: 0.1308 - accuracy: 0.9285  
Epoch 269: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 814ms/step - loss: 0.1308 - accuracy: 0.9285 - val\_loss: 0  
.2964 - val\_accuracy: 0.8964  
Epoch 270/300  
7/7 [=====] - ETA: 0s - loss: 0.0992 - accuracy: 0.9296  
Epoch 270: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 806ms/step - loss: 0.0992 - accuracy: 0.9296 - val\_loss: 0  
.1958 - val\_accuracy: 0.9275  
Epoch 271/300  
7/7 [=====] - ETA: 0s - loss: 0.1089 - accuracy: 0.9318  
Epoch 271: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 805ms/step - loss: 0.1089 - accuracy: 0.9318 - val\_loss: 0  
.3036 - val\_accuracy: 0.8964  
Epoch 272/300  
7/7 [=====] - ETA: 0s - loss: 0.0749 - accuracy: 0.9654  
Epoch 272: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 811ms/step - loss: 0.0749 - accuracy: 0.9654 - val\_loss: 0  
.2834 - val\_accuracy: 0.8860  
Epoch 273/300  
7/7 [=====] - ETA: 0s - loss: 0.0638 - accuracy: 0.9687  
Epoch 273: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 806ms/step - loss: 0.0638 - accuracy: 0.9687 - val\_loss: 0  
.2630 - val\_accuracy: 0.9119  
Epoch 274/300  
7/7 [=====] - ETA: 0s - loss: 0.0686 - accuracy: 0.9654  
Epoch 274: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 808ms/step - loss: 0.0686 - accuracy: 0.9654 - val\_loss: 0  
.3001 - val\_accuracy: 0.9067  
Epoch 275/300  
7/7 [=====] - ETA: 0s - loss: 0.0803 - accuracy: 0.9598  
Epoch 275: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 801ms/step - loss: 0.0803 - accuracy: 0.9598 - val\_loss: 0  
.2431 - val\_accuracy: 0.9171  
Epoch 276/300  
7/7 [=====] - ETA: 0s - loss: 0.0970 - accuracy: 0.9475  
Epoch 276: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 786ms/step - loss: 0.0970 - accuracy: 0.9475 - val\_loss: 0  
.2640 - val\_accuracy: 0.9119  
Epoch 277/300  
7/7 [=====] - ETA: 0s - loss: 0.0883 - accuracy: 0.9587  
Epoch 277: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 834ms/step - loss: 0.0883 - accuracy: 0.9587 - val\_loss: 0  
.2822 - val\_accuracy: 0.9067  
Epoch 278/300  
7/7 [=====] - ETA: 0s - loss: 0.0766 - accuracy: 0.9654  
Epoch 278: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 7s 1s/step - loss: 0.0766 - accuracy: 0.9654 - val\_loss: 0.25  
34 - val\_accuracy: 0.9223  
Epoch 279/300  
7/7 [=====] - ETA: 0s - loss: 0.0597 - accuracy: 0.9687  
Epoch 279: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 816ms/step - loss: 0.0597 - accuracy: 0.9687 - val\_loss: 0  
.2836 - val\_accuracy: 0.8964  
Epoch 280/300  
7/7 [=====] - ETA: 0s - loss: 0.0660 - accuracy: 0.9587  
Epoch 280: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 788ms/step - loss: 0.0660 - accuracy: 0.9587 - val\_loss: 0  
.2370 - val\_accuracy: 0.9119  
Epoch 281/300  
7/7 [=====] - ETA: 0s - loss: 0.0766 - accuracy: 0.9508  
Epoch 281: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 805ms/step - loss: 0.0766 - accuracy: 0.9508 - val\_loss: 0  
.2288 - val\_accuracy: 0.9275  
Epoch 282/300  
7/7 [=====] - ETA: 0s - loss: 0.0599 - accuracy: 0.9665  
Epoch 282: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 802ms/step - loss: 0.0599 - accuracy: 0.9665 - val\_loss: 0  
.2153 - val\_accuracy: 0.9326  
Epoch 283/300  
7/7 [=====] - ETA: 0s - loss: 0.0601 - accuracy: 0.9631



Epoch 283: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 774ms/step - loss: 0.0601 - accuracy: 0.9631 - val\_loss: 0.2574 - val\_accuracy: 0.9016  
Epoch 284/300  
7/7 [=====] - ETA: 0s - loss: 0.0793 - accuracy: 0.9486  
Epoch 284: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 808ms/step - loss: 0.0793 - accuracy: 0.9486 - val\_loss: 0.4471 - val\_accuracy: 0.8446  
Epoch 285/300  
7/7 [=====] - ETA: 0s - loss: 0.0986 - accuracy: 0.9341  
Epoch 285: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 794ms/step - loss: 0.0986 - accuracy: 0.9341 - val\_loss: 0.2051 - val\_accuracy: 0.9171  
Epoch 286/300  
7/7 [=====] - ETA: 0s - loss: 0.0935 - accuracy: 0.9430  
Epoch 286: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 793ms/step - loss: 0.0935 - accuracy: 0.9430 - val\_loss: 0.2588 - val\_accuracy: 0.8964  
Epoch 287/300  
7/7 [=====] - ETA: 0s - loss: 0.0808 - accuracy: 0.9397  
Epoch 287: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 771ms/step - loss: 0.0808 - accuracy: 0.9397 - val\_loss: 0.2839 - val\_accuracy: 0.9016  
Epoch 288/300  
7/7 [=====] - ETA: 0s - loss: 0.0765 - accuracy: 0.9486  
Epoch 288: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 788ms/step - loss: 0.0765 - accuracy: 0.9486 - val\_loss: 0.2019 - val\_accuracy: 0.9378  
Epoch 289/300  
7/7 [=====] - ETA: 0s - loss: 0.0689 - accuracy: 0.9609  
Epoch 289: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 789ms/step - loss: 0.0689 - accuracy: 0.9609 - val\_loss: 0.3236 - val\_accuracy: 0.8808  
Epoch 290/300  
7/7 [=====] - ETA: 0s - loss: 0.0743 - accuracy: 0.9564  
Epoch 290: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 792ms/step - loss: 0.0743 - accuracy: 0.9564 - val\_loss: 0.2486 - val\_accuracy: 0.9067  
Epoch 291/300  
7/7 [=====] - ETA: 0s - loss: 0.0464 - accuracy: 0.9743  
Epoch 291: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 789ms/step - loss: 0.0464 - accuracy: 0.9743 - val\_loss: 0.2267 - val\_accuracy: 0.9171  
Epoch 292/300  
7/7 [=====] - ETA: 0s - loss: 0.0522 - accuracy: 0.9620  
Epoch 292: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 796ms/step - loss: 0.0522 - accuracy: 0.9620 - val\_loss: 0.2301 - val\_accuracy: 0.9275  
Epoch 293/300  
7/7 [=====] - ETA: 0s - loss: 0.0477 - accuracy: 0.9821  
Epoch 293: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 764ms/step - loss: 0.0477 - accuracy: 0.9821 - val\_loss: 0.2406 - val\_accuracy: 0.9016  
Epoch 294/300  
7/7 [=====] - ETA: 0s - loss: 0.0567 - accuracy: 0.9721  
Epoch 294: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 806ms/step - loss: 0.0567 - accuracy: 0.9721 - val\_loss: 0.2174 - val\_accuracy: 0.9430  
Epoch 295/300  
7/7 [=====] - ETA: 0s - loss: 0.0652 - accuracy: 0.9642  
Epoch 295: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 787ms/step - loss: 0.0652 - accuracy: 0.9642 - val\_loss: 0.2458 - val\_accuracy: 0.9223  
Epoch 296/300  
7/7 [=====] - ETA: 0s - loss: 0.0526 - accuracy: 0.9609  
Epoch 296: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 5s 790ms/step - loss: 0.0526 - accuracy: 0.9609 - val\_loss: 0.1954 - val\_accuracy: 0.9223  
Epoch 297/300  
7/7 [=====] - ETA: 0s - loss: 0.0556 - accuracy: 0.9709  
Epoch 297: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 794ms/step - loss: 0.0556 - accuracy: 0.9709 - val\_loss: 0.2936 - val\_accuracy: 0.9067  
Epoch 298/300  
7/7 [=====] - ETA: 0s - loss: 0.0466 - accuracy: 0.9788  
Epoch 298: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 822ms/step - loss: 0.0466 - accuracy: 0.9788 - val\_loss: 0.2187 - val\_accuracy: 0.9430  
Epoch 299/300  
7/7 [=====] - ETA: 0s - loss: 0.0419 - accuracy: 0.9788  
Epoch 299: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 807ms/step - loss: 0.0419 - accuracy: 0.9788 - val\_loss: 0.2398 - val\_accuracy: 0.9223

Epoch 300/300  
7/7 [=====] - ETA: 0s - loss: 0.0535 - accuracy: 0.9777  
Epoch 300: val\_accuracy did not improve from 0.94819  
7/7 [=====] - 6s 807ms/step - loss: 0.0535 - accuracy: 0.9777 - val\_loss: 0.2760 - val\_accuracy: 0.9119  
Created model and loaded weights from file

In [89]:

```
results.loc[index,['Architecture','Dropout','Loss Fn','LR']] = ['CNN 2D',0.2, 'Cross-Entropy',0.0001]
```

**Evaluation: Training and Validation**

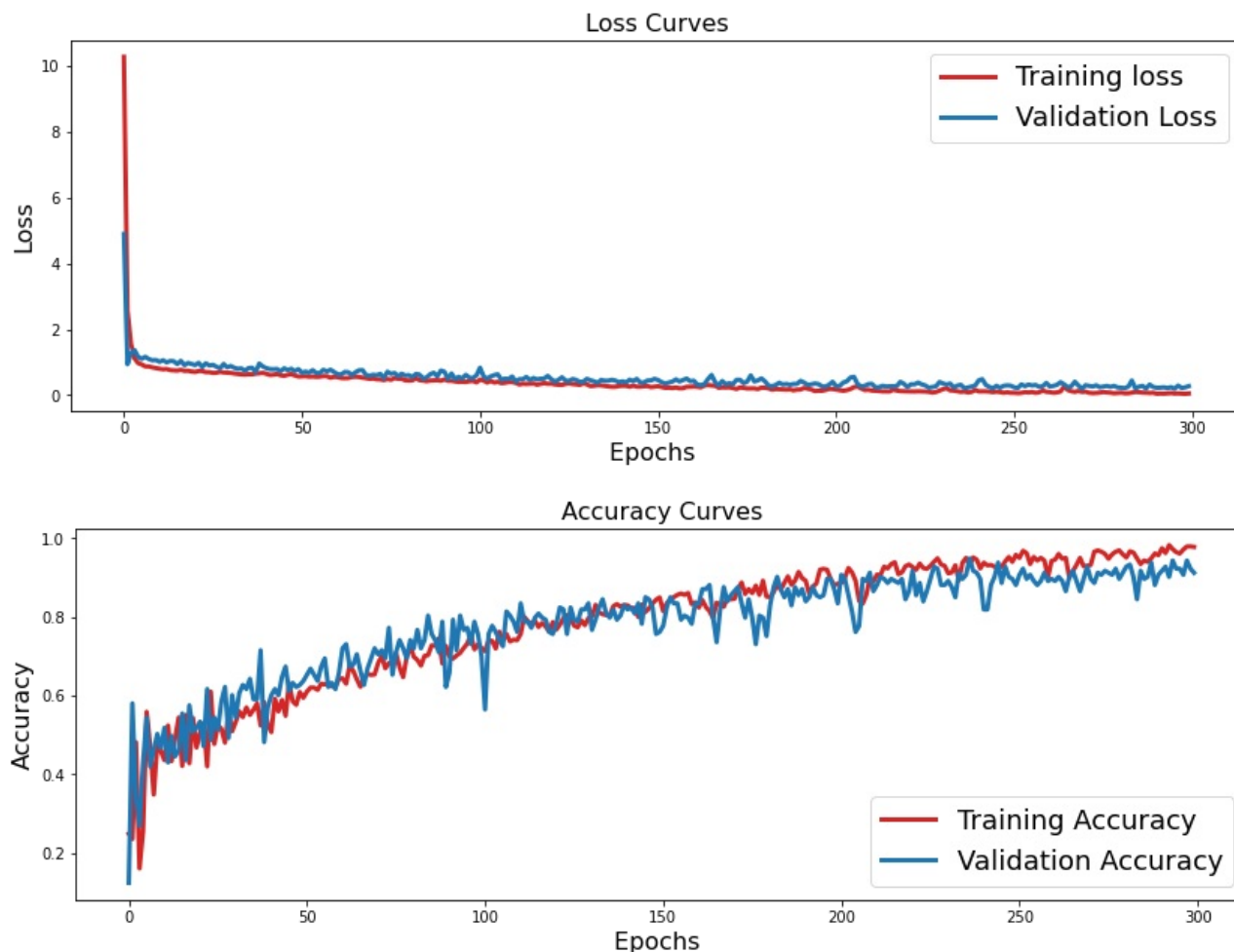
In [90]:

```
evaluation_train_val(model,x_train,y_train,x_val,y_val,results,index)
```

Training Accuracy: 0.9720670580863953  
Training Loss: 0.09344641119241714  
Validation Accuracy: 0.9481865167617798  
Validation Loss: 0.2115217000246048

In [91]:

```
plotfn(history)
```



**Evaluation: Testing**

In [92]:

```
evaluation_test(model,x_test,y_test,results,index)
```

7/7 [=====] - 0s 43ms/step - loss: 0.5742 - accuracy: 0.8135  
Test accuracy: 0.8134714961051941  
Test loss: 0.5742360949516296

Evaluation Metrics

F1 score

In [95]:

```
_,_,_, val_f1 = predictfn(model, x_val,y_val)
```

7/7 [=====] - 1s 79ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.94	0.97	16
extrastole	0.91	0.83	0.87	12
murmur	0.95	0.93	0.94	56
normal	0.95	0.97	0.96	109
accuracy			0.95	193
macro avg	0.95	0.92	0.93	193
weighted avg	0.95	0.95	0.95	193

In [96]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model, x_test,y_test)
```

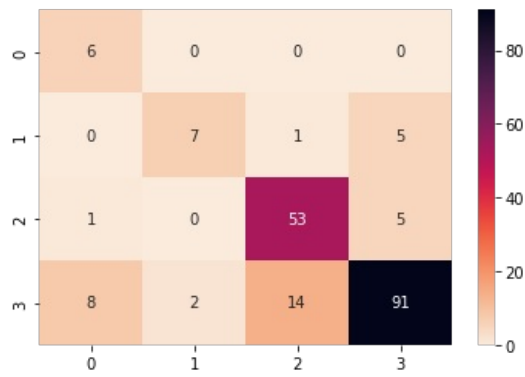
7/7 [=====] - 0s 41ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.40	0.57	15
extrastole	0.54	0.78	0.64	9
murmur	0.90	0.78	0.83	68
normal	0.79	0.90	0.84	101
accuracy			0.81	193
macro avg	0.81	0.71	0.72	193
weighted avg	0.83	0.81	0.81	193

Confusion Matrix

In [97]:

```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

```
roc = plot_ROC(y_test,predictions)
```



Out[99]:

### Predicting a sample's label

```
model_name = "heartbeat_classifier2D_1.h5"
model.save(model_name)
```

## In [108]:

Out[108]:

In [107]:

### Predicting a Normal sample

```
test.iloc[50]
```

Out[112]:

[illegible]

In [113]:

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 0s 169ms/step
Label Prediction Probabilities: [[6.0757096e-13 1.3180223e-05 3.9696847e-03 9.9601716e-01]]
-----
Label:
Normal heartbeat
confidence: 0.99601716
```

#### ***Predicting an Extrahls sample***

In [116]:

```
test.iloc[77]
```

Out[116]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [117]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 164ms/step
Label Prediction Probabilities: [[9.9999630e-01 5.2413147e-19 9.6985815e-09 3.7232078e-06]]
-----
Label:
Extrahls heartbeat
confidence: 0.9999963
```

#### ***Predicting an Extrasystole sample***

In [140]:

```
test.iloc[96]
```

Out[140]:

```
filename    /content/set_b/extrastole__207_1308159792607_B...
label                               extrastole
offset                                           1
Name: 990, dtype: object
```

In [141]:

```
sample_predict(model_name,96)
```

```
1/1 [=====] - 0s 175ms/step
Label Prediction Probabilities: [[3.6787995e-04 6.6052234e-01 9.7590564e-03 3.2935071e-01]]
-----
Label:
Extrasystole heartbeat
confidence: 0.66052234
```

## **CNN Experiment 2:**

Changing in Dropout layers:

In [142]:

```
model = Sequential()
model.add(Conv2D(16, (3,3), padding = 'same', input_shape=(x_train.shape[1],x_train.shape[2],x_train.shape[3]), activation='relu'))
model.add(MaxPooling2D())
model.add(Dropout(0.2))

model.add(Conv2D(32,(3,3), padding = 'same', activation='relu'))
model.add(MaxPooling2D())
model.add(Dropout(0.4))

model.add(Conv2D(64, (3,3), padding = 'same', activation='relu'))
model.add(MaxPooling2D())
model.add(Dropout(0.4))

model.add(Conv2D(128, (3,3), padding = 'same', activation='relu'))
model.add(MaxPooling2D())
model.add(Dropout(0.2))
model.add(GlobalAveragePooling2D())

model.add(Dense(len(encoder.classes_), activation='softmax'))
model.summary()
```

Model: "sequential\_1"

Layer (type)	Output Shape	Param #
conv2d_4 (Conv2D)	(None, 40, 130, 16)	160
max_pooling2d_4 (MaxPooling2D)	(None, 20, 65, 16)	0
dropout_3 (Dropout)	(None, 20, 65, 16)	0
conv2d_5 (Conv2D)	(None, 20, 65, 32)	4640
max_pooling2d_5 (MaxPooling2D)	(None, 10, 32, 32)	0
dropout_4 (Dropout)	(None, 10, 32, 32)	0
conv2d_6 (Conv2D)	(None, 10, 32, 64)	18496
max_pooling2d_6 (MaxPooling2D)	(None, 5, 16, 64)	0
dropout_5 (Dropout)	(None, 5, 16, 64)	0
conv2d_7 (Conv2D)	(None, 5, 16, 128)	73856
max_pooling2d_7 (MaxPooling2D)	(None, 2, 8, 128)	0
dropout_6 (Dropout)	(None, 2, 8, 128)	0
global_average_pooling2d_1 (GlobalAveragePooling2D)	(None, 128)	0
dense_1 (Dense)	(None, 4)	516
Total params: 97,668		
Trainable params: 97,668		
Non-trainable params: 0		

In [143]:

```
history, model = compile_fit(model)

Epoch 1/300
7/7 [=====] - ETA: 0s - loss: 11.0311 - accuracy: 0.2939
Epoch 1: val_accuracy improved from -inf to 0.05699, saving model to /content/weights.best.hdf5
7/7 [=====] - 7s 862ms/step - loss: 11.0311 - accuracy: 0.2939 - val_loss: 2.1939 - val_accuracy: 0.0570
Epoch 2/300
7/7 [=====] - ETA: 0s - loss: 2.9923 - accuracy: 0.2156
Epoch 2: val_accuracy improved from 0.05699 to 0.64767, saving model to /content/weights.best.hdf5
7/7 [=====] - 6s 800ms/step - loss: 2.9923 - accuracy: 0.2156 - val_loss: 0.9055 - val_accuracy: 0.6477
Epoch 3/300
7/7 [=====] - ETA: 0s - loss: 1.8430 - accuracy: 0.3989
```

Epoch 3: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 770ms/step - loss: 1.8430 - accuracy: 0.3989 - val\_loss: 1.1665 - val\_accuracy: 0.3679  
Epoch 4/300  
7/7 [=====] - ETA: 0s - loss: 1.3633 - accuracy: 0.1922  
Epoch 4: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 759ms/step - loss: 1.3633 - accuracy: 0.1922 - val\_loss: 1.2334 - val\_accuracy: 0.1399  
Epoch 5/300  
7/7 [=====] - ETA: 0s - loss: 1.0555 - accuracy: 0.3687  
Epoch 5: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 790ms/step - loss: 1.0555 - accuracy: 0.3687 - val\_loss: 1.1929 - val\_accuracy: 0.1762  
Epoch 6/300  
7/7 [=====] - ETA: 0s - loss: 1.1078 - accuracy: 0.3743  
Epoch 6: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 800ms/step - loss: 1.1078 - accuracy: 0.3743 - val\_loss: 1.2561 - val\_accuracy: 0.1399  
Epoch 7/300  
7/7 [=====] - ETA: 0s - loss: 0.9557 - accuracy: 0.3408  
Epoch 7: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 807ms/step - loss: 0.9557 - accuracy: 0.3408 - val\_loss: 1.2777 - val\_accuracy: 0.1399  
Epoch 8/300  
7/7 [=====] - ETA: 0s - loss: 0.9703 - accuracy: 0.3263  
Epoch 8: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 785ms/step - loss: 0.9703 - accuracy: 0.3263 - val\_loss: 1.2651 - val\_accuracy: 0.1347  
Epoch 9/300  
7/7 [=====] - ETA: 0s - loss: 0.9159 - accuracy: 0.3821  
Epoch 9: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 794ms/step - loss: 0.9159 - accuracy: 0.3821 - val\_loss: 1.2375 - val\_accuracy: 0.1347  
Epoch 10/300  
7/7 [=====] - ETA: 0s - loss: 0.8862 - accuracy: 0.4335  
Epoch 10: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 786ms/step - loss: 0.8862 - accuracy: 0.4335 - val\_loss: 1.2567 - val\_accuracy: 0.1347  
Epoch 11/300  
7/7 [=====] - ETA: 0s - loss: 0.8994 - accuracy: 0.4056  
Epoch 11: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 783ms/step - loss: 0.8994 - accuracy: 0.4056 - val\_loss: 1.2471 - val\_accuracy: 0.1658  
Epoch 12/300  
7/7 [=====] - ETA: 0s - loss: 0.8748 - accuracy: 0.4369  
Epoch 12: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 814ms/step - loss: 0.8748 - accuracy: 0.4369 - val\_loss: 1.2614 - val\_accuracy: 0.1503  
Epoch 13/300  
7/7 [=====] - ETA: 0s - loss: 0.8707 - accuracy: 0.3911  
Epoch 13: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 756ms/step - loss: 0.8707 - accuracy: 0.3911 - val\_loss: 1.2476 - val\_accuracy: 0.1710  
Epoch 14/300  
7/7 [=====] - ETA: 0s - loss: 0.8764 - accuracy: 0.4525  
Epoch 14: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 781ms/step - loss: 0.8764 - accuracy: 0.4525 - val\_loss: 1.2508 - val\_accuracy: 0.1917  
Epoch 15/300  
7/7 [=====] - ETA: 0s - loss: 0.8288 - accuracy: 0.4402  
Epoch 15: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 773ms/step - loss: 0.8288 - accuracy: 0.4402 - val\_loss: 1.2141 - val\_accuracy: 0.2280  
Epoch 16/300  
7/7 [=====] - ETA: 0s - loss: 0.8216 - accuracy: 0.4961  
Epoch 16: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 768ms/step - loss: 0.8216 - accuracy: 0.4961 - val\_loss: 1.2420 - val\_accuracy: 0.2332  
Epoch 17/300  
7/7 [=====] - ETA: 0s - loss: 0.8241 - accuracy: 0.4402  
Epoch 17: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 802ms/step - loss: 0.8241 - accuracy: 0.4402 - val\_loss: 1.2247 - val\_accuracy: 0.2746  
Epoch 18/300  
7/7 [=====] - ETA: 0s - loss: 0.8198 - accuracy: 0.4715  
Epoch 18: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 772ms/step - loss: 0.8198 - accuracy: 0.4715 - val\_loss: 1.1989 - val\_accuracy: 0.3005  
Epoch 19/300  
7/7 [=====] - ETA: 0s - loss: 0.8369 - accuracy: 0.4179  
Epoch 19: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 7s 990ms/step - loss: 0.8369 - accuracy: 0.4179 - val\_loss: 1.1524 - val\_accuracy: 0.3316

Epoch 20/300  
7/7 [=====] - ETA: 0s - loss: 0.8214 - accuracy: 0.5207  
Epoch 20: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 824ms/step - loss: 0.8214 - accuracy: 0.5207 - val\_loss: 1.2261 - val\_accuracy: 0.3057  
Epoch 21/300  
7/7 [=====] - ETA: 0s - loss: 0.8324 - accuracy: 0.4302  
Epoch 21: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 815ms/step - loss: 0.8324 - accuracy: 0.4302 - val\_loss: 1.0649 - val\_accuracy: 0.4249  
Epoch 22/300  
7/7 [=====] - ETA: 0s - loss: 0.7760 - accuracy: 0.5184  
Epoch 22: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 797ms/step - loss: 0.7760 - accuracy: 0.5184 - val\_loss: 1.1562 - val\_accuracy: 0.3161  
Epoch 23/300  
7/7 [=====] - ETA: 0s - loss: 0.7907 - accuracy: 0.5240  
Epoch 23: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 785ms/step - loss: 0.7907 - accuracy: 0.5240 - val\_loss: 1.1170 - val\_accuracy: 0.3523  
Epoch 24/300  
7/7 [=====] - ETA: 0s - loss: 0.7903 - accuracy: 0.4503  
Epoch 24: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 799ms/step - loss: 0.7903 - accuracy: 0.4503 - val\_loss: 1.0711 - val\_accuracy: 0.3938  
Epoch 25/300  
7/7 [=====] - ETA: 0s - loss: 0.8199 - accuracy: 0.5039  
Epoch 25: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 781ms/step - loss: 0.8199 - accuracy: 0.5039 - val\_loss: 1.1798 - val\_accuracy: 0.3264  
Epoch 26/300  
7/7 [=====] - ETA: 0s - loss: 0.7706 - accuracy: 0.5162  
Epoch 26: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 793ms/step - loss: 0.7706 - accuracy: 0.5162 - val\_loss: 1.0583 - val\_accuracy: 0.4041  
Epoch 27/300  
7/7 [=====] - ETA: 0s - loss: 0.7794 - accuracy: 0.4838  
Epoch 27: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 805ms/step - loss: 0.7794 - accuracy: 0.4838 - val\_loss: 1.0785 - val\_accuracy: 0.3886  
Epoch 28/300  
7/7 [=====] - ETA: 0s - loss: 0.7925 - accuracy: 0.5017  
Epoch 28: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 774ms/step - loss: 0.7925 - accuracy: 0.5017 - val\_loss: 1.0626 - val\_accuracy: 0.4093  
Epoch 29/300  
7/7 [=====] - ETA: 0s - loss: 0.7719 - accuracy: 0.5050  
Epoch 29: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 793ms/step - loss: 0.7719 - accuracy: 0.5050 - val\_loss: 1.0664 - val\_accuracy: 0.4093  
Epoch 30/300  
7/7 [=====] - ETA: 0s - loss: 0.7532 - accuracy: 0.5173  
Epoch 30: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 781ms/step - loss: 0.7532 - accuracy: 0.5173 - val\_loss: 1.0547 - val\_accuracy: 0.4249  
Epoch 31/300  
7/7 [=====] - ETA: 0s - loss: 0.7437 - accuracy: 0.4916  
Epoch 31: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 807ms/step - loss: 0.7437 - accuracy: 0.4916 - val\_loss: 1.0951 - val\_accuracy: 0.3990  
Epoch 32/300  
7/7 [=====] - ETA: 0s - loss: 0.7442 - accuracy: 0.5006  
Epoch 32: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 782ms/step - loss: 0.7442 - accuracy: 0.5006 - val\_loss: 1.0289 - val\_accuracy: 0.4456  
Epoch 33/300  
7/7 [=====] - ETA: 0s - loss: 0.7773 - accuracy: 0.5229  
Epoch 33: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 795ms/step - loss: 0.7773 - accuracy: 0.5229 - val\_loss: 1.0896 - val\_accuracy: 0.4197  
Epoch 34/300  
7/7 [=====] - ETA: 0s - loss: 0.7661 - accuracy: 0.5263  
Epoch 34: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 799ms/step - loss: 0.7661 - accuracy: 0.5263 - val\_loss: 1.0203 - val\_accuracy: 0.4611  
Epoch 35/300  
7/7 [=====] - ETA: 0s - loss: 0.7442 - accuracy: 0.4916  
Epoch 35: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 775ms/step - loss: 0.7442 - accuracy: 0.4916 - val\_loss: 1.0121 - val\_accuracy: 0.4560  
Epoch 36/300  
7/7 [=====] - ETA: 0s - loss: 0.7436 - accuracy: 0.5687  
Epoch 36: val\_accuracy did not improve from 0.64767



7/7 [=====] - 5s 782ms/step - loss: 0.7436 - accuracy: 0.5687 - val\_loss: 1.0924 - val\_accuracy: 0.3834  
Epoch 37/300  
7/7 [=====] - ETA: 0s - loss: 0.7351 - accuracy: 0.4715  
Epoch 37: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 771ms/step - loss: 0.7351 - accuracy: 0.4715 - val\_loss: 1.0129 - val\_accuracy: 0.4508  
Epoch 38/300  
7/7 [=====] - ETA: 0s - loss: 0.7356 - accuracy: 0.5162  
Epoch 38: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 776ms/step - loss: 0.7356 - accuracy: 0.5162 - val\_loss: 1.0498 - val\_accuracy: 0.3990  
Epoch 39/300  
7/7 [=====] - ETA: 0s - loss: 0.7280 - accuracy: 0.5229  
Epoch 39: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 779ms/step - loss: 0.7280 - accuracy: 0.5229 - val\_loss: 1.0091 - val\_accuracy: 0.4508  
Epoch 40/300  
7/7 [=====] - ETA: 0s - loss: 0.7219 - accuracy: 0.5006  
Epoch 40: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 777ms/step - loss: 0.7219 - accuracy: 0.5006 - val\_loss: 1.0324 - val\_accuracy: 0.4301  
Epoch 41/300  
7/7 [=====] - ETA: 0s - loss: 0.7071 - accuracy: 0.5408  
Epoch 41: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 757ms/step - loss: 0.7071 - accuracy: 0.5408 - val\_loss: 1.0485 - val\_accuracy: 0.4197  
Epoch 42/300  
7/7 [=====] - ETA: 0s - loss: 0.7229 - accuracy: 0.4994  
Epoch 42: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 757ms/step - loss: 0.7229 - accuracy: 0.4994 - val\_loss: 0.9564 - val\_accuracy: 0.4819  
Epoch 43/300  
7/7 [=====] - ETA: 0s - loss: 0.7353 - accuracy: 0.5296  
Epoch 43: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 793ms/step - loss: 0.7353 - accuracy: 0.5296 - val\_loss: 1.0514 - val\_accuracy: 0.3886  
Epoch 44/300  
7/7 [=====] - ETA: 0s - loss: 0.7140 - accuracy: 0.5374  
Epoch 44: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 793ms/step - loss: 0.7140 - accuracy: 0.5374 - val\_loss: 0.9874 - val\_accuracy: 0.4404  
Epoch 45/300  
7/7 [=====] - ETA: 0s - loss: 0.6954 - accuracy: 0.4983  
Epoch 45: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 781ms/step - loss: 0.6954 - accuracy: 0.4983 - val\_loss: 0.9884 - val\_accuracy: 0.4611  
Epoch 46/300  
7/7 [=====] - ETA: 0s - loss: 0.7194 - accuracy: 0.5285  
Epoch 46: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 773ms/step - loss: 0.7194 - accuracy: 0.5285 - val\_loss: 1.0164 - val\_accuracy: 0.4404  
Epoch 47/300  
7/7 [=====] - ETA: 0s - loss: 0.6872 - accuracy: 0.5307  
Epoch 47: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 794ms/step - loss: 0.6872 - accuracy: 0.5307 - val\_loss: 0.9214 - val\_accuracy: 0.4715  
Epoch 48/300  
7/7 [=====] - ETA: 0s - loss: 0.7099 - accuracy: 0.5017  
Epoch 48: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 796ms/step - loss: 0.7099 - accuracy: 0.5017 - val\_loss: 0.9867 - val\_accuracy: 0.4663  
Epoch 49/300  
7/7 [=====] - ETA: 0s - loss: 0.6926 - accuracy: 0.5497  
Epoch 49: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 778ms/step - loss: 0.6926 - accuracy: 0.5497 - val\_loss: 0.9590 - val\_accuracy: 0.4663  
Epoch 50/300  
7/7 [=====] - ETA: 0s - loss: 0.7214 - accuracy: 0.5285  
Epoch 50: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 785ms/step - loss: 0.7214 - accuracy: 0.5285 - val\_loss: 1.0046 - val\_accuracy: 0.4508  
Epoch 51/300  
7/7 [=====] - ETA: 0s - loss: 0.7318 - accuracy: 0.5106  
Epoch 51: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 804ms/step - loss: 0.7318 - accuracy: 0.5106 - val\_loss: 0.9414 - val\_accuracy: 0.4870  
Epoch 52/300  
7/7 [=====] - ETA: 0s - loss: 0.6964 - accuracy: 0.5251  
Epoch 52: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 789ms/step - loss: 0.6964 - accuracy: 0.5251 - val\_loss: 0.9937 - val\_accuracy: 0.4663  
Epoch 53/300

7/7 [=====] - ETA: 0s - loss: 0.7025 - accuracy: 0.5564  
Epoch 53: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 797ms/step - loss: 0.7025 - accuracy: 0.5564 - val\_loss: 0.9866 - val\_accuracy: 0.4663  
Epoch 54/300  
7/7 [=====] - ETA: 0s - loss: 0.6726 - accuracy: 0.5039  
Epoch 54: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 777ms/step - loss: 0.6726 - accuracy: 0.5039 - val\_loss: 0.9252 - val\_accuracy: 0.4819  
Epoch 55/300  
7/7 [=====] - ETA: 0s - loss: 0.6668 - accuracy: 0.5877  
Epoch 55: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 804ms/step - loss: 0.6668 - accuracy: 0.5877 - val\_loss: 0.9458 - val\_accuracy: 0.4767  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.6606 - accuracy: 0.5140  
Epoch 56: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 7s 1s/step - loss: 0.6606 - accuracy: 0.5140 - val\_loss: 0.8322 - val\_accuracy: 0.6166  
Epoch 57/300  
7/7 [=====] - ETA: 0s - loss: 0.7026 - accuracy: 0.5732  
Epoch 57: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 813ms/step - loss: 0.7026 - accuracy: 0.5732 - val\_loss: 1.0084 - val\_accuracy: 0.4767  
Epoch 58/300  
7/7 [=====] - ETA: 0s - loss: 0.7138 - accuracy: 0.5508  
Epoch 58: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 790ms/step - loss: 0.7138 - accuracy: 0.5508 - val\_loss: 0.8902 - val\_accuracy: 0.5648  
Epoch 59/300  
7/7 [=====] - ETA: 0s - loss: 0.6769 - accuracy: 0.5788  
Epoch 59: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 809ms/step - loss: 0.6769 - accuracy: 0.5788 - val\_loss: 0.9114 - val\_accuracy: 0.4819  
Epoch 60/300  
7/7 [=====] - ETA: 0s - loss: 0.6533 - accuracy: 0.5777  
Epoch 60: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 786ms/step - loss: 0.6533 - accuracy: 0.5777 - val\_loss: 0.9135 - val\_accuracy: 0.5130  
Epoch 61/300  
7/7 [=====] - ETA: 0s - loss: 0.6846 - accuracy: 0.5285  
Epoch 61: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 763ms/step - loss: 0.6846 - accuracy: 0.5285 - val\_loss: 0.8920 - val\_accuracy: 0.5026  
Epoch 62/300  
7/7 [=====] - ETA: 0s - loss: 0.6597 - accuracy: 0.5553  
Epoch 62: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 759ms/step - loss: 0.6597 - accuracy: 0.5553 - val\_loss: 0.8596 - val\_accuracy: 0.5544  
Epoch 63/300  
7/7 [=====] - ETA: 0s - loss: 0.6623 - accuracy: 0.5620  
Epoch 63: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 807ms/step - loss: 0.6623 - accuracy: 0.5620 - val\_loss: 0.9355 - val\_accuracy: 0.4715  
Epoch 64/300  
7/7 [=====] - ETA: 0s - loss: 0.6548 - accuracy: 0.5486  
Epoch 64: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 807ms/step - loss: 0.6548 - accuracy: 0.5486 - val\_loss: 0.8747 - val\_accuracy: 0.5440  
Epoch 65/300  
7/7 [=====] - ETA: 0s - loss: 0.6508 - accuracy: 0.5866  
Epoch 65: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 777ms/step - loss: 0.6508 - accuracy: 0.5866 - val\_loss: 0.8532 - val\_accuracy: 0.5389  
Epoch 66/300  
7/7 [=====] - ETA: 0s - loss: 0.6360 - accuracy: 0.5687  
Epoch 66: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 803ms/step - loss: 0.6360 - accuracy: 0.5687 - val\_loss: 0.8895 - val\_accuracy: 0.5233  
Epoch 67/300  
7/7 [=====] - ETA: 0s - loss: 0.6501 - accuracy: 0.5721  
Epoch 67: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 787ms/step - loss: 0.6501 - accuracy: 0.5721 - val\_loss: 0.8741 - val\_accuracy: 0.5803  
Epoch 68/300  
7/7 [=====] - ETA: 0s - loss: 0.6338 - accuracy: 0.5575  
Epoch 68: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 765ms/step - loss: 0.6338 - accuracy: 0.5575 - val\_loss: 0.8438 - val\_accuracy: 0.5803  
Epoch 69/300  
7/7 [=====] - ETA: 0s - loss: 0.6539 - accuracy: 0.5587  
Epoch 69: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 792ms/step - loss: 0.6539 - accuracy: 0.5587 - val\_loss: 0

.8487 - val\_accuracy: 0.6114  
Epoch 70/300  
7/7 [=====] - ETA: 0s - loss: 0.6388 - accuracy: 0.5922  
Epoch 70: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 7s 1s/step - loss: 0.6388 - accuracy: 0.5922 - val\_loss: 0.86  
74 - val\_accuracy: 0.5699  
Epoch 71/300  
7/7 [=====] - ETA: 0s - loss: 0.6508 - accuracy: 0.5765  
Epoch 71: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 7s 946ms/step - loss: 0.6508 - accuracy: 0.5765 - val\_loss: 0  
.8789 - val\_accuracy: 0.5492  
Epoch 72/300  
7/7 [=====] - ETA: 0s - loss: 0.6314 - accuracy: 0.5441  
Epoch 72: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 825ms/step - loss: 0.6314 - accuracy: 0.5441 - val\_loss: 0  
.9262 - val\_accuracy: 0.4922  
Epoch 73/300  
7/7 [=====] - ETA: 0s - loss: 0.6298 - accuracy: 0.5933  
Epoch 73: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 792ms/step - loss: 0.6298 - accuracy: 0.5933 - val\_loss: 0  
.8555 - val\_accuracy: 0.5855  
Epoch 74/300  
7/7 [=====] - ETA: 0s - loss: 0.6185 - accuracy: 0.5508  
Epoch 74: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 800ms/step - loss: 0.6185 - accuracy: 0.5508 - val\_loss: 0  
.8555 - val\_accuracy: 0.5648  
Epoch 75/300  
7/7 [=====] - ETA: 0s - loss: 0.6048 - accuracy: 0.5989  
Epoch 75: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 795ms/step - loss: 0.6048 - accuracy: 0.5989 - val\_loss: 0  
.8702 - val\_accuracy: 0.5803  
Epoch 76/300  
7/7 [=====] - ETA: 0s - loss: 0.6098 - accuracy: 0.5732  
Epoch 76: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 789ms/step - loss: 0.6098 - accuracy: 0.5732 - val\_loss: 0  
.8190 - val\_accuracy: 0.5959  
Epoch 77/300  
7/7 [=====] - ETA: 0s - loss: 0.5998 - accuracy: 0.6000  
Epoch 77: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 801ms/step - loss: 0.5998 - accuracy: 0.6000 - val\_loss: 0  
.8256 - val\_accuracy: 0.5959  
Epoch 78/300  
7/7 [=====] - ETA: 0s - loss: 0.6222 - accuracy: 0.5844  
Epoch 78: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 777ms/step - loss: 0.6222 - accuracy: 0.5844 - val\_loss: 0  
.7909 - val\_accuracy: 0.6425  
Epoch 79/300  
7/7 [=====] - ETA: 0s - loss: 0.6321 - accuracy: 0.5888  
Epoch 79: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 799ms/step - loss: 0.6321 - accuracy: 0.5888 - val\_loss: 0  
.8778 - val\_accuracy: 0.5648  
Epoch 80/300  
7/7 [=====] - ETA: 0s - loss: 0.6261 - accuracy: 0.5877  
Epoch 80: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 5s 785ms/step - loss: 0.6261 - accuracy: 0.5877 - val\_loss: 0  
.8707 - val\_accuracy: 0.5492  
Epoch 81/300  
7/7 [=====] - ETA: 0s - loss: 0.6198 - accuracy: 0.5587  
Epoch 81: val\_accuracy improved from 0.64767 to 0.66839, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 791ms/step - loss: 0.6198 - accuracy: 0.5587 - val\_loss: 0  
.7773 - val\_accuracy: 0.6684  
Epoch 82/300  
7/7 [=====] - ETA: 0s - loss: 0.6088 - accuracy: 0.6056  
Epoch 82: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 763ms/step - loss: 0.6088 - accuracy: 0.6056 - val\_loss: 0  
.8956 - val\_accuracy: 0.6010  
Epoch 83/300  
7/7 [=====] - ETA: 0s - loss: 0.6213 - accuracy: 0.6134  
Epoch 83: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 817ms/step - loss: 0.6213 - accuracy: 0.6134 - val\_loss: 0  
.8485 - val\_accuracy: 0.6269  
Epoch 84/300  
7/7 [=====] - ETA: 0s - loss: 0.5856 - accuracy: 0.5654  
Epoch 84: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 814ms/step - loss: 0.5856 - accuracy: 0.5654 - val\_loss: 0  
.7789 - val\_accuracy: 0.6373  
Epoch 85/300  
7/7 [=====] - ETA: 0s - loss: 0.6017 - accuracy: 0.6022  
Epoch 85: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 796ms/step - loss: 0.6017 - accuracy: 0.6022 - val\_loss: 0  
.8333 - val\_accuracy: 0.6010  
Epoch 86/300  
7/7 [=====] - ETA: 0s - loss: 0.6019 - accuracy: 0.6223

Epoch 86: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 807ms/step - loss: 0.6019 - accuracy: 0.6223 - val\_loss: 0.8342 - val\_accuracy: 0.5959  
Epoch 87/300  
7/7 [=====] - ETA: 0s - loss: 0.5821 - accuracy: 0.5844  
Epoch 87: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 784ms/step - loss: 0.5821 - accuracy: 0.5844 - val\_loss: 0.7991 - val\_accuracy: 0.6373  
Epoch 88/300  
7/7 [=====] - ETA: 0s - loss: 0.5972 - accuracy: 0.5966  
Epoch 88: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 764ms/step - loss: 0.5972 - accuracy: 0.5966 - val\_loss: 0.7762 - val\_accuracy: 0.6477  
Epoch 89/300  
7/7 [=====] - ETA: 0s - loss: 0.6042 - accuracy: 0.5866  
Epoch 89: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 771ms/step - loss: 0.6042 - accuracy: 0.5866 - val\_loss: 0.8262 - val\_accuracy: 0.5803  
Epoch 90/300  
7/7 [=====] - ETA: 0s - loss: 0.6003 - accuracy: 0.6346  
Epoch 90: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 798ms/step - loss: 0.6003 - accuracy: 0.6346 - val\_loss: 0.7888 - val\_accuracy: 0.6477  
Epoch 91/300  
7/7 [=====] - ETA: 0s - loss: 0.5894 - accuracy: 0.6067  
Epoch 91: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 895ms/step - loss: 0.5894 - accuracy: 0.6067 - val\_loss: 0.8248 - val\_accuracy: 0.6062  
Epoch 92/300  
7/7 [=====] - ETA: 0s - loss: 0.6016 - accuracy: 0.5553  
Epoch 92: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 7s 911ms/step - loss: 0.6016 - accuracy: 0.5553 - val\_loss: 0.7809 - val\_accuracy: 0.6477  
Epoch 93/300  
7/7 [=====] - ETA: 0s - loss: 0.5848 - accuracy: 0.6726  
Epoch 93: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 779ms/step - loss: 0.5848 - accuracy: 0.6726 - val\_loss: 0.8424 - val\_accuracy: 0.5907  
Epoch 94/300  
7/7 [=====] - ETA: 0s - loss: 0.5782 - accuracy: 0.5765  
Epoch 94: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 789ms/step - loss: 0.5782 - accuracy: 0.5765 - val\_loss: 0.8147 - val\_accuracy: 0.6218  
Epoch 95/300  
7/7 [=====] - ETA: 0s - loss: 0.5887 - accuracy: 0.6447  
Epoch 95: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 797ms/step - loss: 0.5887 - accuracy: 0.6447 - val\_loss: 0.8580 - val\_accuracy: 0.6010  
Epoch 96/300  
7/7 [=====] - ETA: 0s - loss: 0.5949 - accuracy: 0.5855  
Epoch 96: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 784ms/step - loss: 0.5949 - accuracy: 0.5855 - val\_loss: 0.7986 - val\_accuracy: 0.6632  
Epoch 97/300  
7/7 [=====] - ETA: 0s - loss: 0.6149 - accuracy: 0.6168  
Epoch 97: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 785ms/step - loss: 0.6149 - accuracy: 0.6168 - val\_loss: 0.8590 - val\_accuracy: 0.5596  
Epoch 98/300  
7/7 [=====] - ETA: 0s - loss: 0.5711 - accuracy: 0.6078  
Epoch 98: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 801ms/step - loss: 0.5711 - accuracy: 0.6078 - val\_loss: 0.8300 - val\_accuracy: 0.5959  
Epoch 99/300  
7/7 [=====] - ETA: 0s - loss: 0.5835 - accuracy: 0.6436  
Epoch 99: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 789ms/step - loss: 0.5835 - accuracy: 0.6436 - val\_loss: 0.8350 - val\_accuracy: 0.5907  
Epoch 100/300  
7/7 [=====] - ETA: 0s - loss: 0.5910 - accuracy: 0.5542  
Epoch 100: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 785ms/step - loss: 0.5910 - accuracy: 0.5542 - val\_loss: 0.7615 - val\_accuracy: 0.6528  
Epoch 101/300  
7/7 [=====] - ETA: 0s - loss: 0.6010 - accuracy: 0.6313  
Epoch 101: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 800ms/step - loss: 0.6010 - accuracy: 0.6313 - val\_loss: 0.8636 - val\_accuracy: 0.5596  
Epoch 102/300  
7/7 [=====] - ETA: 0s - loss: 0.5709 - accuracy: 0.6145  
Epoch 102: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 785ms/step - loss: 0.5709 - accuracy: 0.6145 - val\_loss: 0.8042 - val\_accuracy: 0.6166

Epoch 103/300  
7/7 [=====] - ETA: 0s - loss: 0.5796 - accuracy: 0.5855  
Epoch 103: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 803ms/step - loss: 0.5796 - accuracy: 0.5855 - val\_loss: 0.7773 - val\_accuracy: 0.6580  
Epoch 104/300  
7/7 [=====] - ETA: 0s - loss: 0.5753 - accuracy: 0.6358  
Epoch 104: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 805ms/step - loss: 0.5753 - accuracy: 0.6358 - val\_loss: 0.8131 - val\_accuracy: 0.6010  
Epoch 105/300  
7/7 [=====] - ETA: 0s - loss: 0.5826 - accuracy: 0.6223  
Epoch 105: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 785ms/step - loss: 0.5826 - accuracy: 0.6223 - val\_loss: 0.8339 - val\_accuracy: 0.5907  
Epoch 106/300  
7/7 [=====] - ETA: 0s - loss: 0.5983 - accuracy: 0.6190  
Epoch 106: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 6s 811ms/step - loss: 0.5983 - accuracy: 0.6190 - val\_loss: 0.7817 - val\_accuracy: 0.6425  
Epoch 107/300  
7/7 [=====] - ETA: 0s - loss: 0.5960 - accuracy: 0.5955  
Epoch 107: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 777ms/step - loss: 0.5960 - accuracy: 0.5955 - val\_loss: 0.7660 - val\_accuracy: 0.6269  
Epoch 108/300  
7/7 [=====] - ETA: 0s - loss: 0.5826 - accuracy: 0.6279  
Epoch 108: val\_accuracy did not improve from 0.66839  
7/7 [=====] - 5s 779ms/step - loss: 0.5826 - accuracy: 0.6279 - val\_loss: 0.8629 - val\_accuracy: 0.5699  
Epoch 109/300  
7/7 [=====] - ETA: 0s - loss: 0.5730 - accuracy: 0.5844  
Epoch 109: val\_accuracy improved from 0.66839 to 0.67876, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 804ms/step - loss: 0.5730 - accuracy: 0.5844 - val\_loss: 0.7597 - val\_accuracy: 0.6788  
Epoch 110/300  
7/7 [=====] - ETA: 0s - loss: 0.5947 - accuracy: 0.6212  
Epoch 110: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 776ms/step - loss: 0.5947 - accuracy: 0.6212 - val\_loss: 0.8620 - val\_accuracy: 0.5959  
Epoch 111/300  
7/7 [=====] - ETA: 0s - loss: 0.5611 - accuracy: 0.6268  
Epoch 111: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 771ms/step - loss: 0.5611 - accuracy: 0.6268 - val\_loss: 0.7517 - val\_accuracy: 0.6425  
Epoch 112/300  
7/7 [=====] - ETA: 0s - loss: 0.5634 - accuracy: 0.6190  
Epoch 112: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 797ms/step - loss: 0.5634 - accuracy: 0.6190 - val\_loss: 0.8255 - val\_accuracy: 0.5959  
Epoch 113/300  
7/7 [=====] - ETA: 0s - loss: 0.5609 - accuracy: 0.6078  
Epoch 113: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 773ms/step - loss: 0.5609 - accuracy: 0.6078 - val\_loss: 0.7723 - val\_accuracy: 0.6269  
Epoch 114/300  
7/7 [=====] - ETA: 0s - loss: 0.5495 - accuracy: 0.6402  
Epoch 114: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 807ms/step - loss: 0.5495 - accuracy: 0.6402 - val\_loss: 0.7853 - val\_accuracy: 0.6218  
Epoch 115/300  
7/7 [=====] - ETA: 0s - loss: 0.5504 - accuracy: 0.6067  
Epoch 115: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 797ms/step - loss: 0.5504 - accuracy: 0.6067 - val\_loss: 0.7302 - val\_accuracy: 0.6684  
Epoch 116/300  
7/7 [=====] - ETA: 0s - loss: 0.5577 - accuracy: 0.6257  
Epoch 116: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 783ms/step - loss: 0.5577 - accuracy: 0.6257 - val\_loss: 0.7946 - val\_accuracy: 0.6062  
Epoch 117/300  
7/7 [=====] - ETA: 0s - loss: 0.5279 - accuracy: 0.6603  
Epoch 117: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 794ms/step - loss: 0.5279 - accuracy: 0.6603 - val\_loss: 0.7262 - val\_accuracy: 0.6425  
Epoch 118/300  
7/7 [=====] - ETA: 0s - loss: 0.5452 - accuracy: 0.6369  
Epoch 118: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 788ms/step - loss: 0.5452 - accuracy: 0.6369 - val\_loss: 0.7933 - val\_accuracy: 0.6062  
Epoch 119/300  
7/7 [=====] - ETA: 0s - loss: 0.5327 - accuracy: 0.6302  
Epoch 119: val\_accuracy did not improve from 0.67876

7/7 [=====] - 5s 776ms/step - loss: 0.5327 - accuracy: 0.6302 - val\_loss: 0.7515 - val\_accuracy: 0.6477  
Epoch 120/300  
7/7 [=====] - ETA: 0s - loss: 0.5208 - accuracy: 0.6324  
Epoch 120: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 800ms/step - loss: 0.5208 - accuracy: 0.6324 - val\_loss: 0.7291 - val\_accuracy: 0.6580  
Epoch 121/300  
7/7 [=====] - ETA: 0s - loss: 0.5688 - accuracy: 0.6268  
Epoch 121: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 802ms/step - loss: 0.5688 - accuracy: 0.6268 - val\_loss: 0.7327 - val\_accuracy: 0.6477  
Epoch 122/300  
7/7 [=====] - ETA: 0s - loss: 0.5467 - accuracy: 0.6413  
Epoch 122: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 763ms/step - loss: 0.5467 - accuracy: 0.6413 - val\_loss: 0.7197 - val\_accuracy: 0.6528  
Epoch 123/300  
7/7 [=====] - ETA: 0s - loss: 0.5233 - accuracy: 0.6436  
Epoch 123: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 774ms/step - loss: 0.5233 - accuracy: 0.6436 - val\_loss: 0.7901 - val\_accuracy: 0.6321  
Epoch 124/300  
7/7 [=====] - ETA: 0s - loss: 0.5282 - accuracy: 0.6268  
Epoch 124: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 766ms/step - loss: 0.5282 - accuracy: 0.6268 - val\_loss: 0.6879 - val\_accuracy: 0.6684  
Epoch 125/300  
7/7 [=====] - ETA: 0s - loss: 0.5598 - accuracy: 0.6615  
Epoch 125: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 792ms/step - loss: 0.5598 - accuracy: 0.6615 - val\_loss: 0.8415 - val\_accuracy: 0.5855  
Epoch 126/300  
7/7 [=====] - ETA: 0s - loss: 0.5695 - accuracy: 0.6201  
Epoch 126: val\_accuracy improved from 0.67876 to 0.72021, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 817ms/step - loss: 0.5695 - accuracy: 0.6201 - val\_loss: 0.6639 - val\_accuracy: 0.7202  
Epoch 127/300  
7/7 [=====] - ETA: 0s - loss: 0.5159 - accuracy: 0.6793  
Epoch 127: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 786ms/step - loss: 0.5159 - accuracy: 0.6793 - val\_loss: 0.8395 - val\_accuracy: 0.5907  
Epoch 128/300  
7/7 [=====] - ETA: 0s - loss: 0.5439 - accuracy: 0.6168  
Epoch 128: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 7s 1s/step - loss: 0.5439 - accuracy: 0.6168 - val\_loss: 0.7169 - val\_accuracy: 0.6788  
Epoch 129/300  
7/7 [=====] - ETA: 0s - loss: 0.5400 - accuracy: 0.6056  
Epoch 129: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 756ms/step - loss: 0.5400 - accuracy: 0.6056 - val\_loss: 0.8265 - val\_accuracy: 0.5959  
Epoch 130/300  
7/7 [=====] - ETA: 0s - loss: 0.5510 - accuracy: 0.6447  
Epoch 130: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 801ms/step - loss: 0.5510 - accuracy: 0.6447 - val\_loss: 0.7824 - val\_accuracy: 0.6269  
Epoch 131/300  
7/7 [=====] - ETA: 0s - loss: 0.5683 - accuracy: 0.6078  
Epoch 131: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 785ms/step - loss: 0.5683 - accuracy: 0.6078 - val\_loss: 0.7361 - val\_accuracy: 0.6632  
Epoch 132/300  
7/7 [=====] - ETA: 0s - loss: 0.5194 - accuracy: 0.6782  
Epoch 132: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 784ms/step - loss: 0.5194 - accuracy: 0.6782 - val\_loss: 0.7227 - val\_accuracy: 0.6425  
Epoch 133/300  
7/7 [=====] - ETA: 0s - loss: 0.5182 - accuracy: 0.6313  
Epoch 133: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 792ms/step - loss: 0.5182 - accuracy: 0.6313 - val\_loss: 0.7359 - val\_accuracy: 0.6580  
Epoch 134/300  
7/7 [=====] - ETA: 0s - loss: 0.5179 - accuracy: 0.6358  
Epoch 134: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 812ms/step - loss: 0.5179 - accuracy: 0.6358 - val\_loss: 0.7428 - val\_accuracy: 0.6425  
Epoch 135/300  
7/7 [=====] - ETA: 0s - loss: 0.5190 - accuracy: 0.6603  
Epoch 135: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 787ms/step - loss: 0.5190 - accuracy: 0.6603 - val\_loss: 0.6999 - val\_accuracy: 0.6736  
Epoch 136/300

7/7 [=====] - ETA: 0s - loss: 0.5330 - accuracy: 0.6447  
Epoch 136: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 788ms/step - loss: 0.5330 - accuracy: 0.6447 - val\_loss: 0.7158 - val\_accuracy: 0.6632  
Epoch 137/300  
7/7 [=====] - ETA: 0s - loss: 0.5255 - accuracy: 0.6637  
Epoch 137: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 776ms/step - loss: 0.5255 - accuracy: 0.6637 - val\_loss: 0.7624 - val\_accuracy: 0.6373  
Epoch 138/300  
7/7 [=====] - ETA: 0s - loss: 0.5082 - accuracy: 0.6413  
Epoch 138: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 767ms/step - loss: 0.5082 - accuracy: 0.6413 - val\_loss: 0.6929 - val\_accuracy: 0.6632  
Epoch 139/300  
7/7 [=====] - ETA: 0s - loss: 0.5198 - accuracy: 0.6603  
Epoch 139: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 770ms/step - loss: 0.5198 - accuracy: 0.6603 - val\_loss: 0.7556 - val\_accuracy: 0.6010  
Epoch 140/300  
7/7 [=====] - ETA: 0s - loss: 0.4912 - accuracy: 0.6223  
Epoch 140: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 788ms/step - loss: 0.4912 - accuracy: 0.6223 - val\_loss: 0.6853 - val\_accuracy: 0.6580  
Epoch 141/300  
7/7 [=====] - ETA: 0s - loss: 0.5248 - accuracy: 0.6726  
Epoch 141: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 788ms/step - loss: 0.5248 - accuracy: 0.6726 - val\_loss: 0.8172 - val\_accuracy: 0.5751  
Epoch 142/300  
7/7 [=====] - ETA: 0s - loss: 0.5137 - accuracy: 0.6603  
Epoch 142: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 798ms/step - loss: 0.5137 - accuracy: 0.6603 - val\_loss: 0.6755 - val\_accuracy: 0.7098  
Epoch 143/300  
7/7 [=====] - ETA: 0s - loss: 0.5178 - accuracy: 0.6436  
Epoch 143: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 816ms/step - loss: 0.5178 - accuracy: 0.6436 - val\_loss: 0.7434 - val\_accuracy: 0.6580  
Epoch 144/300  
7/7 [=====] - ETA: 0s - loss: 0.5323 - accuracy: 0.6447  
Epoch 144: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 805ms/step - loss: 0.5323 - accuracy: 0.6447 - val\_loss: 0.6856 - val\_accuracy: 0.6995  
Epoch 145/300  
7/7 [=====] - ETA: 0s - loss: 0.5301 - accuracy: 0.6492  
Epoch 145: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 781ms/step - loss: 0.5301 - accuracy: 0.6492 - val\_loss: 0.7299 - val\_accuracy: 0.6425  
Epoch 146/300  
7/7 [=====] - ETA: 0s - loss: 0.5199 - accuracy: 0.6603  
Epoch 146: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 777ms/step - loss: 0.5199 - accuracy: 0.6603 - val\_loss: 0.6861 - val\_accuracy: 0.6684  
Epoch 147/300  
7/7 [=====] - ETA: 0s - loss: 0.4954 - accuracy: 0.6749  
Epoch 147: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 806ms/step - loss: 0.4954 - accuracy: 0.6749 - val\_loss: 0.7188 - val\_accuracy: 0.6373  
Epoch 148/300  
7/7 [=====] - ETA: 0s - loss: 0.5118 - accuracy: 0.6547  
Epoch 148: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 805ms/step - loss: 0.5118 - accuracy: 0.6547 - val\_loss: 0.6799 - val\_accuracy: 0.7098  
Epoch 149/300  
7/7 [=====] - ETA: 0s - loss: 0.5281 - accuracy: 0.6235  
Epoch 149: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 795ms/step - loss: 0.5281 - accuracy: 0.6235 - val\_loss: 0.6949 - val\_accuracy: 0.6736  
Epoch 150/300  
7/7 [=====] - ETA: 0s - loss: 0.5171 - accuracy: 0.6615  
Epoch 150: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 764ms/step - loss: 0.5171 - accuracy: 0.6615 - val\_loss: 0.7384 - val\_accuracy: 0.6114  
Epoch 151/300  
7/7 [=====] - ETA: 0s - loss: 0.5311 - accuracy: 0.6682  
Epoch 151: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 802ms/step - loss: 0.5311 - accuracy: 0.6682 - val\_loss: 0.7017 - val\_accuracy: 0.6425  
Epoch 152/300  
7/7 [=====] - ETA: 0s - loss: 0.5102 - accuracy: 0.6358  
Epoch 152: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 794ms/step - loss: 0.5102 - accuracy: 0.6358 - val\_loss: 0

.7100 - val\_accuracy: 0.6684  
Epoch 153/300  
7/7 [=====] - ETA: 0s - loss: 0.5058 - accuracy: 0.6570  
Epoch 153: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 792ms/step - loss: 0.5058 - accuracy: 0.6570 - val\_loss: 0.6604 - val\_accuracy: 0.6788  
Epoch 154/300  
7/7 [=====] - ETA: 0s - loss: 0.4993 - accuracy: 0.6525  
Epoch 154: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 813ms/step - loss: 0.4993 - accuracy: 0.6525 - val\_loss: 0.7366 - val\_accuracy: 0.6269  
Epoch 155/300  
7/7 [=====] - ETA: 0s - loss: 0.4906 - accuracy: 0.6771  
Epoch 155: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 800ms/step - loss: 0.4906 - accuracy: 0.6771 - val\_loss: 0.6640 - val\_accuracy: 0.6839  
Epoch 156/300  
7/7 [=====] - ETA: 0s - loss: 0.5013 - accuracy: 0.6838  
Epoch 156: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 794ms/step - loss: 0.5013 - accuracy: 0.6838 - val\_loss: 0.7093 - val\_accuracy: 0.6477  
Epoch 157/300  
7/7 [=====] - ETA: 0s - loss: 0.4826 - accuracy: 0.6894  
Epoch 157: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 773ms/step - loss: 0.4826 - accuracy: 0.6894 - val\_loss: 0.6856 - val\_accuracy: 0.6943  
Epoch 158/300  
7/7 [=====] - ETA: 0s - loss: 0.5037 - accuracy: 0.6291  
Epoch 158: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 777ms/step - loss: 0.5037 - accuracy: 0.6291 - val\_loss: 0.6818 - val\_accuracy: 0.6632  
Epoch 159/300  
7/7 [=====] - ETA: 0s - loss: 0.4788 - accuracy: 0.7151  
Epoch 159: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 777ms/step - loss: 0.4788 - accuracy: 0.7151 - val\_loss: 0.7079 - val\_accuracy: 0.6477  
Epoch 160/300  
7/7 [=====] - ETA: 0s - loss: 0.4392 - accuracy: 0.6816  
Epoch 160: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 778ms/step - loss: 0.4392 - accuracy: 0.6816 - val\_loss: 0.6106 - val\_accuracy: 0.7202  
Epoch 161/300  
7/7 [=====] - ETA: 0s - loss: 0.4875 - accuracy: 0.6693  
Epoch 161: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 799ms/step - loss: 0.4875 - accuracy: 0.6693 - val\_loss: 0.6777 - val\_accuracy: 0.6684  
Epoch 162/300  
7/7 [=====] - ETA: 0s - loss: 0.4973 - accuracy: 0.6726  
Epoch 162: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 800ms/step - loss: 0.4973 - accuracy: 0.6726 - val\_loss: 0.7174 - val\_accuracy: 0.5855  
Epoch 163/300  
7/7 [=====] - ETA: 0s - loss: 0.5321 - accuracy: 0.6335  
Epoch 163: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 8s 1s/step - loss: 0.5321 - accuracy: 0.6335 - val\_loss: 0.6569 - val\_accuracy: 0.6995  
Epoch 164/300  
7/7 [=====] - ETA: 0s - loss: 0.4878 - accuracy: 0.7151  
Epoch 164: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 804ms/step - loss: 0.4878 - accuracy: 0.7151 - val\_loss: 0.7023 - val\_accuracy: 0.6736  
Epoch 165/300  
7/7 [=====] - ETA: 0s - loss: 0.4840 - accuracy: 0.6391  
Epoch 165: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 803ms/step - loss: 0.4840 - accuracy: 0.6391 - val\_loss: 0.6418 - val\_accuracy: 0.6943  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.4661 - accuracy: 0.7061  
Epoch 166: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 791ms/step - loss: 0.4661 - accuracy: 0.7061 - val\_loss: 0.7418 - val\_accuracy: 0.6321  
Epoch 167/300  
7/7 [=====] - ETA: 0s - loss: 0.4469 - accuracy: 0.6939  
Epoch 167: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 808ms/step - loss: 0.4469 - accuracy: 0.6939 - val\_loss: 0.6361 - val\_accuracy: 0.6839  
Epoch 168/300  
7/7 [=====] - ETA: 0s - loss: 0.4620 - accuracy: 0.7073  
Epoch 168: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 790ms/step - loss: 0.4620 - accuracy: 0.7073 - val\_loss: 0.7337 - val\_accuracy: 0.6477  
Epoch 169/300  
7/7 [=====] - ETA: 0s - loss: 0.5036 - accuracy: 0.6704



Epoch 169: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 798ms/step - loss: 0.5036 - accuracy: 0.6704 - val\_loss: 0.6368 - val\_accuracy: 0.6839  
Epoch 170/300  
7/7 [=====] - ETA: 0s - loss: 0.5098 - accuracy: 0.6670  
Epoch 170: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 800ms/step - loss: 0.5098 - accuracy: 0.6670 - val\_loss: 0.6773 - val\_accuracy: 0.6684  
Epoch 171/300  
7/7 [=====] - ETA: 0s - loss: 0.4721 - accuracy: 0.6983  
Epoch 171: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 808ms/step - loss: 0.4721 - accuracy: 0.6983 - val\_loss: 0.7216 - val\_accuracy: 0.6580  
Epoch 172/300  
7/7 [=====] - ETA: 0s - loss: 0.4637 - accuracy: 0.6793  
Epoch 172: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 777ms/step - loss: 0.4637 - accuracy: 0.6793 - val\_loss: 0.6827 - val\_accuracy: 0.6528  
Epoch 173/300  
7/7 [=====] - ETA: 0s - loss: 0.4858 - accuracy: 0.6581  
Epoch 173: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 797ms/step - loss: 0.4858 - accuracy: 0.6581 - val\_loss: 0.6946 - val\_accuracy: 0.6684  
Epoch 174/300  
7/7 [=====] - ETA: 0s - loss: 0.4804 - accuracy: 0.7095  
Epoch 174: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 783ms/step - loss: 0.4804 - accuracy: 0.7095 - val\_loss: 0.6754 - val\_accuracy: 0.6788  
Epoch 175/300  
7/7 [=====] - ETA: 0s - loss: 0.4898 - accuracy: 0.6905  
Epoch 175: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 789ms/step - loss: 0.4898 - accuracy: 0.6905 - val\_loss: 0.6847 - val\_accuracy: 0.6528  
Epoch 176/300  
7/7 [=====] - ETA: 0s - loss: 0.4798 - accuracy: 0.6737  
Epoch 176: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 811ms/step - loss: 0.4798 - accuracy: 0.6737 - val\_loss: 0.6398 - val\_accuracy: 0.6736  
Epoch 177/300  
7/7 [=====] - ETA: 0s - loss: 0.4685 - accuracy: 0.6872  
Epoch 177: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 808ms/step - loss: 0.4685 - accuracy: 0.6872 - val\_loss: 0.6599 - val\_accuracy: 0.6736  
Epoch 178/300  
7/7 [=====] - ETA: 0s - loss: 0.4664 - accuracy: 0.6715  
Epoch 178: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 792ms/step - loss: 0.4664 - accuracy: 0.6715 - val\_loss: 0.6333 - val\_accuracy: 0.7098  
Epoch 179/300  
7/7 [=====] - ETA: 0s - loss: 0.4498 - accuracy: 0.7106  
Epoch 179: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 813ms/step - loss: 0.4498 - accuracy: 0.7106 - val\_loss: 0.7208 - val\_accuracy: 0.6166  
Epoch 180/300  
7/7 [=====] - ETA: 0s - loss: 0.4636 - accuracy: 0.6760  
Epoch 180: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 832ms/step - loss: 0.4636 - accuracy: 0.6760 - val\_loss: 0.6374 - val\_accuracy: 0.7202  
Epoch 181/300  
7/7 [=====] - ETA: 0s - loss: 0.4483 - accuracy: 0.6983  
Epoch 181: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 5s 773ms/step - loss: 0.4483 - accuracy: 0.6983 - val\_loss: 0.6833 - val\_accuracy: 0.6736  
Epoch 182/300  
7/7 [=====] - ETA: 0s - loss: 0.4516 - accuracy: 0.6972  
Epoch 182: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 800ms/step - loss: 0.4516 - accuracy: 0.6972 - val\_loss: 0.6100 - val\_accuracy: 0.7202  
Epoch 183/300  
7/7 [=====] - ETA: 0s - loss: 0.4414 - accuracy: 0.7084  
Epoch 183: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 806ms/step - loss: 0.4414 - accuracy: 0.7084 - val\_loss: 0.6642 - val\_accuracy: 0.6528  
Epoch 184/300  
7/7 [=====] - ETA: 0s - loss: 0.4403 - accuracy: 0.7151  
Epoch 184: val\_accuracy did not improve from 0.72021  
7/7 [=====] - 6s 803ms/step - loss: 0.4403 - accuracy: 0.7151 - val\_loss: 0.6806 - val\_accuracy: 0.6528  
Epoch 185/300  
7/7 [=====] - ETA: 0s - loss: 0.4467 - accuracy: 0.6860  
Epoch 185: val\_accuracy improved from 0.72021 to 0.73575, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 814ms/step - loss: 0.4467 - accuracy: 0.6860 - val\_loss: 0.6030 - val\_accuracy: 0.7358

Epoch 186/300  
7/7 [=====] - ETA: 0s - loss: 0.4642 - accuracy: 0.6827  
Epoch 186: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 803ms/step - loss: 0.4642 - accuracy: 0.6827 - val\_loss: 0.6625 - val\_accuracy: 0.6684  
Epoch 187/300  
7/7 [=====] - ETA: 0s - loss: 0.4403 - accuracy: 0.7095  
Epoch 187: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 5s 784ms/step - loss: 0.4403 - accuracy: 0.7095 - val\_loss: 0.6625 - val\_accuracy: 0.6425  
Epoch 188/300  
7/7 [=====] - ETA: 0s - loss: 0.4347 - accuracy: 0.7028  
Epoch 188: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 5s 782ms/step - loss: 0.4347 - accuracy: 0.7028 - val\_loss: 0.6478 - val\_accuracy: 0.6477  
Epoch 189/300  
7/7 [=====] - ETA: 0s - loss: 0.4581 - accuracy: 0.7028  
Epoch 189: val\_accuracy improved from 0.73575 to 0.75130, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 787ms/step - loss: 0.4581 - accuracy: 0.7028 - val\_loss: 0.5991 - val\_accuracy: 0.7513  
Epoch 190/300  
7/7 [=====] - ETA: 0s - loss: 0.4534 - accuracy: 0.7140  
Epoch 190: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 764ms/step - loss: 0.4534 - accuracy: 0.7140 - val\_loss: 0.6802 - val\_accuracy: 0.6580  
Epoch 191/300  
7/7 [=====] - ETA: 0s - loss: 0.4489 - accuracy: 0.6983  
Epoch 191: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 804ms/step - loss: 0.4489 - accuracy: 0.6983 - val\_loss: 0.6147 - val\_accuracy: 0.6891  
Epoch 192/300  
7/7 [=====] - ETA: 0s - loss: 0.4484 - accuracy: 0.7061  
Epoch 192: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 779ms/step - loss: 0.4484 - accuracy: 0.7061 - val\_loss: 0.6629 - val\_accuracy: 0.6839  
Epoch 193/300  
7/7 [=====] - ETA: 0s - loss: 0.4321 - accuracy: 0.7430  
Epoch 193: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 810ms/step - loss: 0.4321 - accuracy: 0.7430 - val\_loss: 0.6046 - val\_accuracy: 0.6995  
Epoch 194/300  
7/7 [=====] - ETA: 0s - loss: 0.4284 - accuracy: 0.6883  
Epoch 194: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 772ms/step - loss: 0.4284 - accuracy: 0.6883 - val\_loss: 0.5995 - val\_accuracy: 0.7098  
Epoch 195/300  
7/7 [=====] - ETA: 0s - loss: 0.4276 - accuracy: 0.7374  
Epoch 195: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 788ms/step - loss: 0.4276 - accuracy: 0.7374 - val\_loss: 0.6597 - val\_accuracy: 0.6580  
Epoch 196/300  
7/7 [=====] - ETA: 0s - loss: 0.4179 - accuracy: 0.7050  
Epoch 196: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 810ms/step - loss: 0.4179 - accuracy: 0.7050 - val\_loss: 0.5615 - val\_accuracy: 0.7409  
Epoch 197/300  
7/7 [=====] - ETA: 0s - loss: 0.4459 - accuracy: 0.6983  
Epoch 197: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 809ms/step - loss: 0.4459 - accuracy: 0.6983 - val\_loss: 0.6234 - val\_accuracy: 0.6995  
Epoch 198/300  
7/7 [=====] - ETA: 0s - loss: 0.4551 - accuracy: 0.7184  
Epoch 198: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 890ms/step - loss: 0.4551 - accuracy: 0.7184 - val\_loss: 0.7810 - val\_accuracy: 0.5959  
Epoch 199/300  
7/7 [=====] - ETA: 0s - loss: 0.4446 - accuracy: 0.7073  
Epoch 199: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 7s 961ms/step - loss: 0.4446 - accuracy: 0.7073 - val\_loss: 0.5832 - val\_accuracy: 0.6943  
Epoch 200/300  
7/7 [=====] - ETA: 0s - loss: 0.4259 - accuracy: 0.7263  
Epoch 200: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 801ms/step - loss: 0.4259 - accuracy: 0.7263 - val\_loss: 0.6312 - val\_accuracy: 0.6891  
Epoch 201/300  
7/7 [=====] - ETA: 0s - loss: 0.4320 - accuracy: 0.6994  
Epoch 201: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 796ms/step - loss: 0.4320 - accuracy: 0.6994 - val\_loss: 0.5963 - val\_accuracy: 0.7098  
Epoch 202/300  
7/7 [=====] - ETA: 0s - loss: 0.4107 - accuracy: 0.7352  
Epoch 202: val\_accuracy did not improve from 0.75130

7/7 [=====] - 6s 810ms/step - loss: 0.4107 - accuracy: 0.7352 - val\_loss: 0.6082 - val\_accuracy: 0.6891  
Epoch 203/300  
7/7 [=====] - ETA: 0s - loss: 0.4099 - accuracy: 0.7307  
Epoch 203: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 779ms/step - loss: 0.4099 - accuracy: 0.7307 - val\_loss: 0.6410 - val\_accuracy: 0.6580  
Epoch 204/300  
7/7 [=====] - ETA: 0s - loss: 0.4017 - accuracy: 0.7006  
Epoch 204: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 823ms/step - loss: 0.4017 - accuracy: 0.7006 - val\_loss: 0.5583 - val\_accuracy: 0.7150  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.4573 - accuracy: 0.7084  
Epoch 205: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 802ms/step - loss: 0.4573 - accuracy: 0.7084 - val\_loss: 0.5649 - val\_accuracy: 0.7098  
Epoch 206/300  
7/7 [=====] - ETA: 0s - loss: 0.4071 - accuracy: 0.7296  
Epoch 206: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 796ms/step - loss: 0.4071 - accuracy: 0.7296 - val\_loss: 0.6579 - val\_accuracy: 0.6632  
Epoch 207/300  
7/7 [=====] - ETA: 0s - loss: 0.4076 - accuracy: 0.7341  
Epoch 207: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 806ms/step - loss: 0.4076 - accuracy: 0.7341 - val\_loss: 0.5756 - val\_accuracy: 0.7098  
Epoch 208/300  
7/7 [=====] - ETA: 0s - loss: 0.4301 - accuracy: 0.7028  
Epoch 208: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 781ms/step - loss: 0.4301 - accuracy: 0.7028 - val\_loss: 0.5525 - val\_accuracy: 0.7409  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.4344 - accuracy: 0.6994  
Epoch 209: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 803ms/step - loss: 0.4344 - accuracy: 0.6994 - val\_loss: 0.7867 - val\_accuracy: 0.5648  
Epoch 210/300  
7/7 [=====] - ETA: 0s - loss: 0.4307 - accuracy: 0.7184  
Epoch 210: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 5s 766ms/step - loss: 0.4307 - accuracy: 0.7184 - val\_loss: 0.5991 - val\_accuracy: 0.6943  
Epoch 211/300  
7/7 [=====] - ETA: 0s - loss: 0.4285 - accuracy: 0.6715  
Epoch 211: val\_accuracy improved from 0.75130 to 0.78238, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 776ms/step - loss: 0.4285 - accuracy: 0.6715 - val\_loss: 0.5249 - val\_accuracy: 0.7824  
Epoch 212/300  
7/7 [=====] - ETA: 0s - loss: 0.4117 - accuracy: 0.7765  
Epoch 212: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 802ms/step - loss: 0.4117 - accuracy: 0.7765 - val\_loss: 0.6659 - val\_accuracy: 0.6684  
Epoch 213/300  
7/7 [=====] - ETA: 0s - loss: 0.4267 - accuracy: 0.7263  
Epoch 213: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 764ms/step - loss: 0.4267 - accuracy: 0.7263 - val\_loss: 0.5416 - val\_accuracy: 0.7565  
Epoch 214/300  
7/7 [=====] - ETA: 0s - loss: 0.4208 - accuracy: 0.7050  
Epoch 214: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 778ms/step - loss: 0.4208 - accuracy: 0.7050 - val\_loss: 0.6686 - val\_accuracy: 0.6477  
Epoch 215/300  
7/7 [=====] - ETA: 0s - loss: 0.4080 - accuracy: 0.7397  
Epoch 215: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 783ms/step - loss: 0.4080 - accuracy: 0.7397 - val\_loss: 0.6008 - val\_accuracy: 0.6788  
Epoch 216/300  
7/7 [=====] - ETA: 0s - loss: 0.3900 - accuracy: 0.7263  
Epoch 216: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 790ms/step - loss: 0.3900 - accuracy: 0.7263 - val\_loss: 0.5392 - val\_accuracy: 0.7150  
Epoch 217/300  
7/7 [=====] - ETA: 0s - loss: 0.3722 - accuracy: 0.7665  
Epoch 217: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 791ms/step - loss: 0.3722 - accuracy: 0.7665 - val\_loss: 0.6535 - val\_accuracy: 0.6477  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.3706 - accuracy: 0.7575  
Epoch 218: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 786ms/step - loss: 0.3706 - accuracy: 0.7575 - val\_loss: 0.5564 - val\_accuracy: 0.6891  
Epoch 219/300

7/7 [=====] - ETA: 0s - loss: 0.4316 - accuracy: 0.7140  
Epoch 219: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 778ms/step - loss: 0.4316 - accuracy: 0.7140 - val\_loss: 0.5219 - val\_accuracy: 0.7409  
Epoch 220/300  
7/7 [=====] - ETA: 0s - loss: 0.4006 - accuracy: 0.7285  
Epoch 220: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 775ms/step - loss: 0.4006 - accuracy: 0.7285 - val\_loss: 0.7317 - val\_accuracy: 0.6218  
Epoch 221/300  
7/7 [=====] - ETA: 0s - loss: 0.3840 - accuracy: 0.7419  
Epoch 221: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 777ms/step - loss: 0.3840 - accuracy: 0.7419 - val\_loss: 0.5570 - val\_accuracy: 0.7461  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.3770 - accuracy: 0.7263  
Epoch 222: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 772ms/step - loss: 0.3770 - accuracy: 0.7263 - val\_loss: 0.5377 - val\_accuracy: 0.7409  
Epoch 223/300  
7/7 [=====] - ETA: 0s - loss: 0.3699 - accuracy: 0.7542  
Epoch 223: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 819ms/step - loss: 0.3699 - accuracy: 0.7542 - val\_loss: 0.6084 - val\_accuracy: 0.6632  
Epoch 224/300  
7/7 [=====] - ETA: 0s - loss: 0.3771 - accuracy: 0.7397  
Epoch 224: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 782ms/step - loss: 0.3771 - accuracy: 0.7397 - val\_loss: 0.6077 - val\_accuracy: 0.6736  
Epoch 225/300  
7/7 [=====] - ETA: 0s - loss: 0.4243 - accuracy: 0.7218  
Epoch 225: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 7s 1s/step - loss: 0.4243 - accuracy: 0.7218 - val\_loss: 0.6232 - val\_accuracy: 0.6736  
Epoch 226/300  
7/7 [=====] - ETA: 0s - loss: 0.4105 - accuracy: 0.7363  
Epoch 226: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 805ms/step - loss: 0.4105 - accuracy: 0.7363 - val\_loss: 0.5726 - val\_accuracy: 0.7720  
Epoch 227/300  
7/7 [=====] - ETA: 0s - loss: 0.3863 - accuracy: 0.7654  
Epoch 227: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 805ms/step - loss: 0.3863 - accuracy: 0.7654 - val\_loss: 0.5954 - val\_accuracy: 0.7254  
Epoch 228/300  
7/7 [=====] - ETA: 0s - loss: 0.3956 - accuracy: 0.7073  
Epoch 228: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 818ms/step - loss: 0.3956 - accuracy: 0.7073 - val\_loss: 0.5680 - val\_accuracy: 0.6891  
Epoch 229/300  
7/7 [=====] - ETA: 0s - loss: 0.3643 - accuracy: 0.7709  
Epoch 229: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 789ms/step - loss: 0.3643 - accuracy: 0.7709 - val\_loss: 0.6011 - val\_accuracy: 0.6839  
Epoch 230/300  
7/7 [=====] - ETA: 0s - loss: 0.3699 - accuracy: 0.7330  
Epoch 230: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 769ms/step - loss: 0.3699 - accuracy: 0.7330 - val\_loss: 0.4905 - val\_accuracy: 0.7772  
Epoch 231/300  
7/7 [=====] - ETA: 0s - loss: 0.3655 - accuracy: 0.7631  
Epoch 231: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 806ms/step - loss: 0.3655 - accuracy: 0.7631 - val\_loss: 0.5769 - val\_accuracy: 0.7306  
Epoch 232/300  
7/7 [=====] - ETA: 0s - loss: 0.3512 - accuracy: 0.7676  
Epoch 232: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 798ms/step - loss: 0.3512 - accuracy: 0.7676 - val\_loss: 0.5252 - val\_accuracy: 0.7306  
Epoch 233/300  
7/7 [=====] - ETA: 0s - loss: 0.3539 - accuracy: 0.7542  
Epoch 233: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 8s 1s/step - loss: 0.3539 - accuracy: 0.7542 - val\_loss: 0.5492 - val\_accuracy: 0.7098  
Epoch 234/300  
7/7 [=====] - ETA: 0s - loss: 0.3739 - accuracy: 0.7810  
Epoch 234: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 799ms/step - loss: 0.3739 - accuracy: 0.7810 - val\_loss: 0.4991 - val\_accuracy: 0.7617  
Epoch 235/300  
7/7 [=====] - ETA: 0s - loss: 0.3729 - accuracy: 0.7821  
Epoch 235: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 834ms/step - loss: 0.3729 - accuracy: 0.7821 - val\_loss: 0

.6205 - val\_accuracy: 0.6891  
Epoch 236/300  
7/7 [=====] - ETA: 0s - loss: 0.3691 - accuracy: 0.7531  
Epoch 236: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 788ms/step - loss: 0.3691 - accuracy: 0.7531 - val\_loss: 0  
.5201 - val\_accuracy: 0.7565  
Epoch 237/300  
7/7 [=====] - ETA: 0s - loss: 0.3670 - accuracy: 0.7486  
Epoch 237: val\_accuracy improved from 0.78238 to 0.80311, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 812ms/step - loss: 0.3670 - accuracy: 0.7486 - val\_loss: 0  
.4749 - val\_accuracy: 0.8031  
Epoch 238/300  
7/7 [=====] - ETA: 0s - loss: 0.3629 - accuracy: 0.7821  
Epoch 238: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 779ms/step - loss: 0.3629 - accuracy: 0.7821 - val\_loss: 0  
.6036 - val\_accuracy: 0.7047  
Epoch 239/300  
7/7 [=====] - ETA: 0s - loss: 0.3616 - accuracy: 0.7631  
Epoch 239: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 781ms/step - loss: 0.3616 - accuracy: 0.7631 - val\_loss: 0  
.5079 - val\_accuracy: 0.7720  
Epoch 240/300  
7/7 [=====] - ETA: 0s - loss: 0.3562 - accuracy: 0.7352  
Epoch 240: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 805ms/step - loss: 0.3562 - accuracy: 0.7352 - val\_loss: 0  
.4542 - val\_accuracy: 0.7824  
Epoch 241/300  
7/7 [=====] - ETA: 0s - loss: 0.3854 - accuracy: 0.7732  
Epoch 241: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 789ms/step - loss: 0.3854 - accuracy: 0.7732 - val\_loss: 0  
.6370 - val\_accuracy: 0.6528  
Epoch 242/300  
7/7 [=====] - ETA: 0s - loss: 0.4131 - accuracy: 0.7531  
Epoch 242: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 813ms/step - loss: 0.4131 - accuracy: 0.7531 - val\_loss: 0  
.5193 - val\_accuracy: 0.7565  
Epoch 243/300  
7/7 [=====] - ETA: 0s - loss: 0.3829 - accuracy: 0.7374  
Epoch 243: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 781ms/step - loss: 0.3829 - accuracy: 0.7374 - val\_loss: 0  
.4938 - val\_accuracy: 0.7876  
Epoch 244/300  
7/7 [=====] - ETA: 0s - loss: 0.3833 - accuracy: 0.7397  
Epoch 244: val\_accuracy improved from 0.80311 to 0.82383, saving model to /content/weights.best.hdf5  
7/7 [=====] - 9s 1s/step - loss: 0.3833 - accuracy: 0.7397 - val\_loss: 0.46  
00 - val\_accuracy: 0.8238  
Epoch 245/300  
7/7 [=====] - ETA: 0s - loss: 0.3476 - accuracy: 0.7676  
Epoch 245: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 790ms/step - loss: 0.3476 - accuracy: 0.7676 - val\_loss: 0  
.5929 - val\_accuracy: 0.7150  
Epoch 246/300  
7/7 [=====] - ETA: 0s - loss: 0.3418 - accuracy: 0.7654  
Epoch 246: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 798ms/step - loss: 0.3418 - accuracy: 0.7654 - val\_loss: 0  
.4480 - val\_accuracy: 0.8031  
Epoch 247/300  
7/7 [=====] - ETA: 0s - loss: 0.3660 - accuracy: 0.7497  
Epoch 247: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 767ms/step - loss: 0.3660 - accuracy: 0.7497 - val\_loss: 0  
.4415 - val\_accuracy: 0.8187  
Epoch 248/300  
7/7 [=====] - ETA: 0s - loss: 0.3601 - accuracy: 0.7989  
Epoch 248: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 766ms/step - loss: 0.3601 - accuracy: 0.7989 - val\_loss: 0  
.6345 - val\_accuracy: 0.6891  
Epoch 249/300  
7/7 [=====] - ETA: 0s - loss: 0.3654 - accuracy: 0.7453  
Epoch 249: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 802ms/step - loss: 0.3654 - accuracy: 0.7453 - val\_loss: 0  
.4776 - val\_accuracy: 0.7979  
Epoch 250/300  
7/7 [=====] - ETA: 0s - loss: 0.3558 - accuracy: 0.7743  
Epoch 250: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 792ms/step - loss: 0.3558 - accuracy: 0.7743 - val\_loss: 0  
.5574 - val\_accuracy: 0.7098  
Epoch 251/300  
7/7 [=====] - ETA: 0s - loss: 0.3419 - accuracy: 0.7721  
Epoch 251: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 767ms/step - loss: 0.3419 - accuracy: 0.7721 - val\_loss: 0  
.5237 - val\_accuracy: 0.7513  
Epoch 252/300  
7/7 [=====] - ETA: 0s - loss: 0.3387 - accuracy: 0.7832

Epoch 252: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 777ms/step - loss: 0.3387 - accuracy: 0.7832 - val\_loss: 0.4771 - val\_accuracy: 0.7876  
Epoch 253/300  
7/7 [=====] - ETA: 0s - loss: 0.3451 - accuracy: 0.7631  
Epoch 253: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 800ms/step - loss: 0.3451 - accuracy: 0.7631 - val\_loss: 0.5083 - val\_accuracy: 0.7565  
Epoch 254/300  
7/7 [=====] - ETA: 0s - loss: 0.3292 - accuracy: 0.8089  
Epoch 254: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 786ms/step - loss: 0.3292 - accuracy: 0.8089 - val\_loss: 0.6239 - val\_accuracy: 0.6736  
Epoch 255/300  
7/7 [=====] - ETA: 0s - loss: 0.3595 - accuracy: 0.7587  
Epoch 255: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 822ms/step - loss: 0.3595 - accuracy: 0.7587 - val\_loss: 0.4484 - val\_accuracy: 0.8083  
Epoch 256/300  
7/7 [=====] - ETA: 0s - loss: 0.3705 - accuracy: 0.7821  
Epoch 256: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 807ms/step - loss: 0.3705 - accuracy: 0.7821 - val\_loss: 0.5647 - val\_accuracy: 0.6891  
Epoch 257/300  
7/7 [=====] - ETA: 0s - loss: 0.3708 - accuracy: 0.7832  
Epoch 257: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 783ms/step - loss: 0.3708 - accuracy: 0.7832 - val\_loss: 0.4757 - val\_accuracy: 0.7824  
Epoch 258/300  
7/7 [=====] - ETA: 0s - loss: 0.3560 - accuracy: 0.7732  
Epoch 258: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 783ms/step - loss: 0.3560 - accuracy: 0.7732 - val\_loss: 0.5146 - val\_accuracy: 0.7617  
Epoch 259/300  
7/7 [=====] - ETA: 0s - loss: 0.3638 - accuracy: 0.7698  
Epoch 259: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 772ms/step - loss: 0.3638 - accuracy: 0.7698 - val\_loss: 0.4662 - val\_accuracy: 0.7979  
Epoch 260/300  
7/7 [=====] - ETA: 0s - loss: 0.3626 - accuracy: 0.7821  
Epoch 260: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 786ms/step - loss: 0.3626 - accuracy: 0.7821 - val\_loss: 0.5434 - val\_accuracy: 0.7461  
Epoch 261/300  
7/7 [=====] - ETA: 0s - loss: 0.3420 - accuracy: 0.7799  
Epoch 261: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 777ms/step - loss: 0.3420 - accuracy: 0.7799 - val\_loss: 0.5249 - val\_accuracy: 0.7720  
Epoch 262/300  
7/7 [=====] - ETA: 0s - loss: 0.3530 - accuracy: 0.7620  
Epoch 262: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 808ms/step - loss: 0.3530 - accuracy: 0.7620 - val\_loss: 0.4925 - val\_accuracy: 0.7979  
Epoch 263/300  
7/7 [=====] - ETA: 0s - loss: 0.3472 - accuracy: 0.7732  
Epoch 263: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 795ms/step - loss: 0.3472 - accuracy: 0.7732 - val\_loss: 0.5191 - val\_accuracy: 0.7565  
Epoch 264/300  
7/7 [=====] - ETA: 0s - loss: 0.3301 - accuracy: 0.7877  
Epoch 264: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 782ms/step - loss: 0.3301 - accuracy: 0.7877 - val\_loss: 0.5250 - val\_accuracy: 0.7358  
Epoch 265/300  
7/7 [=====] - ETA: 0s - loss: 0.3380 - accuracy: 0.7765  
Epoch 265: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 810ms/step - loss: 0.3380 - accuracy: 0.7765 - val\_loss: 0.4785 - val\_accuracy: 0.7979  
Epoch 266/300  
7/7 [=====] - ETA: 0s - loss: 0.3259 - accuracy: 0.8022  
Epoch 266: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 799ms/step - loss: 0.3259 - accuracy: 0.8022 - val\_loss: 0.4767 - val\_accuracy: 0.7668  
Epoch 267/300  
7/7 [=====] - ETA: 0s - loss: 0.3272 - accuracy: 0.7832  
Epoch 267: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 943ms/step - loss: 0.3272 - accuracy: 0.7832 - val\_loss: 0.4659 - val\_accuracy: 0.7668  
Epoch 268/300  
7/7 [=====] - ETA: 0s - loss: 0.3426 - accuracy: 0.7788  
Epoch 268: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 7s 869ms/step - loss: 0.3426 - accuracy: 0.7788 - val\_loss: 0.5102 - val\_accuracy: 0.7513

Epoch 269/300  
7/7 [=====] - ETA: 0s - loss: 0.3385 - accuracy: 0.7810  
Epoch 269: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 795ms/step - loss: 0.3385 - accuracy: 0.7810 - val\_loss: 0.5175 - val\_accuracy: 0.7513  
Epoch 270/300  
7/7 [=====] - ETA: 0s - loss: 0.3443 - accuracy: 0.7765  
Epoch 270: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 774ms/step - loss: 0.3443 - accuracy: 0.7765 - val\_loss: 0.5347 - val\_accuracy: 0.7513  
Epoch 271/300  
7/7 [=====] - ETA: 0s - loss: 0.3555 - accuracy: 0.7911  
Epoch 271: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 776ms/step - loss: 0.3555 - accuracy: 0.7911 - val\_loss: 0.4428 - val\_accuracy: 0.8135  
Epoch 272/300  
7/7 [=====] - ETA: 0s - loss: 0.3387 - accuracy: 0.7408  
Epoch 272: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 782ms/step - loss: 0.3387 - accuracy: 0.7408 - val\_loss: 0.4955 - val\_accuracy: 0.7772  
Epoch 273/300  
7/7 [=====] - ETA: 0s - loss: 0.3189 - accuracy: 0.7922  
Epoch 273: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 807ms/step - loss: 0.3189 - accuracy: 0.7922 - val\_loss: 0.5003 - val\_accuracy: 0.7617  
Epoch 274/300  
7/7 [=====] - ETA: 0s - loss: 0.2999 - accuracy: 0.8235  
Epoch 274: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 795ms/step - loss: 0.2999 - accuracy: 0.8235 - val\_loss: 0.4942 - val\_accuracy: 0.7617  
Epoch 275/300  
7/7 [=====] - ETA: 0s - loss: 0.3021 - accuracy: 0.7821  
Epoch 275: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 773ms/step - loss: 0.3021 - accuracy: 0.7821 - val\_loss: 0.4210 - val\_accuracy: 0.8187  
Epoch 276/300  
7/7 [=====] - ETA: 0s - loss: 0.3115 - accuracy: 0.8011  
Epoch 276: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 788ms/step - loss: 0.3115 - accuracy: 0.8011 - val\_loss: 0.4867 - val\_accuracy: 0.7720  
Epoch 277/300  
7/7 [=====] - ETA: 0s - loss: 0.3168 - accuracy: 0.8034  
Epoch 277: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 6s 789ms/step - loss: 0.3168 - accuracy: 0.8034 - val\_loss: 0.5181 - val\_accuracy: 0.7254  
Epoch 278/300  
7/7 [=====] - ETA: 0s - loss: 0.2847 - accuracy: 0.7978  
Epoch 278: val\_accuracy did not improve from 0.82383  
7/7 [=====] - 5s 758ms/step - loss: 0.2847 - accuracy: 0.7978 - val\_loss: 0.4670 - val\_accuracy: 0.7565  
Epoch 279/300  
7/7 [=====] - ETA: 0s - loss: 0.3205 - accuracy: 0.7754  
Epoch 279: val\_accuracy improved from 0.82383 to 0.85492, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 792ms/step - loss: 0.3205 - accuracy: 0.7754 - val\_loss: 0.3886 - val\_accuracy: 0.8549  
Epoch 280/300  
7/7 [=====] - ETA: 0s - loss: 0.2929 - accuracy: 0.8134  
Epoch 280: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 796ms/step - loss: 0.2929 - accuracy: 0.8134 - val\_loss: 0.4629 - val\_accuracy: 0.7772  
Epoch 281/300  
7/7 [=====] - ETA: 0s - loss: 0.3120 - accuracy: 0.8101  
Epoch 281: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 5s 783ms/step - loss: 0.3120 - accuracy: 0.8101 - val\_loss: 0.4339 - val\_accuracy: 0.7876  
Epoch 282/300  
7/7 [=====] - ETA: 0s - loss: 0.3080 - accuracy: 0.8123  
Epoch 282: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 5s 761ms/step - loss: 0.3080 - accuracy: 0.8123 - val\_loss: 0.4671 - val\_accuracy: 0.7720  
Epoch 283/300  
7/7 [=====] - ETA: 0s - loss: 0.3278 - accuracy: 0.7978  
Epoch 283: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 5s 771ms/step - loss: 0.3278 - accuracy: 0.7978 - val\_loss: 0.4632 - val\_accuracy: 0.7876  
Epoch 284/300  
7/7 [=====] - ETA: 0s - loss: 0.3246 - accuracy: 0.7944  
Epoch 284: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 794ms/step - loss: 0.3246 - accuracy: 0.7944 - val\_loss: 0.4259 - val\_accuracy: 0.7979  
Epoch 285/300  
7/7 [=====] - ETA: 0s - loss: 0.2975 - accuracy: 0.7966  
Epoch 285: val\_accuracy did not improve from 0.85492

```

7/7 [=====] - 5s 794ms/step - loss: 0.2975 - accuracy: 0.7966 - val_loss: 0
.5063 - val_accuracy: 0.7513
Epoch 286/300
7/7 [=====] - ETA: 0s - loss: 0.2860 - accuracy: 0.8201
Epoch 286: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 761ms/step - loss: 0.2860 - accuracy: 0.8201 - val_loss: 0
.4536 - val_accuracy: 0.7824
Epoch 287/300
7/7 [=====] - ETA: 0s - loss: 0.2923 - accuracy: 0.7966
Epoch 287: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 779ms/step - loss: 0.2923 - accuracy: 0.7966 - val_loss: 0
.4416 - val_accuracy: 0.7876
Epoch 288/300
7/7 [=====] - ETA: 0s - loss: 0.2580 - accuracy: 0.8559
Epoch 288: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 786ms/step - loss: 0.2580 - accuracy: 0.8559 - val_loss: 0
.4490 - val_accuracy: 0.7979
Epoch 289/300
7/7 [=====] - ETA: 0s - loss: 0.2866 - accuracy: 0.7933
Epoch 289: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 763ms/step - loss: 0.2866 - accuracy: 0.7933 - val_loss: 0
.4486 - val_accuracy: 0.7927
Epoch 290/300
7/7 [=====] - ETA: 0s - loss: 0.3123 - accuracy: 0.7844
Epoch 290: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 776ms/step - loss: 0.3123 - accuracy: 0.7844 - val_loss: 0
.4924 - val_accuracy: 0.7668
Epoch 291/300
7/7 [=====] - ETA: 0s - loss: 0.2932 - accuracy: 0.8045
Epoch 291: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 796ms/step - loss: 0.2932 - accuracy: 0.8045 - val_loss: 0
.4710 - val_accuracy: 0.7824
Epoch 292/300
7/7 [=====] - ETA: 0s - loss: 0.3026 - accuracy: 0.8235
Epoch 292: val_accuracy did not improve from 0.85492
7/7 [=====] - 6s 801ms/step - loss: 0.3026 - accuracy: 0.8235 - val_loss: 0
.4592 - val_accuracy: 0.7979
Epoch 293/300
7/7 [=====] - ETA: 0s - loss: 0.2919 - accuracy: 0.8011
Epoch 293: val_accuracy did not improve from 0.85492
7/7 [=====] - 6s 824ms/step - loss: 0.2919 - accuracy: 0.8011 - val_loss: 0
.3999 - val_accuracy: 0.8290
Epoch 294/300
7/7 [=====] - ETA: 0s - loss: 0.3487 - accuracy: 0.7587
Epoch 294: val_accuracy did not improve from 0.85492
7/7 [=====] - 5s 780ms/step - loss: 0.3487 - accuracy: 0.7587 - val_loss: 0
.7128 - val_accuracy: 0.6684
Epoch 295/300
7/7 [=====] - ETA: 0s - loss: 0.3698 - accuracy: 0.7777
Epoch 295: val_accuracy did not improve from 0.85492
7/7 [=====] - 6s 794ms/step - loss: 0.3698 - accuracy: 0.7777 - val_loss: 0
.4449 - val_accuracy: 0.8187
Epoch 296/300
7/7 [=====] - ETA: 0s - loss: 0.2929 - accuracy: 0.8034
Epoch 296: val_accuracy did not improve from 0.85492
7/7 [=====] - 6s 816ms/step - loss: 0.2929 - accuracy: 0.8034 - val_loss: 0
.3947 - val_accuracy: 0.8446
Epoch 297/300
7/7 [=====] - ETA: 0s - loss: 0.2646 - accuracy: 0.8413
Epoch 297: val_accuracy did not improve from 0.85492
7/7 [=====] - 6s 806ms/step - loss: 0.2646 - accuracy: 0.8413 - val_loss: 0
.4197 - val_accuracy: 0.8342
Epoch 298/300
7/7 [=====] - ETA: 0s - loss: 0.2642 - accuracy: 0.8246
Epoch 298: val_accuracy did not improve from 0.85492
7/7 [=====] - 6s 808ms/step - loss: 0.2642 - accuracy: 0.8246 - val_loss: 0
.3854 - val_accuracy: 0.8187
Epoch 299/300
7/7 [=====] - ETA: 0s - loss: 0.2771 - accuracy: 0.8045
Epoch 299: val_accuracy improved from 0.85492 to 0.86010, saving model to /content/weights.best.hdf5
7/7 [=====] - 6s 807ms/step - loss: 0.2771 - accuracy: 0.8045 - val_loss: 0
.3585 - val_accuracy: 0.8601
Epoch 300/300
7/7 [=====] - ETA: 0s - loss: 0.3298 - accuracy: 0.8179
Epoch 300: val_accuracy did not improve from 0.86010
7/7 [=====] - 6s 802ms/step - loss: 0.3298 - accuracy: 0.8179 - val_loss: 0
.5180 - val_accuracy: 0.7668
Created model and loaded weights from file

```

In [144]:

```
results.loc[index,['Architecture','Dropout','Loss Fn','LR']] = ['CNN 2D','0.2 & 0.4','Cross-Entropy',0.0001]
```



## Evaluation: Training and Validation

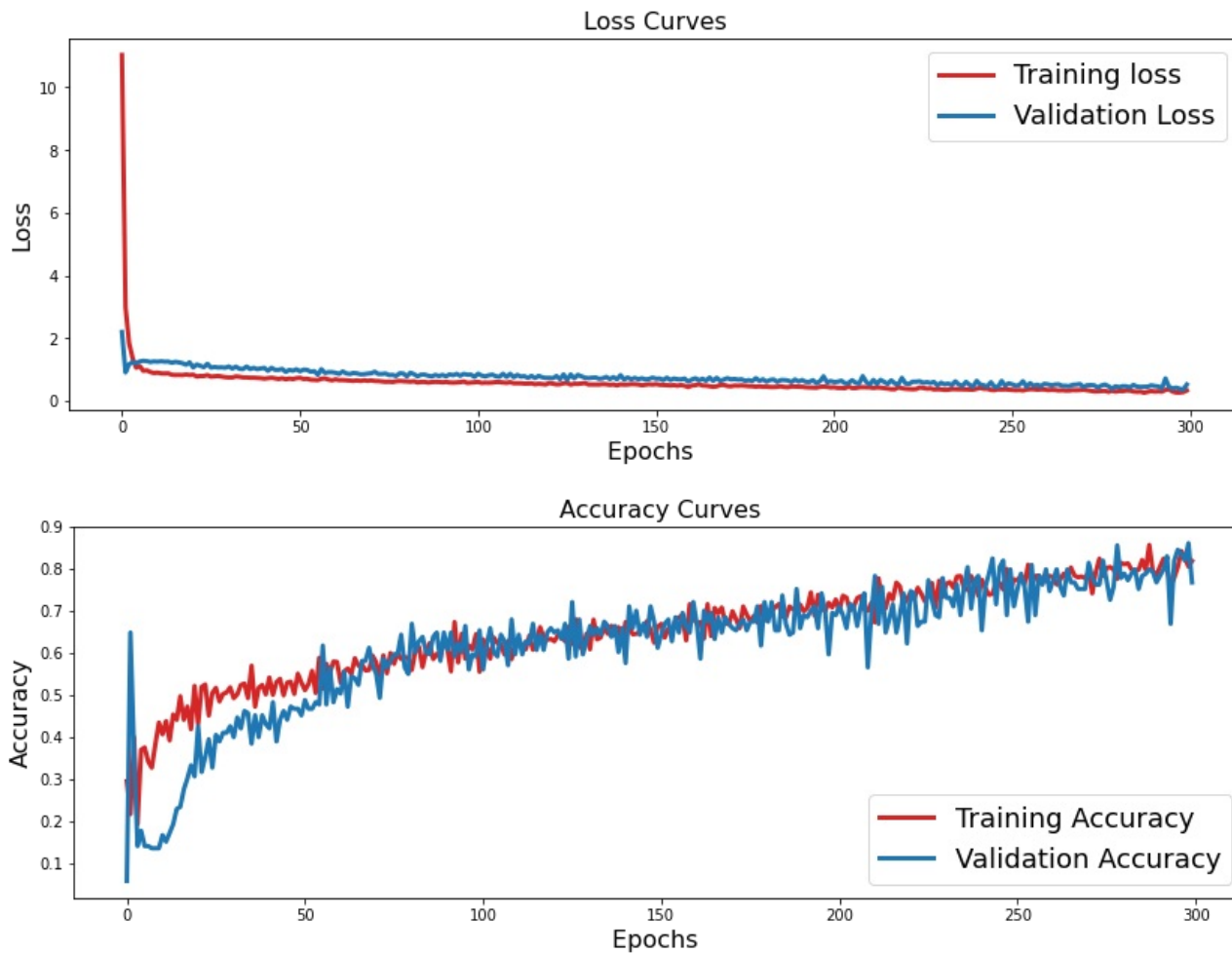
In [145]:

```
evaluation_train_val(model,x_train,y_train,x_val,y_val,results,index)
```

Training Accuracy: 0.9117318391799927  
Training Loss: 0.30648255348205566  
Validation Accuracy: 0.8601036071777344  
Validation Loss: 0.3584531843662262

In [146]:

```
plotfn(history)
```



## Evaluation: Testing

In [147]:

```
evaluation_test(model,x_test,y_test,results,index)
```

7/7 [=====] - 0s 48ms/step - loss: 0.5061 - accuracy: 0.7979  
Test accuracy: 0.7979274392127991  
Test loss: 0.5060573220252991

## Evaluation Metrics

F1 score

In [148]:

```
_,_,_, val_f1 = predictfn(model, x_val,y_val)
```

7/7 [=====] - 0s 48ms/step

	precision	recall	f1-score	support
extrahls	0.93	0.93	0.93	15
extrastole	0.91	0.45	0.61	22
murmur	0.89	0.89	0.89	55
normal	0.83	0.92	0.87	101
accuracy			0.86	193
macro avg	0.89	0.80	0.83	193
weighted avg	0.86	0.86	0.85	193

In [149]:

```
predictions, y_pred , y_true, test_f1 = predictfn(model, x_test,y_test)
```

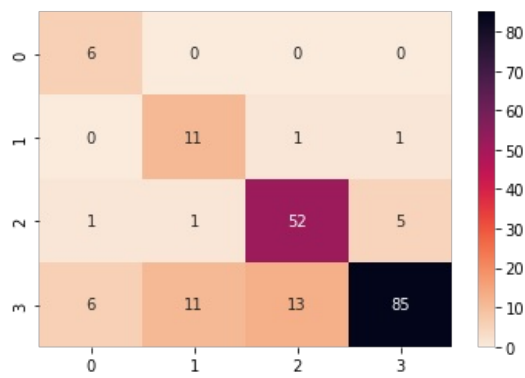
7/7 [=====] - 0s 46ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.46	0.63	13
extrastole	0.85	0.48	0.61	23
murmur	0.88	0.79	0.83	66
normal	0.74	0.93	0.83	91
accuracy			0.80	193
macro avg	0.87	0.67	0.72	193
weighted avg	0.82	0.80	0.79	193

Confusion Matrix

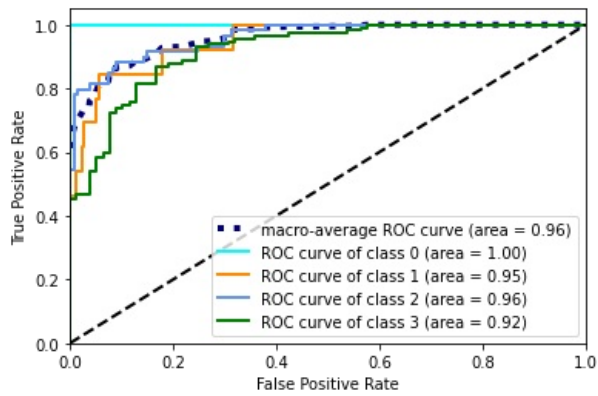
In [150]:

```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

```
roc = plot_ROC(y_test, predictions)
```



```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

Out[152]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572

### Predicting a sample's label

In [153]:

```
model_name = "heartbeat_classifier2D_2.h5"
model.save(model_name)
```

### Predicting a Murmur sample

In [155]:

```
test.iloc[5]
```

Out[155]:

[illegible]

In [154]:

```
sample_predict(model_name, 5)
```

```
1/1 [=====] - 0s 445ms/step
Label Prediction Probabilities: [[2.1426851e-05 6.7254900e-06 9.9958450e-01 3.8739174e-04]]
-----
Label:
Murmur heartbeat
confidence: 0.9995845
```

### Predicting a Normal sample

In [157]:

```
test.iloc[50]
```

Out[157]:

[illegible]

In [156]:

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 0s 149ms/step
Label Prediction Probabilities: [[6.2798676e-06 3.2975901e-02 2.9800212e-01 6.6901565e-01]]
-----
Label:
Normal heartbeat
confidence: 0.66901565
```

#### ***Predicting an Extrahls sample***

In [159]:

```
test.iloc[77]
```

Out[159]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [158]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 132ms/step
Label Prediction Probabilities: [[9.9954081e-01 2.0443778e-16 2.3870100e-05 4.3538024e-04]]
-----
Label:
Extrahls heartbeat
confidence: 0.9995408
```

#### ***Predicting an Extrasystole sample***

In [161]:

```
test.iloc[96]
```

Out[161]:

```
filename    /content/set_b/extrastole__207_1308159792607_B...
label                               extrastole
offset                                           1
Name: 990, dtype: object
```

In [160]:

```
sample_predict(model_name,96)
```

```
1/1 [=====] - 0s 199ms/step
Label Prediction Probabilities: [[0.00722221 0.5254265  0.1157811  0.35157013]]
-----
Label:
Extrasystole heartbeat
confidence: 0.5254265
```

## **CNN Experiment 3:**

### **Changing in loss function:**

#### **Poisson Loss**

- The Poisson loss is the mean of the elements of the Tensor
- $loss = y\_pred - y\_true * \log(y\_pred)$ .

In [164]:

```
model = Sequential()  
Conv2Dmodel(model,0.2)
```

Model: "sequential\_3"

Layer (type)	Output Shape	Param #
conv2d_12 (Conv2D)	(None, 40, 130, 16)	160
max_pooling2d_12 (MaxPoolin g2D)	(None, 20, 65, 16)	0
dropout_10 (Dropout)	(None, 20, 65, 16)	0
conv2d_13 (Conv2D)	(None, 20, 65, 32)	4640
max_pooling2d_13 (MaxPoolin g2D)	(None, 10, 32, 32)	0
dropout_11 (Dropout)	(None, 10, 32, 32)	0
conv2d_14 (Conv2D)	(None, 10, 32, 64)	18496
max_pooling2d_14 (MaxPoolin g2D)	(None, 5, 16, 64)	0
dropout_12 (Dropout)	(None, 5, 16, 64)	0
conv2d_15 (Conv2D)	(None, 5, 16, 128)	73856
max_pooling2d_15 (MaxPoolin g2D)	(None, 2, 8, 128)	0
global_average_pooling2d_3 (GlobalAveragePooling2D)	(None, 128)	0
dense_3 (Dense)	(None, 4)	516

```
=====  
Total params: 97,668  
Trainable params: 97,668  
Non-trainable params: 0
```

In [165]:

```
history, model = compile_fit(model, 'poisson')
```

```
Epoch 1/300  
7/7 [=====] - ETA: 0s - loss: 2.5774 - accuracy: 0.1665  
Epoch 1: val_accuracy improved from -inf to 0.05699, saving model to /content/weights.best.hdf5  
7/7 [=====] - 7s 858ms/step - loss: 2.5774 - accuracy: 0.1665 - val_loss: 3  
.0422 - val_accuracy: 0.0570  
Epoch 2/300  
7/7 [=====] - ETA: 0s - loss: 2.4607 - accuracy: 0.1441  
Epoch 2: val_accuracy improved from 0.05699 to 0.15026, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 785ms/step - loss: 2.4607 - accuracy: 0.1441 - val_loss: 2  
.9194 - val_accuracy: 0.1503  
Epoch 3/300  
7/7 [=====] - ETA: 0s - loss: 2.3793 - accuracy: 0.1821  
Epoch 3: val_accuracy improved from 0.15026 to 0.21244, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 790ms/step - loss: 2.3793 - accuracy: 0.1821 - val_loss: 2  
.7868 - val_accuracy: 0.2124  
Epoch 4/300  
7/7 [=====] - ETA: 0s - loss: 2.3569 - accuracy: 0.2101  
Epoch 4: val_accuracy improved from 0.21244 to 0.27979, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 883ms/step - loss: 2.3569 - accuracy: 0.2101 - val_loss: 2  
.6899 - val_accuracy: 0.2798  
Epoch 5/300  
7/7 [=====] - ETA: 0s - loss: 2.3632 - accuracy: 0.2045  
Epoch 5: val_accuracy did not improve from 0.27979  
7/7 [=====] - 7s 942ms/step - loss: 2.3632 - accuracy: 0.2045 - val_loss: 2  
.6358 - val_accuracy: 0.1295  
Epoch 6/300  
7/7 [=====] - ETA: 0s - loss: 2.3739 - accuracy: 0.1922  
Epoch 6: val_accuracy did not improve from 0.27979  
7/7 [=====] - 5s 770ms/step - loss: 2.3739 - accuracy: 0.1922 - val_loss: 2  
.4620 - val_accuracy: 0.1606  
Epoch 7/300  
7/7 [=====] - ETA: 0s - loss: 2.3581 - accuracy: 0.1911  
Epoch 7: val_accuracy did not improve from 0.27979
```

7/7 [=====] - 5s 775ms/step - loss: 2.3581 - accuracy: 0.1911 - val\_loss: 2.1979 - val\_accuracy: 0.2591  
Epoch 8/300  
7/7 [=====] - ETA: 0s - loss: 2.3356 - accuracy: 0.2291  
Epoch 8: val\_accuracy did not improve from 0.27979  
7/7 [=====] - 6s 801ms/step - loss: 2.3356 - accuracy: 0.2291 - val\_loss: 1.5344 - val\_accuracy: 0.2228  
Epoch 9/300  
7/7 [=====] - ETA: 0s - loss: 1.7854 - accuracy: 0.3620  
Epoch 9: val\_accuracy improved from 0.27979 to 0.58031, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 822ms/step - loss: 1.7854 - accuracy: 0.3620 - val\_loss: 0.6614 - val\_accuracy: 0.5803  
Epoch 10/300  
7/7 [=====] - ETA: 0s - loss: 1.4907 - accuracy: 0.3497  
Epoch 10: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 804ms/step - loss: 1.4907 - accuracy: 0.3497 - val\_loss: 0.6374 - val\_accuracy: 0.0570  
Epoch 11/300  
7/7 [=====] - ETA: 0s - loss: 1.1179 - accuracy: 0.2045  
Epoch 11: val\_accuracy improved from 0.58031 to 0.58549, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 807ms/step - loss: 1.1179 - accuracy: 0.2045 - val\_loss: 0.5854 - val\_accuracy: 0.5855  
Epoch 12/300  
7/7 [=====] - ETA: 0s - loss: 0.6403 - accuracy: 0.5955  
Epoch 12: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 5s 779ms/step - loss: 0.6403 - accuracy: 0.5955 - val\_loss: 0.5950 - val\_accuracy: 0.1554  
Epoch 13/300  
7/7 [=====] - ETA: 0s - loss: 0.5966 - accuracy: 0.3709  
Epoch 13: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 5s 789ms/step - loss: 0.5966 - accuracy: 0.3709 - val\_loss: 0.5974 - val\_accuracy: 0.1036  
Epoch 14/300  
7/7 [=====] - ETA: 0s - loss: 0.5913 - accuracy: 0.1274  
Epoch 14: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 6s 801ms/step - loss: 0.5913 - accuracy: 0.1274 - val\_loss: 0.5978 - val\_accuracy: 0.0881  
Epoch 15/300  
7/7 [=====] - ETA: 0s - loss: 0.5811 - accuracy: 0.0626  
Epoch 15: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 5s 777ms/step - loss: 0.5811 - accuracy: 0.0626 - val\_loss: 0.5928 - val\_accuracy: 0.0829  
Epoch 16/300  
7/7 [=====] - ETA: 0s - loss: 0.5644 - accuracy: 0.1263  
Epoch 16: val\_accuracy improved from 0.58549 to 0.61658, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 791ms/step - loss: 0.5644 - accuracy: 0.1263 - val\_loss: 0.5907 - val\_accuracy: 0.6166  
Epoch 17/300  
7/7 [=====] - ETA: 0s - loss: 0.5534 - accuracy: 0.2559  
Epoch 17: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 768ms/step - loss: 0.5534 - accuracy: 0.2559 - val\_loss: 0.5897 - val\_accuracy: 0.2280  
Epoch 18/300  
7/7 [=====] - ETA: 0s - loss: 0.5320 - accuracy: 0.1341  
Epoch 18: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 770ms/step - loss: 0.5320 - accuracy: 0.1341 - val\_loss: 0.5618 - val\_accuracy: 0.1244  
Epoch 19/300  
7/7 [=====] - ETA: 0s - loss: 0.5202 - accuracy: 0.3676  
Epoch 19: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 767ms/step - loss: 0.5202 - accuracy: 0.3676 - val\_loss: 0.5336 - val\_accuracy: 0.5855  
Epoch 20/300  
7/7 [=====] - ETA: 0s - loss: 0.5047 - accuracy: 0.4559  
Epoch 20: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 800ms/step - loss: 0.5047 - accuracy: 0.4559 - val\_loss: 0.5477 - val\_accuracy: 0.1347  
Epoch 21/300  
7/7 [=====] - ETA: 0s - loss: 0.4965 - accuracy: 0.1698  
Epoch 21: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 766ms/step - loss: 0.4965 - accuracy: 0.1698 - val\_loss: 0.5270 - val\_accuracy: 0.2850  
Epoch 22/300  
7/7 [=====] - ETA: 0s - loss: 0.4826 - accuracy: 0.4872  
Epoch 22: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 780ms/step - loss: 0.4826 - accuracy: 0.4872 - val\_loss: 0.5198 - val\_accuracy: 0.2176  
Epoch 23/300  
7/7 [=====] - ETA: 0s - loss: 0.4777 - accuracy: 0.3285  
Epoch 23: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 796ms/step - loss: 0.4777 - accuracy: 0.3285 - val\_loss: 0.4967 - val\_accuracy: 0.5389  
Epoch 24/300

7/7 [=====] - ETA: 0s - loss: 0.4663 - accuracy: 0.4916  
Epoch 24: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 788ms/step - loss: 0.4663 - accuracy: 0.4916 - val\_loss: 0.4868 - val\_accuracy: 0.5440  
Epoch 25/300  
7/7 [=====] - ETA: 0s - loss: 0.4551 - accuracy: 0.4525  
Epoch 25: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 809ms/step - loss: 0.4551 - accuracy: 0.4525 - val\_loss: 0.4816 - val\_accuracy: 0.5233  
Epoch 26/300  
7/7 [=====] - ETA: 0s - loss: 0.4466 - accuracy: 0.5173  
Epoch 26: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 807ms/step - loss: 0.4466 - accuracy: 0.5173 - val\_loss: 0.4763 - val\_accuracy: 0.5648  
Epoch 27/300  
7/7 [=====] - ETA: 0s - loss: 0.4447 - accuracy: 0.4793  
Epoch 27: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 806ms/step - loss: 0.4447 - accuracy: 0.4793 - val\_loss: 0.4917 - val\_accuracy: 0.4663  
Epoch 28/300  
7/7 [=====] - ETA: 0s - loss: 0.4379 - accuracy: 0.5497  
Epoch 28: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 800ms/step - loss: 0.4379 - accuracy: 0.5497 - val\_loss: 0.5171 - val\_accuracy: 0.3938  
Epoch 29/300  
7/7 [=====] - ETA: 0s - loss: 0.4401 - accuracy: 0.4682  
Epoch 29: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 759ms/step - loss: 0.4401 - accuracy: 0.4682 - val\_loss: 0.4768 - val\_accuracy: 0.5544  
Epoch 30/300  
7/7 [=====] - ETA: 0s - loss: 0.4377 - accuracy: 0.4782  
Epoch 30: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 777ms/step - loss: 0.4377 - accuracy: 0.4782 - val\_loss: 0.4733 - val\_accuracy: 0.5389  
Epoch 31/300  
7/7 [=====] - ETA: 0s - loss: 0.4397 - accuracy: 0.5419  
Epoch 31: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 780ms/step - loss: 0.4397 - accuracy: 0.5419 - val\_loss: 0.4825 - val\_accuracy: 0.5026  
Epoch 32/300  
7/7 [=====] - ETA: 0s - loss: 0.4288 - accuracy: 0.5218  
Epoch 32: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 800ms/step - loss: 0.4288 - accuracy: 0.5218 - val\_loss: 0.4575 - val\_accuracy: 0.5751  
Epoch 33/300  
7/7 [=====] - ETA: 0s - loss: 0.4318 - accuracy: 0.4637  
Epoch 33: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 810ms/step - loss: 0.4318 - accuracy: 0.4637 - val\_loss: 0.4597 - val\_accuracy: 0.5803  
Epoch 34/300  
7/7 [=====] - ETA: 0s - loss: 0.4242 - accuracy: 0.5654  
Epoch 34: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 805ms/step - loss: 0.4242 - accuracy: 0.5654 - val\_loss: 0.4668 - val\_accuracy: 0.5337  
Epoch 35/300  
7/7 [=====] - ETA: 0s - loss: 0.4278 - accuracy: 0.5173  
Epoch 35: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 803ms/step - loss: 0.4278 - accuracy: 0.5173 - val\_loss: 0.4599 - val\_accuracy: 0.5596  
Epoch 36/300  
7/7 [=====] - ETA: 0s - loss: 0.4240 - accuracy: 0.5497  
Epoch 36: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 776ms/step - loss: 0.4240 - accuracy: 0.5497 - val\_loss: 0.4559 - val\_accuracy: 0.5907  
Epoch 37/300  
7/7 [=====] - ETA: 0s - loss: 0.4231 - accuracy: 0.5218  
Epoch 37: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 821ms/step - loss: 0.4231 - accuracy: 0.5218 - val\_loss: 0.4574 - val\_accuracy: 0.5596  
Epoch 38/300  
7/7 [=====] - ETA: 0s - loss: 0.4283 - accuracy: 0.5207  
Epoch 38: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 6s 931ms/step - loss: 0.4283 - accuracy: 0.5207 - val\_loss: 0.4448 - val\_accuracy: 0.5751  
Epoch 39/300  
7/7 [=====] - ETA: 0s - loss: 0.4218 - accuracy: 0.5553  
Epoch 39: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 7s 912ms/step - loss: 0.4218 - accuracy: 0.5553 - val\_loss: 0.4656 - val\_accuracy: 0.5337  
Epoch 40/300  
7/7 [=====] - ETA: 0s - loss: 0.4250 - accuracy: 0.5296  
Epoch 40: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 769ms/step - loss: 0.4250 - accuracy: 0.5296 - val\_loss: 0

.4406 - val\_accuracy: 0.5855  
Epoch 41/300  
7/7 [=====] - ETA: 0s - loss: 0.4196 - accuracy: 0.5654  
Epoch 41: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 776ms/step - loss: 0.4196 - accuracy: 0.5654 - val\_loss: 0  
.4684 - val\_accuracy: 0.5285  
Epoch 42/300  
7/7 [=====] - ETA: 0s - loss: 0.4242 - accuracy: 0.4950  
Epoch 42: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 5s 790ms/step - loss: 0.4242 - accuracy: 0.4950 - val\_loss: 0  
.4473 - val\_accuracy: 0.6062  
Epoch 43/300  
7/7 [=====] - ETA: 0s - loss: 0.4180 - accuracy: 0.5978  
Epoch 43: val\_accuracy improved from 0.61658 to 0.64249, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 785ms/step - loss: 0.4180 - accuracy: 0.5978 - val\_loss: 0  
.4308 - val\_accuracy: 0.6425  
Epoch 44/300  
7/7 [=====] - ETA: 0s - loss: 0.4207 - accuracy: 0.5106  
Epoch 44: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 806ms/step - loss: 0.4207 - accuracy: 0.5106 - val\_loss: 0  
.4391 - val\_accuracy: 0.6166  
Epoch 45/300  
7/7 [=====] - ETA: 0s - loss: 0.4191 - accuracy: 0.6369  
Epoch 45: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 793ms/step - loss: 0.4191 - accuracy: 0.6369 - val\_loss: 0  
.4497 - val\_accuracy: 0.5803  
Epoch 46/300  
7/7 [=====] - ETA: 0s - loss: 0.4160 - accuracy: 0.5117  
Epoch 46: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 5s 780ms/step - loss: 0.4160 - accuracy: 0.5117 - val\_loss: 0  
.4412 - val\_accuracy: 0.6010  
Epoch 47/300  
7/7 [=====] - ETA: 0s - loss: 0.4142 - accuracy: 0.5866  
Epoch 47: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 5s 787ms/step - loss: 0.4142 - accuracy: 0.5866 - val\_loss: 0  
.4290 - val\_accuracy: 0.6269  
Epoch 48/300  
7/7 [=====] - ETA: 0s - loss: 0.4148 - accuracy: 0.5073  
Epoch 48: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 5s 782ms/step - loss: 0.4148 - accuracy: 0.5073 - val\_loss: 0  
.4427 - val\_accuracy: 0.6114  
Epoch 49/300  
7/7 [=====] - ETA: 0s - loss: 0.4109 - accuracy: 0.5788  
Epoch 49: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 5s 765ms/step - loss: 0.4109 - accuracy: 0.5788 - val\_loss: 0  
.4357 - val\_accuracy: 0.6321  
Epoch 50/300  
7/7 [=====] - ETA: 0s - loss: 0.4120 - accuracy: 0.5587  
Epoch 50: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 813ms/step - loss: 0.4120 - accuracy: 0.5587 - val\_loss: 0  
.4540 - val\_accuracy: 0.5699  
Epoch 51/300  
7/7 [=====] - ETA: 0s - loss: 0.4049 - accuracy: 0.5911  
Epoch 51: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 812ms/step - loss: 0.4049 - accuracy: 0.5911 - val\_loss: 0  
.4304 - val\_accuracy: 0.6373  
Epoch 52/300  
7/7 [=====] - ETA: 0s - loss: 0.4033 - accuracy: 0.5620  
Epoch 52: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 5s 783ms/step - loss: 0.4033 - accuracy: 0.5620 - val\_loss: 0  
.4301 - val\_accuracy: 0.6425  
Epoch 53/300  
7/7 [=====] - ETA: 0s - loss: 0.4086 - accuracy: 0.5709  
Epoch 53: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 804ms/step - loss: 0.4086 - accuracy: 0.5709 - val\_loss: 0  
.4395 - val\_accuracy: 0.6269  
Epoch 54/300  
7/7 [=====] - ETA: 0s - loss: 0.4035 - accuracy: 0.5944  
Epoch 54: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 804ms/step - loss: 0.4035 - accuracy: 0.5944 - val\_loss: 0  
.4453 - val\_accuracy: 0.6062  
Epoch 55/300  
7/7 [=====] - ETA: 0s - loss: 0.4010 - accuracy: 0.5922  
Epoch 55: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 800ms/step - loss: 0.4010 - accuracy: 0.5922 - val\_loss: 0  
.4424 - val\_accuracy: 0.6269  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.4033 - accuracy: 0.5709  
Epoch 56: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 803ms/step - loss: 0.4033 - accuracy: 0.5709 - val\_loss: 0  
.4351 - val\_accuracy: 0.6373  
Epoch 57/300  
7/7 [=====] - ETA: 0s - loss: 0.4026 - accuracy: 0.5899



Epoch 57: val\_accuracy improved from 0.64249 to 0.64767, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 813ms/step - loss: 0.4026 - accuracy: 0.5899 - val\_loss: 0.4242 - val\_accuracy: 0.6477

Epoch 58/300  
7/7 [=====] - ETA: 0s - loss: 0.4010 - accuracy: 0.5698  
Epoch 58: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 797ms/step - loss: 0.4010 - accuracy: 0.5698 - val\_loss: 0.4434 - val\_accuracy: 0.6269

Epoch 59/300  
7/7 [=====] - ETA: 0s - loss: 0.3990 - accuracy: 0.6168  
Epoch 59: val\_accuracy did not improve from 0.64767  
7/7 [=====] - 6s 801ms/step - loss: 0.3990 - accuracy: 0.6168 - val\_loss: 0.4441 - val\_accuracy: 0.6218

Epoch 60/300  
7/7 [=====] - ETA: 0s - loss: 0.3977 - accuracy: 0.5654  
Epoch 60: val\_accuracy improved from 0.64767 to 0.65803, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 800ms/step - loss: 0.3977 - accuracy: 0.5654 - val\_loss: 0.4203 - val\_accuracy: 0.6580

Epoch 61/300  
7/7 [=====] - ETA: 0s - loss: 0.3962 - accuracy: 0.6145  
Epoch 61: val\_accuracy did not improve from 0.65803  
7/7 [=====] - 5s 776ms/step - loss: 0.3962 - accuracy: 0.6145 - val\_loss: 0.4465 - val\_accuracy: 0.6321

Epoch 62/300  
7/7 [=====] - ETA: 0s - loss: 0.3972 - accuracy: 0.5922  
Epoch 62: val\_accuracy did not improve from 0.65803  
7/7 [=====] - 6s 804ms/step - loss: 0.3972 - accuracy: 0.5922 - val\_loss: 0.4473 - val\_accuracy: 0.6062

Epoch 63/300  
7/7 [=====] - ETA: 0s - loss: 0.4018 - accuracy: 0.5978  
Epoch 63: val\_accuracy did not improve from 0.65803  
7/7 [=====] - 6s 814ms/step - loss: 0.4018 - accuracy: 0.5978 - val\_loss: 0.4468 - val\_accuracy: 0.6166

Epoch 64/300  
7/7 [=====] - ETA: 0s - loss: 0.4021 - accuracy: 0.5877  
Epoch 64: val\_accuracy did not improve from 0.65803  
7/7 [=====] - 6s 794ms/step - loss: 0.4021 - accuracy: 0.5877 - val\_loss: 0.4284 - val\_accuracy: 0.6580

Epoch 65/300  
7/7 [=====] - ETA: 0s - loss: 0.3952 - accuracy: 0.5799  
Epoch 65: val\_accuracy improved from 0.65803 to 0.66321, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 819ms/step - loss: 0.3952 - accuracy: 0.5799 - val\_loss: 0.4211 - val\_accuracy: 0.6632

Epoch 66/300  
7/7 [=====] - ETA: 0s - loss: 0.3928 - accuracy: 0.6134  
Epoch 66: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 5s 778ms/step - loss: 0.3928 - accuracy: 0.6134 - val\_loss: 0.4330 - val\_accuracy: 0.6528

Epoch 67/300  
7/7 [=====] - ETA: 0s - loss: 0.3870 - accuracy: 0.6134  
Epoch 67: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 5s 769ms/step - loss: 0.3870 - accuracy: 0.6134 - val\_loss: 0.4355 - val\_accuracy: 0.6580

Epoch 68/300  
7/7 [=====] - ETA: 0s - loss: 0.3891 - accuracy: 0.6067  
Epoch 68: val\_accuracy improved from 0.66321 to 0.66839, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 812ms/step - loss: 0.3891 - accuracy: 0.6067 - val\_loss: 0.4230 - val\_accuracy: 0.6684

Epoch 69/300  
7/7 [=====] - ETA: 0s - loss: 0.3923 - accuracy: 0.5989  
Epoch 69: val\_accuracy improved from 0.66839 to 0.67876, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 807ms/step - loss: 0.3923 - accuracy: 0.5989 - val\_loss: 0.4183 - val\_accuracy: 0.6788

Epoch 70/300  
7/7 [=====] - ETA: 0s - loss: 0.3869 - accuracy: 0.6212  
Epoch 70: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 801ms/step - loss: 0.3869 - accuracy: 0.6212 - val\_loss: 0.4260 - val\_accuracy: 0.6736

Epoch 71/300  
7/7 [=====] - ETA: 0s - loss: 0.3907 - accuracy: 0.6011  
Epoch 71: val\_accuracy improved from 0.67876 to 0.69948, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 843ms/step - loss: 0.3907 - accuracy: 0.6011 - val\_loss: 0.4153 - val\_accuracy: 0.6995

Epoch 72/300  
7/7 [=====] - ETA: 0s - loss: 0.3874 - accuracy: 0.6246  
Epoch 72: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 7s 1s/step - loss: 0.3874 - accuracy: 0.6246 - val\_loss: 0.4208 - val\_accuracy: 0.6788

Epoch 73/300  
7/7 [=====] - ETA: 0s - loss: 0.3809 - accuracy: 0.6346  
Epoch 73: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 5s 776ms/step - loss: 0.3809 - accuracy: 0.6346 - val\_loss: 0.4139 - val\_accuracy: 0.6736

Epoch 74/300  
7/7 [=====] - ETA: 0s - loss: 0.3779 - accuracy: 0.6626  
Epoch 74: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 5s 797ms/step - loss: 0.3779 - accuracy: 0.6626 - val\_loss: 0.4222 - val\_accuracy: 0.6788  
Epoch 75/300  
7/7 [=====] - ETA: 0s - loss: 0.3842 - accuracy: 0.6335  
Epoch 75: val\_accuracy improved from 0.69948 to 0.70466, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 799ms/step - loss: 0.3842 - accuracy: 0.6335 - val\_loss: 0.4050 - val\_accuracy: 0.7047  
Epoch 76/300  
7/7 [=====] - ETA: 0s - loss: 0.3797 - accuracy: 0.6492  
Epoch 76: val\_accuracy improved from 0.70466 to 0.71503, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 816ms/step - loss: 0.3797 - accuracy: 0.6492 - val\_loss: 0.4030 - val\_accuracy: 0.7150  
Epoch 77/300  
7/7 [=====] - ETA: 0s - loss: 0.3792 - accuracy: 0.6369  
Epoch 77: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 792ms/step - loss: 0.3792 - accuracy: 0.6369 - val\_loss: 0.4236 - val\_accuracy: 0.6891  
Epoch 78/300  
7/7 [=====] - ETA: 0s - loss: 0.3814 - accuracy: 0.6570  
Epoch 78: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 799ms/step - loss: 0.3814 - accuracy: 0.6570 - val\_loss: 0.4265 - val\_accuracy: 0.6477  
Epoch 79/300  
7/7 [=====] - ETA: 0s - loss: 0.3781 - accuracy: 0.6659  
Epoch 79: val\_accuracy did not improve from 0.71503  
7/7 [=====] - 6s 809ms/step - loss: 0.3781 - accuracy: 0.6659 - val\_loss: 0.4256 - val\_accuracy: 0.6839  
Epoch 80/300  
7/7 [=====] - ETA: 0s - loss: 0.3766 - accuracy: 0.6413  
Epoch 80: val\_accuracy improved from 0.71503 to 0.73575, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 791ms/step - loss: 0.3766 - accuracy: 0.6413 - val\_loss: 0.3975 - val\_accuracy: 0.7358  
Epoch 81/300  
7/7 [=====] - ETA: 0s - loss: 0.3767 - accuracy: 0.6927  
Epoch 81: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 798ms/step - loss: 0.3767 - accuracy: 0.6927 - val\_loss: 0.4221 - val\_accuracy: 0.6943  
Epoch 82/300  
7/7 [=====] - ETA: 0s - loss: 0.3702 - accuracy: 0.6782  
Epoch 82: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 802ms/step - loss: 0.3702 - accuracy: 0.6782 - val\_loss: 0.4263 - val\_accuracy: 0.6839  
Epoch 83/300  
7/7 [=====] - ETA: 0s - loss: 0.3740 - accuracy: 0.6737  
Epoch 83: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 5s 782ms/step - loss: 0.3740 - accuracy: 0.6737 - val\_loss: 0.3977 - val\_accuracy: 0.7150  
Epoch 84/300  
7/7 [=====] - ETA: 0s - loss: 0.3746 - accuracy: 0.6670  
Epoch 84: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 5s 761ms/step - loss: 0.3746 - accuracy: 0.6670 - val\_loss: 0.4048 - val\_accuracy: 0.6839  
Epoch 85/300  
7/7 [=====] - ETA: 0s - loss: 0.3745 - accuracy: 0.6771  
Epoch 85: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 799ms/step - loss: 0.3745 - accuracy: 0.6771 - val\_loss: 0.4161 - val\_accuracy: 0.6943  
Epoch 86/300  
7/7 [=====] - ETA: 0s - loss: 0.3710 - accuracy: 0.7140  
Epoch 86: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 795ms/step - loss: 0.3710 - accuracy: 0.7140 - val\_loss: 0.4222 - val\_accuracy: 0.6684  
Epoch 87/300  
7/7 [=====] - ETA: 0s - loss: 0.3699 - accuracy: 0.6615  
Epoch 87: val\_accuracy improved from 0.73575 to 0.74093, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 796ms/step - loss: 0.3699 - accuracy: 0.6615 - val\_loss: 0.3913 - val\_accuracy: 0.7409  
Epoch 88/300  
7/7 [=====] - ETA: 0s - loss: 0.3679 - accuracy: 0.6927  
Epoch 88: val\_accuracy did not improve from 0.74093  
7/7 [=====] - 6s 811ms/step - loss: 0.3679 - accuracy: 0.6927 - val\_loss: 0.4450 - val\_accuracy: 0.5855  
Epoch 89/300  
7/7 [=====] - ETA: 0s - loss: 0.3697 - accuracy: 0.6972  
Epoch 89: val\_accuracy did not improve from 0.74093  
7/7 [=====] - 5s 773ms/step - loss: 0.3697 - accuracy: 0.6972 - val\_loss: 0.4328 - val\_accuracy: 0.6373  
Epoch 90/300  
7/7 [=====] - ETA: 0s - loss: 0.3717 - accuracy: 0.6827  
Epoch 90: val\_accuracy did not improve from 0.74093

7/7 [=====] - 6s 805ms/step - loss: 0.3717 - accuracy: 0.6827 - val\_loss: 0  
.4091 - val\_accuracy: 0.7098  
Epoch 91/300  
7/7 [=====] - ETA: 0s - loss: 0.3760 - accuracy: 0.6592  
Epoch 91: val\_accuracy did not improve from 0.74093  
7/7 [=====] - 5s 792ms/step - loss: 0.3760 - accuracy: 0.6592 - val\_loss: 0  
.4018 - val\_accuracy: 0.7306  
Epoch 92/300  
7/7 [=====] - ETA: 0s - loss: 0.3713 - accuracy: 0.6849  
Epoch 92: val\_accuracy did not improve from 0.74093  
7/7 [=====] - 6s 800ms/step - loss: 0.3713 - accuracy: 0.6849 - val\_loss: 0  
.4159 - val\_accuracy: 0.7047  
Epoch 93/300  
7/7 [=====] - ETA: 0s - loss: 0.3652 - accuracy: 0.6793  
Epoch 93: val\_accuracy did not improve from 0.74093  
7/7 [=====] - 5s 779ms/step - loss: 0.3652 - accuracy: 0.6793 - val\_loss: 0  
.4067 - val\_accuracy: 0.7047  
Epoch 94/300  
7/7 [=====] - ETA: 0s - loss: 0.3670 - accuracy: 0.6905  
Epoch 94: val\_accuracy did not improve from 0.74093  
7/7 [=====] - 6s 815ms/step - loss: 0.3670 - accuracy: 0.6905 - val\_loss: 0  
.4102 - val\_accuracy: 0.7098  
Epoch 95/300  
7/7 [=====] - ETA: 0s - loss: 0.3645 - accuracy: 0.6804  
Epoch 95: val\_accuracy improved from 0.74093 to 0.76684, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 823ms/step - loss: 0.3645 - accuracy: 0.6804 - val\_loss: 0  
.3864 - val\_accuracy: 0.7668  
Epoch 96/300  
7/7 [=====] - ETA: 0s - loss: 0.3585 - accuracy: 0.7073  
Epoch 96: val\_accuracy improved from 0.76684 to 0.77202, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 804ms/step - loss: 0.3585 - accuracy: 0.7073 - val\_loss: 0  
.3918 - val\_accuracy: 0.7720  
Epoch 97/300  
7/7 [=====] - ETA: 0s - loss: 0.3589 - accuracy: 0.7318  
Epoch 97: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 793ms/step - loss: 0.3589 - accuracy: 0.7318 - val\_loss: 0  
.4097 - val\_accuracy: 0.7254  
Epoch 98/300  
7/7 [=====] - ETA: 0s - loss: 0.3576 - accuracy: 0.6905  
Epoch 98: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 795ms/step - loss: 0.3576 - accuracy: 0.6905 - val\_loss: 0  
.4009 - val\_accuracy: 0.7254  
Epoch 99/300  
7/7 [=====] - ETA: 0s - loss: 0.3594 - accuracy: 0.7162  
Epoch 99: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 5s 791ms/step - loss: 0.3594 - accuracy: 0.7162 - val\_loss: 0  
.4070 - val\_accuracy: 0.7202  
Epoch 100/300  
7/7 [=====] - ETA: 0s - loss: 0.3544 - accuracy: 0.7397  
Epoch 100: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 798ms/step - loss: 0.3544 - accuracy: 0.7397 - val\_loss: 0  
.3908 - val\_accuracy: 0.7668  
Epoch 101/300  
7/7 [=====] - ETA: 0s - loss: 0.3533 - accuracy: 0.7486  
Epoch 101: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 790ms/step - loss: 0.3533 - accuracy: 0.7486 - val\_loss: 0  
.4254 - val\_accuracy: 0.6632  
Epoch 102/300  
7/7 [=====] - ETA: 0s - loss: 0.3550 - accuracy: 0.6972  
Epoch 102: val\_accuracy did not improve from 0.77202  
7/7 [=====] - 6s 801ms/step - loss: 0.3550 - accuracy: 0.6972 - val\_loss: 0  
.3806 - val\_accuracy: 0.7513  
Epoch 103/300  
7/7 [=====] - ETA: 0s - loss: 0.3612 - accuracy: 0.6939  
Epoch 103: val\_accuracy improved from 0.77202 to 0.77720, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 787ms/step - loss: 0.3612 - accuracy: 0.6939 - val\_loss: 0  
.3784 - val\_accuracy: 0.7772  
Epoch 104/300  
7/7 [=====] - ETA: 0s - loss: 0.3571 - accuracy: 0.7330  
Epoch 104: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 5s 759ms/step - loss: 0.3571 - accuracy: 0.7330 - val\_loss: 0  
.3846 - val\_accuracy: 0.7513  
Epoch 105/300  
7/7 [=====] - ETA: 0s - loss: 0.3541 - accuracy: 0.7564  
Epoch 105: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 7s 1s/step - loss: 0.3541 - accuracy: 0.7564 - val\_loss: 0.47  
14 - val\_accuracy: 0.5803  
Epoch 106/300  
7/7 [=====] - ETA: 0s - loss: 0.3689 - accuracy: 0.6849  
Epoch 106: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 799ms/step - loss: 0.3689 - accuracy: 0.6849 - val\_loss: 0  
.4700 - val\_accuracy: 0.5699  
Epoch 107/300

7/7 [=====] - ETA: 0s - loss: 0.3605 - accuracy: 0.6894  
Epoch 107: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 5s 779ms/step - loss: 0.3605 - accuracy: 0.6894 - val\_loss: 0.3915 - val\_accuracy: 0.7720  
Epoch 108/300  
7/7 [=====] - ETA: 0s - loss: 0.3498 - accuracy: 0.7151  
Epoch 108: val\_accuracy improved from 0.77720 to 0.79275, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 800ms/step - loss: 0.3498 - accuracy: 0.7151 - val\_loss: 0.3784 - val\_accuracy: 0.7927  
Epoch 109/300  
7/7 [=====] - ETA: 0s - loss: 0.3468 - accuracy: 0.7296  
Epoch 109: val\_accuracy did not improve from 0.79275  
7/7 [=====] - 5s 779ms/step - loss: 0.3468 - accuracy: 0.7296 - val\_loss: 0.3841 - val\_accuracy: 0.7565  
Epoch 110/300  
7/7 [=====] - ETA: 0s - loss: 0.3468 - accuracy: 0.7453  
Epoch 110: val\_accuracy did not improve from 0.79275  
7/7 [=====] - 5s 790ms/step - loss: 0.3468 - accuracy: 0.7453 - val\_loss: 0.4037 - val\_accuracy: 0.7358  
Epoch 111/300  
7/7 [=====] - ETA: 0s - loss: 0.3552 - accuracy: 0.7240  
Epoch 111: val\_accuracy did not improve from 0.79275  
7/7 [=====] - 6s 797ms/step - loss: 0.3552 - accuracy: 0.7240 - val\_loss: 0.3939 - val\_accuracy: 0.7668  
Epoch 112/300  
7/7 [=====] - ETA: 0s - loss: 0.3494 - accuracy: 0.7318  
Epoch 112: val\_accuracy did not improve from 0.79275  
7/7 [=====] - 6s 807ms/step - loss: 0.3494 - accuracy: 0.7318 - val\_loss: 0.4063 - val\_accuracy: 0.7202  
Epoch 113/300  
7/7 [=====] - ETA: 0s - loss: 0.3469 - accuracy: 0.7687  
Epoch 113: val\_accuracy improved from 0.79275 to 0.79793, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 818ms/step - loss: 0.3469 - accuracy: 0.7687 - val\_loss: 0.3731 - val\_accuracy: 0.7979  
Epoch 114/300  
7/7 [=====] - ETA: 0s - loss: 0.3403 - accuracy: 0.7888  
Epoch 114: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 5s 788ms/step - loss: 0.3403 - accuracy: 0.7888 - val\_loss: 0.4384 - val\_accuracy: 0.6632  
Epoch 115/300  
7/7 [=====] - ETA: 0s - loss: 0.3538 - accuracy: 0.7218  
Epoch 115: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 6s 793ms/step - loss: 0.3538 - accuracy: 0.7218 - val\_loss: 0.4271 - val\_accuracy: 0.6425  
Epoch 116/300  
7/7 [=====] - ETA: 0s - loss: 0.3439 - accuracy: 0.7207  
Epoch 116: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 6s 794ms/step - loss: 0.3439 - accuracy: 0.7207 - val\_loss: 0.3989 - val\_accuracy: 0.7150  
Epoch 117/300  
7/7 [=====] - ETA: 0s - loss: 0.3463 - accuracy: 0.7453  
Epoch 117: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 6s 795ms/step - loss: 0.3463 - accuracy: 0.7453 - val\_loss: 0.4059 - val\_accuracy: 0.7150  
Epoch 118/300  
7/7 [=====] - ETA: 0s - loss: 0.3476 - accuracy: 0.7419  
Epoch 118: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 5s 781ms/step - loss: 0.3476 - accuracy: 0.7419 - val\_loss: 0.4538 - val\_accuracy: 0.6114  
Epoch 119/300  
7/7 [=====] - ETA: 0s - loss: 0.3438 - accuracy: 0.7374  
Epoch 119: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 5s 787ms/step - loss: 0.3438 - accuracy: 0.7374 - val\_loss: 0.4044 - val\_accuracy: 0.7150  
Epoch 120/300  
7/7 [=====] - ETA: 0s - loss: 0.3367 - accuracy: 0.7575  
Epoch 120: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 5s 788ms/step - loss: 0.3367 - accuracy: 0.7575 - val\_loss: 0.3801 - val\_accuracy: 0.7927  
Epoch 121/300  
7/7 [=====] - ETA: 0s - loss: 0.3325 - accuracy: 0.7709  
Epoch 121: val\_accuracy did not improve from 0.79793  
7/7 [=====] - 5s 783ms/step - loss: 0.3325 - accuracy: 0.7709 - val\_loss: 0.3760 - val\_accuracy: 0.7927  
Epoch 122/300  
7/7 [=====] - ETA: 0s - loss: 0.3434 - accuracy: 0.7441  
Epoch 122: val\_accuracy improved from 0.79793 to 0.80311, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 797ms/step - loss: 0.3434 - accuracy: 0.7441 - val\_loss: 0.3787 - val\_accuracy: 0.8031  
Epoch 123/300  
7/7 [=====] - ETA: 0s - loss: 0.3359 - accuracy: 0.7777  
Epoch 123: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 805ms/step - loss: 0.3359 - accuracy: 0.7777 - val\_loss: 0

.3869 - val\_accuracy: 0.7668  
Epoch 124/300  
7/7 [=====] - ETA: 0s - loss: 0.3319 - accuracy: 0.7844  
Epoch 124: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 796ms/step - loss: 0.3319 - accuracy: 0.7844 - val\_loss: 0  
.3770 - val\_accuracy: 0.7668  
Epoch 125/300  
7/7 [=====] - ETA: 0s - loss: 0.3249 - accuracy: 0.8011  
Epoch 125: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.3249 - accuracy: 0.8011 - val\_loss: 0  
.3783 - val\_accuracy: 0.7668  
Epoch 126/300  
7/7 [=====] - ETA: 0s - loss: 0.3358 - accuracy: 0.7866  
Epoch 126: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 761ms/step - loss: 0.3358 - accuracy: 0.7866 - val\_loss: 0  
.4297 - val\_accuracy: 0.6891  
Epoch 127/300  
7/7 [=====] - ETA: 0s - loss: 0.3391 - accuracy: 0.7855  
Epoch 127: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.3391 - accuracy: 0.7855 - val\_loss: 0  
.3977 - val\_accuracy: 0.7513  
Epoch 128/300  
7/7 [=====] - ETA: 0s - loss: 0.3266 - accuracy: 0.7810  
Epoch 128: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 789ms/step - loss: 0.3266 - accuracy: 0.7810 - val\_loss: 0  
.3735 - val\_accuracy: 0.7565  
Epoch 129/300  
7/7 [=====] - ETA: 0s - loss: 0.3238 - accuracy: 0.7899  
Epoch 129: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 781ms/step - loss: 0.3238 - accuracy: 0.7899 - val\_loss: 0  
.3607 - val\_accuracy: 0.7876  
Epoch 130/300  
7/7 [=====] - ETA: 0s - loss: 0.3299 - accuracy: 0.7855  
Epoch 130: val\_accuracy improved from 0.80311 to 0.82902, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 810ms/step - loss: 0.3299 - accuracy: 0.7855 - val\_loss: 0  
.3512 - val\_accuracy: 0.8290  
Epoch 131/300  
7/7 [=====] - ETA: 0s - loss: 0.3389 - accuracy: 0.7810  
Epoch 131: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 5s 785ms/step - loss: 0.3389 - accuracy: 0.7810 - val\_loss: 0  
.3657 - val\_accuracy: 0.7979  
Epoch 132/300  
7/7 [=====] - ETA: 0s - loss: 0.3272 - accuracy: 0.7877  
Epoch 132: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 796ms/step - loss: 0.3272 - accuracy: 0.7877 - val\_loss: 0  
.3661 - val\_accuracy: 0.7824  
Epoch 133/300  
7/7 [=====] - ETA: 0s - loss: 0.3329 - accuracy: 0.7821  
Epoch 133: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 796ms/step - loss: 0.3329 - accuracy: 0.7821 - val\_loss: 0  
.3751 - val\_accuracy: 0.7979  
Epoch 134/300  
7/7 [=====] - ETA: 0s - loss: 0.3233 - accuracy: 0.8268  
Epoch 134: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 805ms/step - loss: 0.3233 - accuracy: 0.8268 - val\_loss: 0  
.4164 - val\_accuracy: 0.6995  
Epoch 135/300  
7/7 [=====] - ETA: 0s - loss: 0.3315 - accuracy: 0.7944  
Epoch 135: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 796ms/step - loss: 0.3315 - accuracy: 0.7944 - val\_loss: 0  
.3964 - val\_accuracy: 0.7202  
Epoch 136/300  
7/7 [=====] - ETA: 0s - loss: 0.3367 - accuracy: 0.7821  
Epoch 136: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 830ms/step - loss: 0.3367 - accuracy: 0.7821 - val\_loss: 0  
.3617 - val\_accuracy: 0.7876  
Epoch 137/300  
7/7 [=====] - ETA: 0s - loss: 0.3285 - accuracy: 0.7911  
Epoch 137: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 5s 790ms/step - loss: 0.3285 - accuracy: 0.7911 - val\_loss: 0  
.3661 - val\_accuracy: 0.7824  
Epoch 138/300  
7/7 [=====] - ETA: 0s - loss: 0.3197 - accuracy: 0.8402  
Epoch 138: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 940ms/step - loss: 0.3197 - accuracy: 0.8402 - val\_loss: 0  
.4167 - val\_accuracy: 0.7098  
Epoch 139/300  
7/7 [=====] - ETA: 0s - loss: 0.3240 - accuracy: 0.8056  
Epoch 139: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 7s 876ms/step - loss: 0.3240 - accuracy: 0.8056 - val\_loss: 0  
.3962 - val\_accuracy: 0.7202  
Epoch 140/300  
7/7 [=====] - ETA: 0s - loss: 0.3231 - accuracy: 0.8067

Epoch 140: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 810ms/step - loss: 0.3231 - accuracy: 0.8067 - val\_loss: 0.3870 - val\_accuracy: 0.7461  
Epoch 141/300  
7/7 [=====] - ETA: 0s - loss: 0.3188 - accuracy: 0.8257  
Epoch 141: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 5s 789ms/step - loss: 0.3188 - accuracy: 0.8257 - val\_loss: 0.4237 - val\_accuracy: 0.6684  
Epoch 142/300  
7/7 [=====] - ETA: 0s - loss: 0.3245 - accuracy: 0.7911  
Epoch 142: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 5s 774ms/step - loss: 0.3245 - accuracy: 0.7911 - val\_loss: 0.3949 - val\_accuracy: 0.7358  
Epoch 143/300  
7/7 [=====] - ETA: 0s - loss: 0.3167 - accuracy: 0.8168  
Epoch 143: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 804ms/step - loss: 0.3167 - accuracy: 0.8168 - val\_loss: 0.3791 - val\_accuracy: 0.7824  
Epoch 144/300  
7/7 [=====] - ETA: 0s - loss: 0.3127 - accuracy: 0.8291  
Epoch 144: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 793ms/step - loss: 0.3127 - accuracy: 0.8291 - val\_loss: 0.3594 - val\_accuracy: 0.8135  
Epoch 145/300  
7/7 [=====] - ETA: 0s - loss: 0.3146 - accuracy: 0.8436  
Epoch 145: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 813ms/step - loss: 0.3146 - accuracy: 0.8436 - val\_loss: 0.3815 - val\_accuracy: 0.7565  
Epoch 146/300  
7/7 [=====] - ETA: 0s - loss: 0.3229 - accuracy: 0.8313  
Epoch 146: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 5s 784ms/step - loss: 0.3229 - accuracy: 0.8313 - val\_loss: 0.4816 - val\_accuracy: 0.6321  
Epoch 147/300  
7/7 [=====] - ETA: 0s - loss: 0.3358 - accuracy: 0.7799  
Epoch 147: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 5s 789ms/step - loss: 0.3358 - accuracy: 0.7799 - val\_loss: 0.4339 - val\_accuracy: 0.6580  
Epoch 148/300  
7/7 [=====] - ETA: 0s - loss: 0.3401 - accuracy: 0.7721  
Epoch 148: val\_accuracy did not improve from 0.82902  
7/7 [=====] - 6s 805ms/step - loss: 0.3401 - accuracy: 0.7721 - val\_loss: 0.3616 - val\_accuracy: 0.8135  
Epoch 149/300  
7/7 [=====] - ETA: 0s - loss: 0.3289 - accuracy: 0.7721  
Epoch 149: val\_accuracy improved from 0.82902 to 0.83420, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 828ms/step - loss: 0.3289 - accuracy: 0.7721 - val\_loss: 0.3544 - val\_accuracy: 0.8342  
Epoch 150/300  
7/7 [=====] - ETA: 0s - loss: 0.3300 - accuracy: 0.8089  
Epoch 150: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 791ms/step - loss: 0.3300 - accuracy: 0.8089 - val\_loss: 0.3736 - val\_accuracy: 0.7876  
Epoch 151/300  
7/7 [=====] - ETA: 0s - loss: 0.3186 - accuracy: 0.8413  
Epoch 151: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 796ms/step - loss: 0.3186 - accuracy: 0.8413 - val\_loss: 0.3781 - val\_accuracy: 0.7565  
Epoch 152/300  
7/7 [=====] - ETA: 0s - loss: 0.3117 - accuracy: 0.8212  
Epoch 152: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 765ms/step - loss: 0.3117 - accuracy: 0.8212 - val\_loss: 0.3758 - val\_accuracy: 0.7772  
Epoch 153/300  
7/7 [=====] - ETA: 0s - loss: 0.3107 - accuracy: 0.8737  
Epoch 153: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 792ms/step - loss: 0.3107 - accuracy: 0.8737 - val\_loss: 0.3974 - val\_accuracy: 0.7461  
Epoch 154/300  
7/7 [=====] - ETA: 0s - loss: 0.3151 - accuracy: 0.8056  
Epoch 154: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 804ms/step - loss: 0.3151 - accuracy: 0.8056 - val\_loss: 0.3603 - val\_accuracy: 0.8135  
Epoch 155/300  
7/7 [=====] - ETA: 0s - loss: 0.3083 - accuracy: 0.8492  
Epoch 155: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 804ms/step - loss: 0.3083 - accuracy: 0.8492 - val\_loss: 0.3557 - val\_accuracy: 0.8187  
Epoch 156/300  
7/7 [=====] - ETA: 0s - loss: 0.3089 - accuracy: 0.8402  
Epoch 156: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 807ms/step - loss: 0.3089 - accuracy: 0.8402 - val\_loss: 0.3564 - val\_accuracy: 0.8135

Epoch 157/300  
7/7 [=====] - ETA: 0s - loss: 0.3061 - accuracy: 0.8603  
Epoch 157: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 792ms/step - loss: 0.3061 - accuracy: 0.8603 - val\_loss: 0.3587 - val\_accuracy: 0.8031  
Epoch 158/300  
7/7 [=====] - ETA: 0s - loss: 0.3116 - accuracy: 0.8346  
Epoch 158: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 819ms/step - loss: 0.3116 - accuracy: 0.8346 - val\_loss: 0.3558 - val\_accuracy: 0.8238  
Epoch 159/300  
7/7 [=====] - ETA: 0s - loss: 0.3174 - accuracy: 0.8179  
Epoch 159: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 782ms/step - loss: 0.3174 - accuracy: 0.8179 - val\_loss: 0.3538 - val\_accuracy: 0.7876  
Epoch 160/300  
7/7 [=====] - ETA: 0s - loss: 0.3229 - accuracy: 0.8246  
Epoch 160: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 822ms/step - loss: 0.3229 - accuracy: 0.8246 - val\_loss: 0.4339 - val\_accuracy: 0.6891  
Epoch 161/300  
7/7 [=====] - ETA: 0s - loss: 0.3276 - accuracy: 0.8503  
Epoch 161: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 812ms/step - loss: 0.3276 - accuracy: 0.8503 - val\_loss: 0.3941 - val\_accuracy: 0.7668  
Epoch 162/300  
7/7 [=====] - ETA: 0s - loss: 0.3359 - accuracy: 0.7877  
Epoch 162: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 790ms/step - loss: 0.3359 - accuracy: 0.7877 - val\_loss: 0.3465 - val\_accuracy: 0.8238  
Epoch 163/300  
7/7 [=====] - ETA: 0s - loss: 0.3265 - accuracy: 0.8078  
Epoch 163: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 799ms/step - loss: 0.3265 - accuracy: 0.8078 - val\_loss: 0.3736 - val\_accuracy: 0.7824  
Epoch 164/300  
7/7 [=====] - ETA: 0s - loss: 0.3161 - accuracy: 0.8335  
Epoch 164: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 789ms/step - loss: 0.3161 - accuracy: 0.8335 - val\_loss: 0.3901 - val\_accuracy: 0.7358  
Epoch 165/300  
7/7 [=====] - ETA: 0s - loss: 0.3074 - accuracy: 0.8525  
Epoch 165: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 814ms/step - loss: 0.3074 - accuracy: 0.8525 - val\_loss: 0.4006 - val\_accuracy: 0.7461  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.3065 - accuracy: 0.8447  
Epoch 166: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 813ms/step - loss: 0.3065 - accuracy: 0.8447 - val\_loss: 0.3671 - val\_accuracy: 0.7772  
Epoch 167/300  
7/7 [=====] - ETA: 0s - loss: 0.2998 - accuracy: 0.8838  
Epoch 167: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 795ms/step - loss: 0.2998 - accuracy: 0.8838 - val\_loss: 0.3578 - val\_accuracy: 0.8238  
Epoch 168/300  
7/7 [=====] - ETA: 0s - loss: 0.2981 - accuracy: 0.8827  
Epoch 168: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 795ms/step - loss: 0.2981 - accuracy: 0.8827 - val\_loss: 0.3519 - val\_accuracy: 0.8187  
Epoch 169/300  
7/7 [=====] - ETA: 0s - loss: 0.2944 - accuracy: 0.9006  
Epoch 169: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 782ms/step - loss: 0.2944 - accuracy: 0.9006 - val\_loss: 0.3577 - val\_accuracy: 0.8083  
Epoch 170/300  
7/7 [=====] - ETA: 0s - loss: 0.3010 - accuracy: 0.8883  
Epoch 170: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 786ms/step - loss: 0.3010 - accuracy: 0.8883 - val\_loss: 0.3746 - val\_accuracy: 0.7927  
Epoch 171/300  
7/7 [=====] - ETA: 0s - loss: 0.3071 - accuracy: 0.8458  
Epoch 171: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 816ms/step - loss: 0.3071 - accuracy: 0.8458 - val\_loss: 0.3593 - val\_accuracy: 0.7668  
Epoch 172/300  
7/7 [=====] - ETA: 0s - loss: 0.3011 - accuracy: 0.8547  
Epoch 172: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 7s 1s/step - loss: 0.3011 - accuracy: 0.8547 - val\_loss: 0.3802 - val\_accuracy: 0.7617  
Epoch 173/300  
7/7 [=====] - ETA: 0s - loss: 0.3022 - accuracy: 0.8704  
Epoch 173: val\_accuracy did not improve from 0.83420

7/7 [=====] - 5s 785ms/step - loss: 0.3022 - accuracy: 0.8704 - val\_loss: 0.3926 - val\_accuracy: 0.7358  
Epoch 174/300  
7/7 [=====] - ETA: 0s - loss: 0.3036 - accuracy: 0.8637  
Epoch 174: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 786ms/step - loss: 0.3036 - accuracy: 0.8637 - val\_loss: 0.3708 - val\_accuracy: 0.8187  
Epoch 175/300  
7/7 [=====] - ETA: 0s - loss: 0.2963 - accuracy: 0.8905  
Epoch 175: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 811ms/step - loss: 0.2963 - accuracy: 0.8905 - val\_loss: 0.3478 - val\_accuracy: 0.8238  
Epoch 176/300  
7/7 [=====] - ETA: 0s - loss: 0.3006 - accuracy: 0.8760  
Epoch 176: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 803ms/step - loss: 0.3006 - accuracy: 0.8760 - val\_loss: 0.3391 - val\_accuracy: 0.8290  
Epoch 177/300  
7/7 [=====] - ETA: 0s - loss: 0.2967 - accuracy: 0.8883  
Epoch 177: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 782ms/step - loss: 0.2967 - accuracy: 0.8883 - val\_loss: 0.3686 - val\_accuracy: 0.8135  
Epoch 178/300  
7/7 [=====] - ETA: 0s - loss: 0.2931 - accuracy: 0.8972  
Epoch 178: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 798ms/step - loss: 0.2931 - accuracy: 0.8972 - val\_loss: 0.3797 - val\_accuracy: 0.7668  
Epoch 179/300  
7/7 [=====] - ETA: 0s - loss: 0.2997 - accuracy: 0.8804  
Epoch 179: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 789ms/step - loss: 0.2997 - accuracy: 0.8804 - val\_loss: 0.4012 - val\_accuracy: 0.7668  
Epoch 180/300  
7/7 [=====] - ETA: 0s - loss: 0.3001 - accuracy: 0.8816  
Epoch 180: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 781ms/step - loss: 0.3001 - accuracy: 0.8816 - val\_loss: 0.3664 - val\_accuracy: 0.7927  
Epoch 181/300  
7/7 [=====] - ETA: 0s - loss: 0.2962 - accuracy: 0.8771  
Epoch 181: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 804ms/step - loss: 0.2962 - accuracy: 0.8771 - val\_loss: 0.3905 - val\_accuracy: 0.7513  
Epoch 182/300  
7/7 [=====] - ETA: 0s - loss: 0.2957 - accuracy: 0.8916  
Epoch 182: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 780ms/step - loss: 0.2957 - accuracy: 0.8916 - val\_loss: 0.4038 - val\_accuracy: 0.7668  
Epoch 183/300  
7/7 [=====] - ETA: 0s - loss: 0.2975 - accuracy: 0.8670  
Epoch 183: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 813ms/step - loss: 0.2975 - accuracy: 0.8670 - val\_loss: 0.3730 - val\_accuracy: 0.8031  
Epoch 184/300  
7/7 [=====] - ETA: 0s - loss: 0.3023 - accuracy: 0.8916  
Epoch 184: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 790ms/step - loss: 0.3023 - accuracy: 0.8916 - val\_loss: 0.3776 - val\_accuracy: 0.7876  
Epoch 185/300  
7/7 [=====] - ETA: 0s - loss: 0.3038 - accuracy: 0.8682  
Epoch 185: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 785ms/step - loss: 0.3038 - accuracy: 0.8682 - val\_loss: 0.3463 - val\_accuracy: 0.8238  
Epoch 186/300  
7/7 [=====] - ETA: 0s - loss: 0.2985 - accuracy: 0.8782  
Epoch 186: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 805ms/step - loss: 0.2985 - accuracy: 0.8782 - val\_loss: 0.3613 - val\_accuracy: 0.8083  
Epoch 187/300  
7/7 [=====] - ETA: 0s - loss: 0.2907 - accuracy: 0.9017  
Epoch 187: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 799ms/step - loss: 0.2907 - accuracy: 0.9017 - val\_loss: 0.3751 - val\_accuracy: 0.8031  
Epoch 188/300  
7/7 [=====] - ETA: 0s - loss: 0.2894 - accuracy: 0.9218  
Epoch 188: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 776ms/step - loss: 0.2894 - accuracy: 0.9218 - val\_loss: 0.3461 - val\_accuracy: 0.8135  
Epoch 189/300  
7/7 [=====] - ETA: 0s - loss: 0.2924 - accuracy: 0.8849  
Epoch 189: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 799ms/step - loss: 0.2924 - accuracy: 0.8849 - val\_loss: 0.3354 - val\_accuracy: 0.8290  
Epoch 190/300



7/7 [=====] - ETA: 0s - loss: 0.2973 - accuracy: 0.8894  
Epoch 190: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 800ms/step - loss: 0.2973 - accuracy: 0.8894 - val\_loss: 0.3526 - val\_accuracy: 0.8342  
Epoch 191/300  
7/7 [=====] - ETA: 0s - loss: 0.2944 - accuracy: 0.8972  
Epoch 191: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 786ms/step - loss: 0.2944 - accuracy: 0.8972 - val\_loss: 0.3540 - val\_accuracy: 0.8342  
Epoch 192/300  
7/7 [=====] - ETA: 0s - loss: 0.2919 - accuracy: 0.9017  
Epoch 192: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 800ms/step - loss: 0.2919 - accuracy: 0.9017 - val\_loss: 0.3497 - val\_accuracy: 0.8342  
Epoch 193/300  
7/7 [=====] - ETA: 0s - loss: 0.2838 - accuracy: 0.9140  
Epoch 193: val\_accuracy improved from 0.83420 to 0.84456, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 792ms/step - loss: 0.2838 - accuracy: 0.9140 - val\_loss: 0.3469 - val\_accuracy: 0.8446  
Epoch 194/300  
7/7 [=====] - ETA: 0s - loss: 0.2860 - accuracy: 0.9274  
Epoch 194: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 800ms/step - loss: 0.2860 - accuracy: 0.9274 - val\_loss: 0.3453 - val\_accuracy: 0.8342  
Epoch 195/300  
7/7 [=====] - ETA: 0s - loss: 0.2909 - accuracy: 0.9017  
Epoch 195: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 6s 808ms/step - loss: 0.2909 - accuracy: 0.9017 - val\_loss: 0.3494 - val\_accuracy: 0.8394  
Epoch 196/300  
7/7 [=====] - ETA: 0s - loss: 0.2838 - accuracy: 0.9251  
Epoch 196: val\_accuracy did not improve from 0.84456  
7/7 [=====] - 5s 765ms/step - loss: 0.2838 - accuracy: 0.9251 - val\_loss: 0.3564 - val\_accuracy: 0.8394  
Epoch 197/300  
7/7 [=====] - ETA: 0s - loss: 0.2838 - accuracy: 0.9117  
Epoch 197: val\_accuracy improved from 0.84456 to 0.84974, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 809ms/step - loss: 0.2838 - accuracy: 0.9117 - val\_loss: 0.3375 - val\_accuracy: 0.8497  
Epoch 198/300  
7/7 [=====] - ETA: 0s - loss: 0.2904 - accuracy: 0.9073  
Epoch 198: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 808ms/step - loss: 0.2904 - accuracy: 0.9073 - val\_loss: 0.3361 - val\_accuracy: 0.8290  
Epoch 199/300  
7/7 [=====] - ETA: 0s - loss: 0.2918 - accuracy: 0.9039  
Epoch 199: val\_accuracy improved from 0.84974 to 0.86528, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 799ms/step - loss: 0.2918 - accuracy: 0.9039 - val\_loss: 0.3298 - val\_accuracy: 0.8653  
Epoch 200/300  
7/7 [=====] - ETA: 0s - loss: 0.2990 - accuracy: 0.8894  
Epoch 200: val\_accuracy improved from 0.86528 to 0.87047, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 795ms/step - loss: 0.2990 - accuracy: 0.8894 - val\_loss: 0.3269 - val\_accuracy: 0.8705  
Epoch 201/300  
7/7 [=====] - ETA: 0s - loss: 0.2882 - accuracy: 0.9050  
Epoch 201: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 800ms/step - loss: 0.2882 - accuracy: 0.9050 - val\_loss: 0.3541 - val\_accuracy: 0.8187  
Epoch 202/300  
7/7 [=====] - ETA: 0s - loss: 0.2901 - accuracy: 0.9061  
Epoch 202: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 802ms/step - loss: 0.2901 - accuracy: 0.9061 - val\_loss: 0.3580 - val\_accuracy: 0.8238  
Epoch 203/300  
7/7 [=====] - ETA: 0s - loss: 0.2817 - accuracy: 0.9263  
Epoch 203: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 808ms/step - loss: 0.2817 - accuracy: 0.9263 - val\_loss: 0.3480 - val\_accuracy: 0.8083  
Epoch 204/300  
7/7 [=====] - ETA: 0s - loss: 0.2778 - accuracy: 0.9229  
Epoch 204: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 7s 1s/step - loss: 0.2778 - accuracy: 0.9229 - val\_loss: 0.386 - val\_accuracy: 0.8342  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.2856 - accuracy: 0.9140  
Epoch 205: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 825ms/step - loss: 0.2856 - accuracy: 0.9140 - val\_loss: 0.3486 - val\_accuracy: 0.8342  
Epoch 206/300  
7/7 [=====] - ETA: 0s - loss: 0.2796 - accuracy: 0.9196  
Epoch 206: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 796ms/step - loss: 0.2796 - accuracy: 0.9196 - val\_loss: 0

.3567 - val\_accuracy: 0.7979  
Epoch 207/300  
7/7 [=====] - ETA: 0s - loss: 0.2810 - accuracy: 0.9196  
Epoch 207: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 792ms/step - loss: 0.2810 - accuracy: 0.9196 - val\_loss: 0  
.3304 - val\_accuracy: 0.8601  
Epoch 208/300  
7/7 [=====] - ETA: 0s - loss: 0.2842 - accuracy: 0.9006  
Epoch 208: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 778ms/step - loss: 0.2842 - accuracy: 0.9006 - val\_loss: 0  
.3361 - val\_accuracy: 0.8394  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.2957 - accuracy: 0.8827  
Epoch 209: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 774ms/step - loss: 0.2957 - accuracy: 0.8827 - val\_loss: 0  
.3430 - val\_accuracy: 0.8446  
Epoch 210/300  
7/7 [=====] - ETA: 0s - loss: 0.2883 - accuracy: 0.9106  
Epoch 210: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 781ms/step - loss: 0.2883 - accuracy: 0.9106 - val\_loss: 0  
.3781 - val\_accuracy: 0.8238  
Epoch 211/300  
7/7 [=====] - ETA: 0s - loss: 0.2897 - accuracy: 0.8972  
Epoch 211: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 778ms/step - loss: 0.2897 - accuracy: 0.8972 - val\_loss: 0  
.3880 - val\_accuracy: 0.7979  
Epoch 212/300  
7/7 [=====] - ETA: 0s - loss: 0.2877 - accuracy: 0.9184  
Epoch 212: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 809ms/step - loss: 0.2877 - accuracy: 0.9184 - val\_loss: 0  
.3484 - val\_accuracy: 0.8238  
Epoch 213/300  
7/7 [=====] - ETA: 0s - loss: 0.2875 - accuracy: 0.9050  
Epoch 213: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 797ms/step - loss: 0.2875 - accuracy: 0.9050 - val\_loss: 0  
.3502 - val\_accuracy: 0.8290  
Epoch 214/300  
7/7 [=====] - ETA: 0s - loss: 0.2813 - accuracy: 0.9263  
Epoch 214: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 803ms/step - loss: 0.2813 - accuracy: 0.9263 - val\_loss: 0  
.3551 - val\_accuracy: 0.8290  
Epoch 215/300  
7/7 [=====] - ETA: 0s - loss: 0.2821 - accuracy: 0.9352  
Epoch 215: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 783ms/step - loss: 0.2821 - accuracy: 0.9352 - val\_loss: 0  
.3724 - val\_accuracy: 0.8187  
Epoch 216/300  
7/7 [=====] - ETA: 0s - loss: 0.2811 - accuracy: 0.9218  
Epoch 216: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 777ms/step - loss: 0.2811 - accuracy: 0.9218 - val\_loss: 0  
.3312 - val\_accuracy: 0.8446  
Epoch 217/300  
7/7 [=====] - ETA: 0s - loss: 0.2862 - accuracy: 0.9173  
Epoch 217: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 772ms/step - loss: 0.2862 - accuracy: 0.9173 - val\_loss: 0  
.3289 - val\_accuracy: 0.8705  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.2895 - accuracy: 0.9117  
Epoch 218: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 775ms/step - loss: 0.2895 - accuracy: 0.9117 - val\_loss: 0  
.3762 - val\_accuracy: 0.7927  
Epoch 219/300  
7/7 [=====] - ETA: 0s - loss: 0.2817 - accuracy: 0.9240  
Epoch 219: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 806ms/step - loss: 0.2817 - accuracy: 0.9240 - val\_loss: 0  
.3588 - val\_accuracy: 0.8238  
Epoch 220/300  
7/7 [=====] - ETA: 0s - loss: 0.2773 - accuracy: 0.9341  
Epoch 220: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 793ms/step - loss: 0.2773 - accuracy: 0.9341 - val\_loss: 0  
.3397 - val\_accuracy: 0.8601  
Epoch 221/300  
7/7 [=====] - ETA: 0s - loss: 0.2743 - accuracy: 0.9464  
Epoch 221: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 786ms/step - loss: 0.2743 - accuracy: 0.9464 - val\_loss: 0  
.3398 - val\_accuracy: 0.8394  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.2772 - accuracy: 0.9363  
Epoch 222: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 791ms/step - loss: 0.2772 - accuracy: 0.9363 - val\_loss: 0  
.3430 - val\_accuracy: 0.8549  
Epoch 223/300  
7/7 [=====] - ETA: 0s - loss: 0.2715 - accuracy: 0.9486

Epoch 223: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 794ms/step - loss: 0.2715 - accuracy: 0.9486 - val\_loss: 0.3453 - val\_accuracy: 0.8497  
Epoch 224/300  
7/7 [=====] - ETA: 0s - loss: 0.2813 - accuracy: 0.9251  
Epoch 224: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 776ms/step - loss: 0.2813 - accuracy: 0.9251 - val\_loss: 0.3452 - val\_accuracy: 0.8342  
Epoch 225/300  
7/7 [=====] - ETA: 0s - loss: 0.2793 - accuracy: 0.9296  
Epoch 225: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 789ms/step - loss: 0.2793 - accuracy: 0.9296 - val\_loss: 0.3492 - val\_accuracy: 0.8497  
Epoch 226/300  
7/7 [=====] - ETA: 0s - loss: 0.2731 - accuracy: 0.9453  
Epoch 226: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 796ms/step - loss: 0.2731 - accuracy: 0.9453 - val\_loss: 0.3292 - val\_accuracy: 0.8601  
Epoch 227/300  
7/7 [=====] - ETA: 0s - loss: 0.2714 - accuracy: 0.9542  
Epoch 227: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 814ms/step - loss: 0.2714 - accuracy: 0.9542 - val\_loss: 0.3568 - val\_accuracy: 0.8342  
Epoch 228/300  
7/7 [=====] - ETA: 0s - loss: 0.2748 - accuracy: 0.9419  
Epoch 228: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 784ms/step - loss: 0.2748 - accuracy: 0.9419 - val\_loss: 0.3492 - val\_accuracy: 0.8394  
Epoch 229/300  
7/7 [=====] - ETA: 0s - loss: 0.2751 - accuracy: 0.9330  
Epoch 229: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 823ms/step - loss: 0.2751 - accuracy: 0.9330 - val\_loss: 0.3354 - val\_accuracy: 0.8497  
Epoch 230/300  
7/7 [=====] - ETA: 0s - loss: 0.2753 - accuracy: 0.9341  
Epoch 230: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 808ms/step - loss: 0.2753 - accuracy: 0.9341 - val\_loss: 0.3386 - val\_accuracy: 0.8549  
Epoch 231/300  
7/7 [=====] - ETA: 0s - loss: 0.2774 - accuracy: 0.9263  
Epoch 231: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 776ms/step - loss: 0.2774 - accuracy: 0.9263 - val\_loss: 0.3451 - val\_accuracy: 0.8446  
Epoch 232/300  
7/7 [=====] - ETA: 0s - loss: 0.2762 - accuracy: 0.9453  
Epoch 232: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 786ms/step - loss: 0.2762 - accuracy: 0.9453 - val\_loss: 0.3363 - val\_accuracy: 0.8653  
Epoch 233/300  
7/7 [=====] - ETA: 0s - loss: 0.2965 - accuracy: 0.9106  
Epoch 233: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 785ms/step - loss: 0.2965 - accuracy: 0.9106 - val\_loss: 0.3510 - val\_accuracy: 0.8446  
Epoch 234/300  
7/7 [=====] - ETA: 0s - loss: 0.2860 - accuracy: 0.9229  
Epoch 234: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 791ms/step - loss: 0.2860 - accuracy: 0.9229 - val\_loss: 0.3339 - val\_accuracy: 0.8549  
Epoch 235/300  
7/7 [=====] - ETA: 0s - loss: 0.2756 - accuracy: 0.9475  
Epoch 235: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 789ms/step - loss: 0.2756 - accuracy: 0.9475 - val\_loss: 0.3628 - val\_accuracy: 0.7927  
Epoch 236/300  
7/7 [=====] - ETA: 0s - loss: 0.2770 - accuracy: 0.9285  
Epoch 236: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 778ms/step - loss: 0.2770 - accuracy: 0.9285 - val\_loss: 0.3775 - val\_accuracy: 0.8031  
Epoch 237/300  
7/7 [=====] - ETA: 0s - loss: 0.2737 - accuracy: 0.9542  
Epoch 237: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 873ms/step - loss: 0.2737 - accuracy: 0.9542 - val\_loss: 0.3892 - val\_accuracy: 0.7668  
Epoch 238/300  
7/7 [=====] - ETA: 0s - loss: 0.2734 - accuracy: 0.9419  
Epoch 238: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 7s 909ms/step - loss: 0.2734 - accuracy: 0.9419 - val\_loss: 0.3695 - val\_accuracy: 0.7772  
Epoch 239/300  
7/7 [=====] - ETA: 0s - loss: 0.2715 - accuracy: 0.9453  
Epoch 239: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 795ms/step - loss: 0.2715 - accuracy: 0.9453 - val\_loss: 0.3496 - val\_accuracy: 0.8290

Epoch 240/300  
7/7 [=====] - ETA: 0s - loss: 0.2687 - accuracy: 0.9564  
Epoch 240: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 776ms/step - loss: 0.2687 - accuracy: 0.9564 - val\_loss: 0.3486 - val\_accuracy: 0.8497  
Epoch 241/300  
7/7 [=====] - ETA: 0s - loss: 0.2684 - accuracy: 0.9520  
Epoch 241: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 809ms/step - loss: 0.2684 - accuracy: 0.9520 - val\_loss: 0.3504 - val\_accuracy: 0.8290  
Epoch 242/300  
7/7 [=====] - ETA: 0s - loss: 0.2686 - accuracy: 0.9676  
Epoch 242: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 800ms/step - loss: 0.2686 - accuracy: 0.9676 - val\_loss: 0.3658 - val\_accuracy: 0.8290  
Epoch 243/300  
7/7 [=====] - ETA: 0s - loss: 0.2712 - accuracy: 0.9453  
Epoch 243: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 784ms/step - loss: 0.2712 - accuracy: 0.9453 - val\_loss: 0.3395 - val\_accuracy: 0.8653  
Epoch 244/300  
7/7 [=====] - ETA: 0s - loss: 0.2746 - accuracy: 0.9520  
Epoch 244: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 803ms/step - loss: 0.2746 - accuracy: 0.9520 - val\_loss: 0.3662 - val\_accuracy: 0.8290  
Epoch 245/300  
7/7 [=====] - ETA: 0s - loss: 0.2700 - accuracy: 0.9531  
Epoch 245: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 794ms/step - loss: 0.2700 - accuracy: 0.9531 - val\_loss: 0.3474 - val\_accuracy: 0.8342  
Epoch 246/300  
7/7 [=====] - ETA: 0s - loss: 0.2716 - accuracy: 0.9441  
Epoch 246: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 799ms/step - loss: 0.2716 - accuracy: 0.9441 - val\_loss: 0.3590 - val\_accuracy: 0.8083  
Epoch 247/300  
7/7 [=====] - ETA: 0s - loss: 0.2733 - accuracy: 0.9419  
Epoch 247: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 806ms/step - loss: 0.2733 - accuracy: 0.9419 - val\_loss: 0.3503 - val\_accuracy: 0.8187  
Epoch 248/300  
7/7 [=====] - ETA: 0s - loss: 0.2723 - accuracy: 0.9497  
Epoch 248: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 790ms/step - loss: 0.2723 - accuracy: 0.9497 - val\_loss: 0.3477 - val\_accuracy: 0.8446  
Epoch 249/300  
7/7 [=====] - ETA: 0s - loss: 0.2684 - accuracy: 0.9665  
Epoch 249: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 784ms/step - loss: 0.2684 - accuracy: 0.9665 - val\_loss: 0.3727 - val\_accuracy: 0.8083  
Epoch 250/300  
7/7 [=====] - ETA: 0s - loss: 0.2787 - accuracy: 0.9251  
Epoch 250: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 809ms/step - loss: 0.2787 - accuracy: 0.9251 - val\_loss: 0.3415 - val\_accuracy: 0.8497  
Epoch 251/300  
7/7 [=====] - ETA: 0s - loss: 0.2729 - accuracy: 0.9341  
Epoch 251: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 794ms/step - loss: 0.2729 - accuracy: 0.9341 - val\_loss: 0.3397 - val\_accuracy: 0.8549  
Epoch 252/300  
7/7 [=====] - ETA: 0s - loss: 0.2701 - accuracy: 0.9553  
Epoch 252: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 771ms/step - loss: 0.2701 - accuracy: 0.9553 - val\_loss: 0.3563 - val\_accuracy: 0.8446  
Epoch 253/300  
7/7 [=====] - ETA: 0s - loss: 0.2747 - accuracy: 0.9419  
Epoch 253: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 806ms/step - loss: 0.2747 - accuracy: 0.9419 - val\_loss: 0.3330 - val\_accuracy: 0.8705  
Epoch 254/300  
7/7 [=====] - ETA: 0s - loss: 0.2674 - accuracy: 0.9542  
Epoch 254: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 791ms/step - loss: 0.2674 - accuracy: 0.9542 - val\_loss: 0.3351 - val\_accuracy: 0.8497  
Epoch 255/300  
7/7 [=====] - ETA: 0s - loss: 0.2680 - accuracy: 0.9620  
Epoch 255: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 792ms/step - loss: 0.2680 - accuracy: 0.9620 - val\_loss: 0.3468 - val\_accuracy: 0.8601  
Epoch 256/300  
7/7 [=====] - ETA: 0s - loss: 0.2702 - accuracy: 0.9497  
Epoch 256: val\_accuracy did not improve from 0.87047

7/7 [=====] - 6s 797ms/step - loss: 0.2702 - accuracy: 0.9497 - val\_loss: 0  
.3531 - val\_accuracy: 0.8290  
Epoch 257/300  
7/7 [=====] - ETA: 0s - loss: 0.2653 - accuracy: 0.9687  
Epoch 257: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 811ms/step - loss: 0.2653 - accuracy: 0.9687 - val\_loss: 0  
.3318 - val\_accuracy: 0.8549  
Epoch 258/300  
7/7 [=====] - ETA: 0s - loss: 0.2670 - accuracy: 0.9609  
Epoch 258: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 784ms/step - loss: 0.2670 - accuracy: 0.9609 - val\_loss: 0  
.3322 - val\_accuracy: 0.8549  
Epoch 259/300  
7/7 [=====] - ETA: 0s - loss: 0.2647 - accuracy: 0.9754  
Epoch 259: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 802ms/step - loss: 0.2647 - accuracy: 0.9754 - val\_loss: 0  
.3464 - val\_accuracy: 0.8549  
Epoch 260/300  
7/7 [=====] - ETA: 0s - loss: 0.2661 - accuracy: 0.9642  
Epoch 260: val\_accuracy improved from 0.87047 to 0.88601, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 807ms/step - loss: 0.2661 - accuracy: 0.9642 - val\_loss: 0  
.3320 - val\_accuracy: 0.8860  
Epoch 261/300  
7/7 [=====] - ETA: 0s - loss: 0.2701 - accuracy: 0.9587  
Epoch 261: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 806ms/step - loss: 0.2701 - accuracy: 0.9587 - val\_loss: 0  
.3521 - val\_accuracy: 0.8290  
Epoch 262/300  
7/7 [=====] - ETA: 0s - loss: 0.2682 - accuracy: 0.9520  
Epoch 262: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 812ms/step - loss: 0.2682 - accuracy: 0.9520 - val\_loss: 0  
.3330 - val\_accuracy: 0.8601  
Epoch 263/300  
7/7 [=====] - ETA: 0s - loss: 0.2778 - accuracy: 0.9475  
Epoch 263: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 804ms/step - loss: 0.2778 - accuracy: 0.9475 - val\_loss: 0  
.3381 - val\_accuracy: 0.8549  
Epoch 264/300  
7/7 [=====] - ETA: 0s - loss: 0.2800 - accuracy: 0.9184  
Epoch 264: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 792ms/step - loss: 0.2800 - accuracy: 0.9184 - val\_loss: 0  
.3490 - val\_accuracy: 0.8446  
Epoch 265/300  
7/7 [=====] - ETA: 0s - loss: 0.2735 - accuracy: 0.9564  
Epoch 265: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 768ms/step - loss: 0.2735 - accuracy: 0.9564 - val\_loss: 0  
.3694 - val\_accuracy: 0.8238  
Epoch 266/300  
7/7 [=====] - ETA: 0s - loss: 0.2725 - accuracy: 0.9453  
Epoch 266: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 801ms/step - loss: 0.2725 - accuracy: 0.9453 - val\_loss: 0  
.3418 - val\_accuracy: 0.8756  
Epoch 267/300  
7/7 [=====] - ETA: 0s - loss: 0.2748 - accuracy: 0.9441  
Epoch 267: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 793ms/step - loss: 0.2748 - accuracy: 0.9441 - val\_loss: 0  
.3402 - val\_accuracy: 0.8549  
Epoch 268/300  
7/7 [=====] - ETA: 0s - loss: 0.2667 - accuracy: 0.9665  
Epoch 268: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 798ms/step - loss: 0.2667 - accuracy: 0.9665 - val\_loss: 0  
.3422 - val\_accuracy: 0.8549  
Epoch 269/300  
7/7 [=====] - ETA: 0s - loss: 0.2712 - accuracy: 0.9441  
Epoch 269: val\_accuracy improved from 0.88601 to 0.89119, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 809ms/step - loss: 0.2712 - accuracy: 0.9441 - val\_loss: 0  
.3370 - val\_accuracy: 0.8912  
Epoch 270/300  
7/7 [=====] - ETA: 0s - loss: 0.2710 - accuracy: 0.9475  
Epoch 270: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 8s 1s/step - loss: 0.2710 - accuracy: 0.9475 - val\_loss: 0.34  
33 - val\_accuracy: 0.8653  
Epoch 271/300  
7/7 [=====] - ETA: 0s - loss: 0.2652 - accuracy: 0.9654  
Epoch 271: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 785ms/step - loss: 0.2652 - accuracy: 0.9654 - val\_loss: 0  
.3565 - val\_accuracy: 0.8549  
Epoch 272/300  
7/7 [=====] - ETA: 0s - loss: 0.2657 - accuracy: 0.9520  
Epoch 272: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 803ms/step - loss: 0.2657 - accuracy: 0.9520 - val\_loss: 0  
.3369 - val\_accuracy: 0.8808  
Epoch 273/300

7/7 [=====] - ETA: 0s - loss: 0.2627 - accuracy: 0.9777  
Epoch 273: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 794ms/step - loss: 0.2627 - accuracy: 0.9777 - val\_loss: 0.3488 - val\_accuracy: 0.8446  
Epoch 274/300  
7/7 [=====] - ETA: 0s - loss: 0.2644 - accuracy: 0.9598  
Epoch 274: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 807ms/step - loss: 0.2644 - accuracy: 0.9598 - val\_loss: 0.3362 - val\_accuracy: 0.8653  
Epoch 275/300  
7/7 [=====] - ETA: 0s - loss: 0.2620 - accuracy: 0.9788  
Epoch 275: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 810ms/step - loss: 0.2620 - accuracy: 0.9788 - val\_loss: 0.3396 - val\_accuracy: 0.8653  
Epoch 276/300  
7/7 [=====] - ETA: 0s - loss: 0.2618 - accuracy: 0.9721  
Epoch 276: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 787ms/step - loss: 0.2618 - accuracy: 0.9721 - val\_loss: 0.3238 - val\_accuracy: 0.8808  
Epoch 277/300  
7/7 [=====] - ETA: 0s - loss: 0.2632 - accuracy: 0.9709  
Epoch 277: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 808ms/step - loss: 0.2632 - accuracy: 0.9709 - val\_loss: 0.3515 - val\_accuracy: 0.8290  
Epoch 278/300  
7/7 [=====] - ETA: 0s - loss: 0.2629 - accuracy: 0.9743  
Epoch 278: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 798ms/step - loss: 0.2629 - accuracy: 0.9743 - val\_loss: 0.3225 - val\_accuracy: 0.8808  
Epoch 279/300  
7/7 [=====] - ETA: 0s - loss: 0.2781 - accuracy: 0.9397  
Epoch 279: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 796ms/step - loss: 0.2781 - accuracy: 0.9397 - val\_loss: 0.3216 - val\_accuracy: 0.8756  
Epoch 280/300  
7/7 [=====] - ETA: 0s - loss: 0.2678 - accuracy: 0.9542  
Epoch 280: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 800ms/step - loss: 0.2678 - accuracy: 0.9542 - val\_loss: 0.3486 - val\_accuracy: 0.8601  
Epoch 281/300  
7/7 [=====] - ETA: 0s - loss: 0.2703 - accuracy: 0.9497  
Epoch 281: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 805ms/step - loss: 0.2703 - accuracy: 0.9497 - val\_loss: 0.3256 - val\_accuracy: 0.8860  
Epoch 282/300  
7/7 [=====] - ETA: 0s - loss: 0.2656 - accuracy: 0.9464  
Epoch 282: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 797ms/step - loss: 0.2656 - accuracy: 0.9464 - val\_loss: 0.3352 - val\_accuracy: 0.8653  
Epoch 283/300  
7/7 [=====] - ETA: 0s - loss: 0.2758 - accuracy: 0.9307  
Epoch 283: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 788ms/step - loss: 0.2758 - accuracy: 0.9307 - val\_loss: 0.3762 - val\_accuracy: 0.8290  
Epoch 284/300  
7/7 [=====] - ETA: 0s - loss: 0.2666 - accuracy: 0.9698  
Epoch 284: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 780ms/step - loss: 0.2666 - accuracy: 0.9698 - val\_loss: 0.3308 - val\_accuracy: 0.8860  
Epoch 285/300  
7/7 [=====] - ETA: 0s - loss: 0.2663 - accuracy: 0.9687  
Epoch 285: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 785ms/step - loss: 0.2663 - accuracy: 0.9687 - val\_loss: 0.3512 - val\_accuracy: 0.8497  
Epoch 286/300  
7/7 [=====] - ETA: 0s - loss: 0.2670 - accuracy: 0.9620  
Epoch 286: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 5s 788ms/step - loss: 0.2670 - accuracy: 0.9620 - val\_loss: 0.3423 - val\_accuracy: 0.8601  
Epoch 287/300  
7/7 [=====] - ETA: 0s - loss: 0.2619 - accuracy: 0.9754  
Epoch 287: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 795ms/step - loss: 0.2619 - accuracy: 0.9754 - val\_loss: 0.3360 - val\_accuracy: 0.8497  
Epoch 288/300  
7/7 [=====] - ETA: 0s - loss: 0.2677 - accuracy: 0.9553  
Epoch 288: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 791ms/step - loss: 0.2677 - accuracy: 0.9553 - val\_loss: 0.3508 - val\_accuracy: 0.8549  
Epoch 289/300  
7/7 [=====] - ETA: 0s - loss: 0.2679 - accuracy: 0.9564  
Epoch 289: val\_accuracy did not improve from 0.89119  
7/7 [=====] - 6s 802ms/step - loss: 0.2679 - accuracy: 0.9564 - val\_loss: 0

```
.3466 - val_accuracy: 0.8601
Epoch 290/300
7/7 [=====] - ETA: 0s - loss: 0.2643 - accuracy: 0.9732
Epoch 290: val_accuracy did not improve from 0.89119
7/7 [=====] - 6s 806ms/step - loss: 0.2643 - accuracy: 0.9732 - val_loss: 0
.3331 - val_accuracy: 0.8601
Epoch 291/300
7/7 [=====] - ETA: 0s - loss: 0.2625 - accuracy: 0.9732
Epoch 291: val_accuracy improved from 0.89119 to 0.89637, saving model to /content/weights.best.hdf5
7/7 [=====] - 5s 790ms/step - loss: 0.2625 - accuracy: 0.9732 - val_loss: 0
.3340 - val_accuracy: 0.8964
Epoch 292/300
7/7 [=====] - ETA: 0s - loss: 0.2655 - accuracy: 0.9631
Epoch 292: val_accuracy did not improve from 0.89637
7/7 [=====] - 5s 780ms/step - loss: 0.2655 - accuracy: 0.9631 - val_loss: 0
.3445 - val_accuracy: 0.8756
Epoch 293/300
7/7 [=====] - ETA: 0s - loss: 0.2655 - accuracy: 0.9598
Epoch 293: val_accuracy did not improve from 0.89637
7/7 [=====] - 5s 787ms/step - loss: 0.2655 - accuracy: 0.9598 - val_loss: 0
.3503 - val_accuracy: 0.8549
Epoch 294/300
7/7 [=====] - ETA: 0s - loss: 0.2603 - accuracy: 0.9799
Epoch 294: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 811ms/step - loss: 0.2603 - accuracy: 0.9799 - val_loss: 0
.3293 - val_accuracy: 0.8601
Epoch 295/300
7/7 [=====] - ETA: 0s - loss: 0.2672 - accuracy: 0.9564
Epoch 295: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 789ms/step - loss: 0.2672 - accuracy: 0.9564 - val_loss: 0
.3498 - val_accuracy: 0.8497
Epoch 296/300
7/7 [=====] - ETA: 0s - loss: 0.2633 - accuracy: 0.9832
Epoch 296: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 801ms/step - loss: 0.2633 - accuracy: 0.9832 - val_loss: 0
.3605 - val_accuracy: 0.8342
Epoch 297/300
7/7 [=====] - ETA: 0s - loss: 0.2653 - accuracy: 0.9575
Epoch 297: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 810ms/step - loss: 0.2653 - accuracy: 0.9575 - val_loss: 0
.3413 - val_accuracy: 0.8187
Epoch 298/300
7/7 [=====] - ETA: 0s - loss: 0.2681 - accuracy: 0.9609
Epoch 298: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 800ms/step - loss: 0.2681 - accuracy: 0.9609 - val_loss: 0
.3271 - val_accuracy: 0.8705
Epoch 299/300
7/7 [=====] - ETA: 0s - loss: 0.2635 - accuracy: 0.9732
Epoch 299: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 790ms/step - loss: 0.2635 - accuracy: 0.9732 - val_loss: 0
.3495 - val_accuracy: 0.8601
Epoch 300/300
7/7 [=====] - ETA: 0s - loss: 0.2618 - accuracy: 0.9743
Epoch 300: val_accuracy did not improve from 0.89637
7/7 [=====] - 6s 799ms/step - loss: 0.2618 - accuracy: 0.9743 - val_loss: 0
.3374 - val_accuracy: 0.8549
Created model and loaded weights from file
```

In [166]:

```
results.loc[index,['Architecture','Dropout','Loss Fn','LR']] = ['CNN 2D',0.2, 'Poisson',0.0001]
```

#### Evaluation: Training and Validation

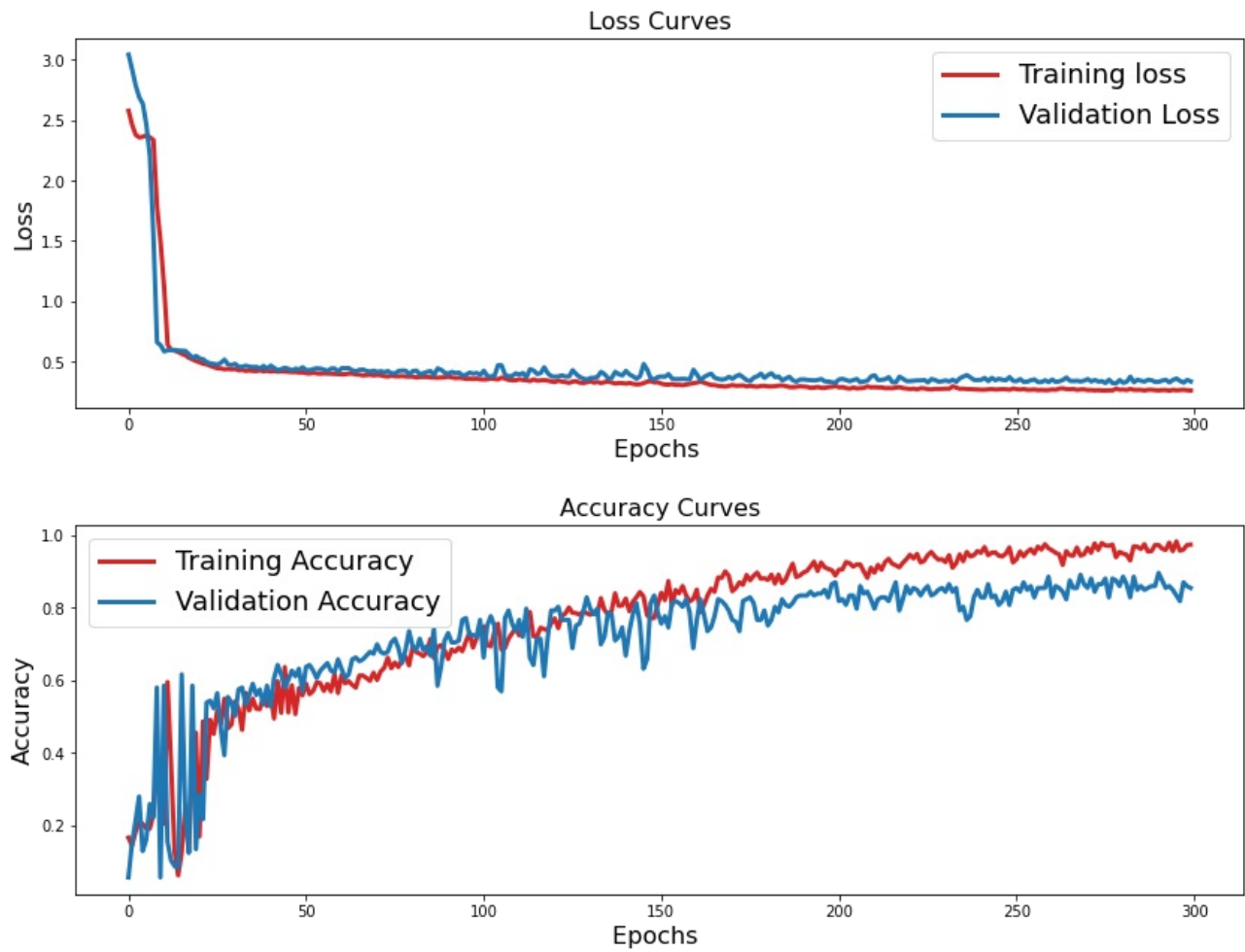
In [167]:

```
evaluation_train_val(model,x_train,y_train,x_val,y_val,results,index)
```

```
Training Accuracy: 0.994413435459137
Training Loss: 0.023900166153907776
Validation Accuracy: 0.8963730335235596
Validation Loss: 0.3361426591873169
```

In [168]:

```
plotfn(history)
```



Evaluation: Testing

In [169]:

```
evaluation_test(model,x_test,y_test,results,index)
```

7/7 [=====] - 0s 47ms/step - loss: 0.6694 - accuracy: 0.8290  
Test accuracy: 0.8290155529975891  
Test loss: 0.6693798899650574

Evaluation Metrics

F1 score

In [170]:

```
_ , _ , _ , val_f1 = predictfn(model, x_val, y_val)
```

7/7 [=====] - 0s 49ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.88	0.94	17
extrastole	0.64	0.64	0.64	11
murmur	0.85	0.96	0.90	49
normal	0.93	0.90	0.91	116
accuracy			0.90	193
macro avg	0.85	0.84	0.85	193
weighted avg	0.90	0.90	0.90	193



In [171]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model,x_test,y_test)
```

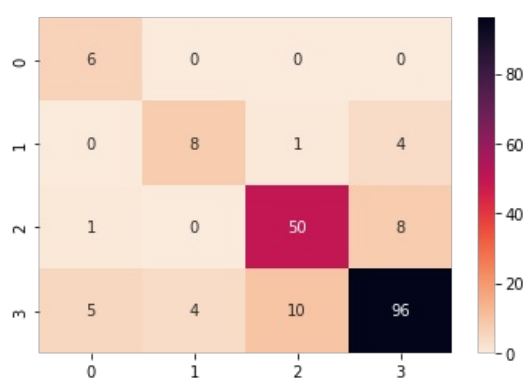
7/7 [=====] - 0s 46ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.50	0.67	12
extrastole	0.62	0.67	0.64	12
murmur	0.85	0.82	0.83	61
normal	0.83	0.89	0.86	108
accuracy			0.83	193
macro avg	0.82	0.72	0.75	193
weighted avg	0.84	0.83	0.83	193

Confusion Matrix

In [172]:

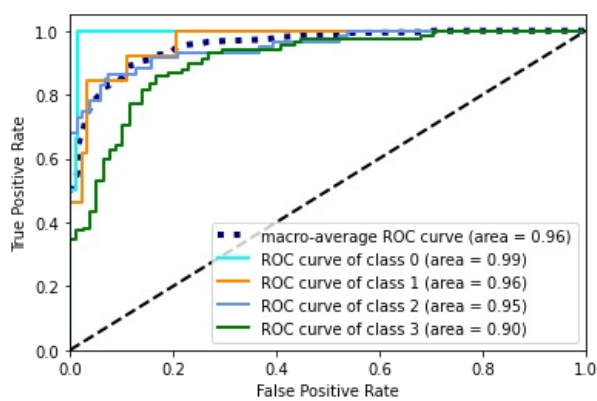
```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

In [173]:

```
roc = plot_ROC(y_test,predictions)
```



In [174]:

```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

Out[174]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547

Predicting a sample's label

In [ ]:

```
model_name = "heartbeat_classifierLoss1.h5"
model.save(model_name)
```

1/1 [=====] - 0s 137ms/step  
Label Prediction Probabilities: [[9.9579092e-06 5.4306501e-01 1.4898846e-01 3.0793658e-01]]  
-----  
Label:  
Extrasystole heartbeat  
confidence: 0.543065

Predicting a Murmur sample

In [182]:

```
test.iloc[5]
```

Out[182]:

filename /content/set\_b/murmur\_\_281\_1311165683454\_D.wav  
label murmur  
offset 3  
Name: 997, dtype: object

In [175]:

```
sample_predict(model_name,5)
```

1/1 [=====] - 0s 157ms/step  
Label Prediction Probabilities: [[2.1426851e-05 6.7254900e-06 9.9958450e-01 3.8739174e-04]]  
-----  
Label:  
Murmur heartbeat  
confidence: 0.9995845

Predicting a Normal sample

In [181]:

```
test.iloc[50]
```

Out[181]:

filename /content/set\_a/normal\_\_201101151127.wav  
label normal  
offset 3  
Name: 165, dtype: object

In [176]:

```
sample_predict(model_name,50)
```

1/1 [=====] - 0s 150ms/step  
Label Prediction Probabilities: [[6.2798676e-06 3.2975901e-02 2.9800212e-01 6.6901565e-01]]  
-----  
Label:  
Normal heartbeat  
confidence: 0.66901565

### Predicting an Extrahls sample

In [180]:

```
test.iloc[77]
```

Out[180]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [177]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 434ms/step
Label Prediction Probabilities: [[9.9954081e-01 2.0443778e-16 2.3870100e-05 4.3538024e-04]]
-----
Label:
Extrahls heartbeat
confidence: 0.9995408
```

### Predicting a Extrasystole sample

In [179]:

```
test.iloc[96]
```

Out[179]:

```
filename    /content/set_b/extrastole__207_1308159792607_B...
label                               extrastole
offset                                           1
Name: 990, dtype: object
```

In [178]:

```
sample_predict(model_name,96)
```

```
1/1 [=====] - 0s 143ms/step
Label Prediction Probabilities: [[0.00722221 0.5254265  0.1157811  0.35157013]]
-----
Label:
Extrasystole heartbeat
confidence: 0.5254265
```

## CNN Experiment 4:

### Changing in loss function:

#### KL Divergence

- Computes Kullback-Leibler divergence loss between  $y_{\text{true}}$  and  $y_{\text{pred}}$ .
- $\text{loss} = y_{\text{true}} * \log(y_{\text{true}} / y_{\text{pred}})$

In [191]:

```
model = Sequential()  
Conv2Dmodel(model,0.2)
```

Model: "sequential\_8"

Layer (type)	Output Shape	Param #
conv2d_32 (Conv2D)	(None, 40, 130, 16)	160
max_pooling2d_32 (MaxPoolin g2D)	(None, 20, 65, 16)	0
dropout_25 (Dropout)	(None, 20, 65, 16)	0
conv2d_33 (Conv2D)	(None, 20, 65, 32)	4640
max_pooling2d_33 (MaxPoolin g2D)	(None, 10, 32, 32)	0
dropout_26 (Dropout)	(None, 10, 32, 32)	0
conv2d_34 (Conv2D)	(None, 10, 32, 64)	18496
max_pooling2d_34 (MaxPoolin g2D)	(None, 5, 16, 64)	0
dropout_27 (Dropout)	(None, 5, 16, 64)	0
conv2d_35 (Conv2D)	(None, 5, 16, 128)	73856
max_pooling2d_35 (MaxPoolin g2D)	(None, 2, 8, 128)	0
global_average_pooling2d_8 (GlobalAveragePooling2D)	(None, 128)	0
dense_8 (Dense)	(None, 4)	516

```
=====  
Total params: 97,668  
Trainable params: 97,668  
Non-trainable params: 0
```

In [192]:

```
history, model = compile_fit(model,keras.losses.kullback_leibler_divergence)
```

Epoch 1/300

```
7/7 [=====] - ETA: 0s - loss: 9.9506 - accuracy: 0.3251  
Epoch 1: val_accuracy improved from -inf to 0.58031, saving model to /content/weights.best.hdf5  
7/7 [=====] - 7s 841ms/step - loss: 9.9506 - accuracy: 0.3251 - val_loss: 3  
.8814 - val_accuracy: 0.5803
```

Epoch 2/300

```
7/7 [=====] - ETA: 0s - loss: 10.0764 - accuracy: 0.4045  
Epoch 2: val_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 807ms/step - loss: 10.0764 - accuracy: 0.4045 - val_loss:  
2.7777 - val_accuracy: 0.4663
```

Epoch 3/300

```
7/7 [=====] - ETA: 0s - loss: 8.8032 - accuracy: 0.5620  
Epoch 3: val_accuracy did not improve from 0.58031  
7/7 [=====] - 5s 760ms/step - loss: 8.8032 - accuracy: 0.5620 - val_loss: 3  
.0635 - val_accuracy: 0.2953
```

Epoch 4/300

```
7/7 [=====] - ETA: 0s - loss: 8.6460 - accuracy: 0.4089  
Epoch 4: val_accuracy improved from 0.58031 to 0.65285, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 773ms/step - loss: 8.6460 - accuracy: 0.4089 - val_loss: 2  
.3039 - val_accuracy: 0.6528
```

Epoch 5/300

```
7/7 [=====] - ETA: 0s - loss: 8.4377 - accuracy: 0.4849  
Epoch 5: val_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 818ms/step - loss: 8.4377 - accuracy: 0.4849 - val_loss: 2  
.1873 - val_accuracy: 0.4663
```

Epoch 6/300

```
7/7 [=====] - ETA: 0s - loss: 7.1496 - accuracy: 0.5743  
Epoch 6: val_accuracy did not improve from 0.65285  
7/7 [=====] - 8s 1s/step - loss: 7.1496 - accuracy: 0.5743 - val_loss: 1.53  
24 - val_accuracy: 0.5959
```

Epoch 7/300

```
7/7 [=====] - ETA: 0s - loss: 4.9004 - accuracy: 0.3240  
Epoch 7: val_accuracy did not improve from 0.65285
```

7/7 [=====] - 6s 804ms/step - loss: 4.9004 - accuracy: 0.3240 - val\_loss: 1.7156 - val\_accuracy: 0.0570  
Epoch 8/300  
7/7 [=====] - ETA: 0s - loss: 3.7948 - accuracy: 0.1374  
Epoch 8: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 780ms/step - loss: 3.7948 - accuracy: 0.1374 - val\_loss: 1.2956 - val\_accuracy: 0.3109  
Epoch 9/300  
7/7 [=====] - ETA: 0s - loss: 2.0527 - accuracy: 0.5665  
Epoch 9: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 771ms/step - loss: 2.0527 - accuracy: 0.5665 - val\_loss: 1.2922 - val\_accuracy: 0.4249  
Epoch 10/300  
7/7 [=====] - ETA: 0s - loss: 1.2685 - accuracy: 0.4168  
Epoch 10: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 779ms/step - loss: 1.2685 - accuracy: 0.4168 - val\_loss: 1.3649 - val\_accuracy: 0.2228  
Epoch 11/300  
7/7 [=====] - ETA: 0s - loss: 1.1139 - accuracy: 0.3441  
Epoch 11: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 764ms/step - loss: 1.1139 - accuracy: 0.3441 - val\_loss: 1.2336 - val\_accuracy: 0.4352  
Epoch 12/300  
7/7 [=====] - ETA: 0s - loss: 0.9623 - accuracy: 0.5061  
Epoch 12: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 789ms/step - loss: 0.9623 - accuracy: 0.5061 - val\_loss: 1.0934 - val\_accuracy: 0.4974  
Epoch 13/300  
7/7 [=====] - ETA: 0s - loss: 0.8901 - accuracy: 0.4737  
Epoch 13: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 777ms/step - loss: 0.8901 - accuracy: 0.4737 - val\_loss: 1.1015 - val\_accuracy: 0.4404  
Epoch 14/300  
7/7 [=====] - ETA: 0s - loss: 0.8387 - accuracy: 0.5464  
Epoch 14: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 8s 1s/step - loss: 0.8387 - accuracy: 0.5464 - val\_loss: 1.0075 - val\_accuracy: 0.4611  
Epoch 15/300  
7/7 [=====] - ETA: 0s - loss: 0.8073 - accuracy: 0.4827  
Epoch 15: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 7s 931ms/step - loss: 0.8073 - accuracy: 0.4827 - val\_loss: 1.0064 - val\_accuracy: 0.4456  
Epoch 16/300  
7/7 [=====] - ETA: 0s - loss: 0.7869 - accuracy: 0.5095  
Epoch 16: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 790ms/step - loss: 0.7869 - accuracy: 0.5095 - val\_loss: 1.0230 - val\_accuracy: 0.4352  
Epoch 17/300  
7/7 [=====] - ETA: 0s - loss: 0.7705 - accuracy: 0.4626  
Epoch 17: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 905ms/step - loss: 0.7705 - accuracy: 0.4626 - val\_loss: 0.9399 - val\_accuracy: 0.4922  
Epoch 18/300  
7/7 [=====] - ETA: 0s - loss: 0.7726 - accuracy: 0.5486  
Epoch 18: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 7s 886ms/step - loss: 0.7726 - accuracy: 0.5486 - val\_loss: 0.9523 - val\_accuracy: 0.4767  
Epoch 19/300  
7/7 [=====] - ETA: 0s - loss: 0.7467 - accuracy: 0.4536  
Epoch 19: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 869ms/step - loss: 0.7467 - accuracy: 0.4536 - val\_loss: 0.9554 - val\_accuracy: 0.4715  
Epoch 20/300  
7/7 [=====] - ETA: 0s - loss: 0.7630 - accuracy: 0.4827  
Epoch 20: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 7s 1s/step - loss: 0.7630 - accuracy: 0.4827 - val\_loss: 0.8846 - val\_accuracy: 0.5440  
Epoch 21/300  
7/7 [=====] - ETA: 0s - loss: 0.7464 - accuracy: 0.5151  
Epoch 21: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 787ms/step - loss: 0.7464 - accuracy: 0.5151 - val\_loss: 0.9588 - val\_accuracy: 0.4715  
Epoch 22/300  
7/7 [=====] - ETA: 0s - loss: 0.7253 - accuracy: 0.5263  
Epoch 22: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 8s 1s/step - loss: 0.7253 - accuracy: 0.5263 - val\_loss: 0.8671 - val\_accuracy: 0.5544  
Epoch 23/300  
7/7 [=====] - ETA: 0s - loss: 0.7134 - accuracy: 0.5475  
Epoch 23: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 807ms/step - loss: 0.7134 - accuracy: 0.5475 - val\_loss: 0.9507 - val\_accuracy: 0.4922  
Epoch 24/300

7/7 [=====] - ETA: 0s - loss: 0.7135 - accuracy: 0.4838  
Epoch 24: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 782ms/step - loss: 0.7135 - accuracy: 0.4838 - val\_loss: 0.7988 - val\_accuracy: 0.6114  
Epoch 25/300  
7/7 [=====] - ETA: 0s - loss: 0.7164 - accuracy: 0.5095  
Epoch 25: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 758ms/step - loss: 0.7164 - accuracy: 0.5095 - val\_loss: 0.9571 - val\_accuracy: 0.4456  
Epoch 26/300  
7/7 [=====] - ETA: 0s - loss: 0.7014 - accuracy: 0.5609  
Epoch 26: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 805ms/step - loss: 0.7014 - accuracy: 0.5609 - val\_loss: 0.8462 - val\_accuracy: 0.5440  
Epoch 27/300  
7/7 [=====] - ETA: 0s - loss: 0.7037 - accuracy: 0.4927  
Epoch 27: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 809ms/step - loss: 0.7037 - accuracy: 0.4927 - val\_loss: 0.9443 - val\_accuracy: 0.4870  
Epoch 28/300  
7/7 [=====] - ETA: 0s - loss: 0.7060 - accuracy: 0.5721  
Epoch 28: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 759ms/step - loss: 0.7060 - accuracy: 0.5721 - val\_loss: 0.9607 - val\_accuracy: 0.4663  
Epoch 29/300  
7/7 [=====] - ETA: 0s - loss: 0.6904 - accuracy: 0.4704  
Epoch 29: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 782ms/step - loss: 0.6904 - accuracy: 0.4704 - val\_loss: 0.8425 - val\_accuracy: 0.5596  
Epoch 30/300  
7/7 [=====] - ETA: 0s - loss: 0.6813 - accuracy: 0.5799  
Epoch 30: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 775ms/step - loss: 0.6813 - accuracy: 0.5799 - val\_loss: 0.8906 - val\_accuracy: 0.5130  
Epoch 31/300  
7/7 [=====] - ETA: 0s - loss: 0.6841 - accuracy: 0.5251  
Epoch 31: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 787ms/step - loss: 0.6841 - accuracy: 0.5251 - val\_loss: 0.9094 - val\_accuracy: 0.4974  
Epoch 32/300  
7/7 [=====] - ETA: 0s - loss: 0.6497 - accuracy: 0.5263  
Epoch 32: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 802ms/step - loss: 0.6497 - accuracy: 0.5263 - val\_loss: 0.8177 - val\_accuracy: 0.5544  
Epoch 33/300  
7/7 [=====] - ETA: 0s - loss: 0.6763 - accuracy: 0.5374  
Epoch 33: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 811ms/step - loss: 0.6763 - accuracy: 0.5374 - val\_loss: 0.8443 - val\_accuracy: 0.5337  
Epoch 34/300  
7/7 [=====] - ETA: 0s - loss: 0.6404 - accuracy: 0.6101  
Epoch 34: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 786ms/step - loss: 0.6404 - accuracy: 0.6101 - val\_loss: 0.8333 - val\_accuracy: 0.5285  
Epoch 35/300  
7/7 [=====] - ETA: 0s - loss: 0.6414 - accuracy: 0.5642  
Epoch 35: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 809ms/step - loss: 0.6414 - accuracy: 0.5642 - val\_loss: 0.8475 - val\_accuracy: 0.5181  
Epoch 36/300  
7/7 [=====] - ETA: 0s - loss: 0.6478 - accuracy: 0.5531  
Epoch 36: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 814ms/step - loss: 0.6478 - accuracy: 0.5531 - val\_loss: 0.7666 - val\_accuracy: 0.5855  
Epoch 37/300  
7/7 [=====] - ETA: 0s - loss: 0.6495 - accuracy: 0.5732  
Epoch 37: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 764ms/step - loss: 0.6495 - accuracy: 0.5732 - val\_loss: 0.8812 - val\_accuracy: 0.5285  
Epoch 38/300  
7/7 [=====] - ETA: 0s - loss: 0.6382 - accuracy: 0.6212  
Epoch 38: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 795ms/step - loss: 0.6382 - accuracy: 0.6212 - val\_loss: 0.8774 - val\_accuracy: 0.5078  
Epoch 39/300  
7/7 [=====] - ETA: 0s - loss: 0.6697 - accuracy: 0.5128  
Epoch 39: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 779ms/step - loss: 0.6697 - accuracy: 0.5128 - val\_loss: 0.8123 - val\_accuracy: 0.5492  
Epoch 40/300  
7/7 [=====] - ETA: 0s - loss: 0.6534 - accuracy: 0.6022  
Epoch 40: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 786ms/step - loss: 0.6534 - accuracy: 0.6022 - val\_loss: 0

.8281 - val\_accuracy: 0.5389  
Epoch 41/300  
7/7 [=====] - ETA: 0s - loss: 0.6235 - accuracy: 0.5575  
Epoch 41: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 801ms/step - loss: 0.6235 - accuracy: 0.5575 - val\_loss: 0  
.7302 - val\_accuracy: 0.6010  
Epoch 42/300  
7/7 [=====] - ETA: 0s - loss: 0.6362 - accuracy: 0.6190  
Epoch 42: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 811ms/step - loss: 0.6362 - accuracy: 0.6190 - val\_loss: 0  
.8505 - val\_accuracy: 0.5285  
Epoch 43/300  
7/7 [=====] - ETA: 0s - loss: 0.6252 - accuracy: 0.5508  
Epoch 43: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 815ms/step - loss: 0.6252 - accuracy: 0.5508 - val\_loss: 0  
.7616 - val\_accuracy: 0.6062  
Epoch 44/300  
7/7 [=====] - ETA: 0s - loss: 0.6077 - accuracy: 0.5855  
Epoch 44: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 809ms/step - loss: 0.6077 - accuracy: 0.5855 - val\_loss: 0  
.7692 - val\_accuracy: 0.5907  
Epoch 45/300  
7/7 [=====] - ETA: 0s - loss: 0.6031 - accuracy: 0.6358  
Epoch 45: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 854ms/step - loss: 0.6031 - accuracy: 0.6358 - val\_loss: 0  
.8885 - val\_accuracy: 0.4870  
Epoch 46/300  
7/7 [=====] - ETA: 0s - loss: 0.6046 - accuracy: 0.5564  
Epoch 46: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 8s 1s/step - loss: 0.6046 - accuracy: 0.5564 - val\_loss: 0.71  
94 - val\_accuracy: 0.6425  
Epoch 47/300  
7/7 [=====] - ETA: 0s - loss: 0.6275 - accuracy: 0.6000  
Epoch 47: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 7s 1s/step - loss: 0.6275 - accuracy: 0.6000 - val\_loss: 0.73  
27 - val\_accuracy: 0.6062  
Epoch 48/300  
7/7 [=====] - ETA: 0s - loss: 0.6156 - accuracy: 0.6246  
Epoch 48: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 9s 1s/step - loss: 0.6156 - accuracy: 0.6246 - val\_loss: 0.81  
57 - val\_accuracy: 0.5596  
Epoch 49/300  
7/7 [=====] - ETA: 0s - loss: 0.5930 - accuracy: 0.6089  
Epoch 49: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 7s 979ms/step - loss: 0.5930 - accuracy: 0.6089 - val\_loss: 0  
.8711 - val\_accuracy: 0.5078  
Epoch 50/300  
7/7 [=====] - ETA: 0s - loss: 0.5933 - accuracy: 0.6279  
Epoch 50: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 9s 1s/step - loss: 0.5933 - accuracy: 0.6279 - val\_loss: 0.84  
63 - val\_accuracy: 0.5233  
Epoch 51/300  
7/7 [=====] - ETA: 0s - loss: 0.6235 - accuracy: 0.5587  
Epoch 51: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 7s 1s/step - loss: 0.6235 - accuracy: 0.5587 - val\_loss: 0.73  
92 - val\_accuracy: 0.6528  
Epoch 52/300  
7/7 [=====] - ETA: 0s - loss: 0.6357 - accuracy: 0.5944  
Epoch 52: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 8s 1s/step - loss: 0.6357 - accuracy: 0.5944 - val\_loss: 0.76  
69 - val\_accuracy: 0.6062  
Epoch 53/300  
7/7 [=====] - ETA: 0s - loss: 0.6098 - accuracy: 0.5855  
Epoch 53: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 9s 1s/step - loss: 0.6098 - accuracy: 0.5855 - val\_loss: 0.75  
85 - val\_accuracy: 0.5699  
Epoch 54/300  
7/7 [=====] - ETA: 0s - loss: 0.5963 - accuracy: 0.6358  
Epoch 54: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 809ms/step - loss: 0.5963 - accuracy: 0.6358 - val\_loss: 0  
.8741 - val\_accuracy: 0.4974  
Epoch 55/300  
7/7 [=====] - ETA: 0s - loss: 0.5829 - accuracy: 0.5832  
Epoch 55: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 773ms/step - loss: 0.5829 - accuracy: 0.5832 - val\_loss: 0  
.7114 - val\_accuracy: 0.6425  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.5713 - accuracy: 0.6089  
Epoch 56: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 5s 789ms/step - loss: 0.5713 - accuracy: 0.6089 - val\_loss: 0  
.6927 - val\_accuracy: 0.6528  
Epoch 57/300  
7/7 [=====] - ETA: 0s - loss: 0.5502 - accuracy: 0.6223

Epoch 57: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 801ms/step - loss: 0.5502 - accuracy: 0.6223 - val\_loss: 0.7996 - val\_accuracy: 0.5544  
Epoch 58/300  
7/7 [=====] - ETA: 0s - loss: 0.5682 - accuracy: 0.6358  
Epoch 58: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 6s 805ms/step - loss: 0.5682 - accuracy: 0.6358 - val\_loss: 0.8440 - val\_accuracy: 0.5544  
Epoch 59/300  
7/7 [=====] - ETA: 0s - loss: 0.5478 - accuracy: 0.6279  
Epoch 59: val\_accuracy improved from 0.65285 to 0.67876, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 775ms/step - loss: 0.5478 - accuracy: 0.6279 - val\_loss: 0.6671 - val\_accuracy: 0.6788  
Epoch 60/300  
7/7 [=====] - ETA: 0s - loss: 0.5367 - accuracy: 0.6313  
Epoch 60: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 784ms/step - loss: 0.5367 - accuracy: 0.6313 - val\_loss: 0.6620 - val\_accuracy: 0.6580  
Epoch 61/300  
7/7 [=====] - ETA: 0s - loss: 0.5355 - accuracy: 0.6212  
Epoch 61: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 788ms/step - loss: 0.5355 - accuracy: 0.6212 - val\_loss: 0.6732 - val\_accuracy: 0.6736  
Epoch 62/300  
7/7 [=====] - ETA: 0s - loss: 0.5515 - accuracy: 0.6056  
Epoch 62: val\_accuracy improved from 0.67876 to 0.69948, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 798ms/step - loss: 0.5515 - accuracy: 0.6056 - val\_loss: 0.5931 - val\_accuracy: 0.6995  
Epoch 63/300  
7/7 [=====] - ETA: 0s - loss: 0.5353 - accuracy: 0.6581  
Epoch 63: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 6s 810ms/step - loss: 0.5353 - accuracy: 0.6581 - val\_loss: 0.7473 - val\_accuracy: 0.6218  
Epoch 64/300  
7/7 [=====] - ETA: 0s - loss: 0.5291 - accuracy: 0.6268  
Epoch 64: val\_accuracy improved from 0.69948 to 0.72539, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 800ms/step - loss: 0.5291 - accuracy: 0.6268 - val\_loss: 0.5736 - val\_accuracy: 0.7254  
Epoch 65/300  
7/7 [=====] - ETA: 0s - loss: 0.5362 - accuracy: 0.6246  
Epoch 65: val\_accuracy did not improve from 0.72539  
7/7 [=====] - 6s 801ms/step - loss: 0.5362 - accuracy: 0.6246 - val\_loss: 0.6277 - val\_accuracy: 0.7150  
Epoch 66/300  
7/7 [=====] - ETA: 0s - loss: 0.5310 - accuracy: 0.6737  
Epoch 66: val\_accuracy did not improve from 0.72539  
7/7 [=====] - 6s 814ms/step - loss: 0.5310 - accuracy: 0.6737 - val\_loss: 0.7385 - val\_accuracy: 0.6166  
Epoch 67/300  
7/7 [=====] - ETA: 0s - loss: 0.5208 - accuracy: 0.6514  
Epoch 67: val\_accuracy did not improve from 0.72539  
7/7 [=====] - 7s 1s/step - loss: 0.5208 - accuracy: 0.6514 - val\_loss: 0.7450 - val\_accuracy: 0.6010  
Epoch 68/300  
7/7 [=====] - ETA: 0s - loss: 0.5377 - accuracy: 0.6413  
Epoch 68: val\_accuracy improved from 0.72539 to 0.73575, saving model to /content/weights.best.hdf5  
7/7 [=====] - 8s 1s/step - loss: 0.5377 - accuracy: 0.6413 - val\_loss: 0.5937 - val\_accuracy: 0.7358  
Epoch 69/300  
7/7 [=====] - ETA: 0s - loss: 0.5407 - accuracy: 0.6559  
Epoch 69: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 8s 1s/step - loss: 0.5407 - accuracy: 0.6559 - val\_loss: 0.7323 - val\_accuracy: 0.6166  
Epoch 70/300  
7/7 [=====] - ETA: 0s - loss: 0.5193 - accuracy: 0.7117  
Epoch 70: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 8s 1s/step - loss: 0.5193 - accuracy: 0.7117 - val\_loss: 0.8126 - val\_accuracy: 0.5751  
Epoch 71/300  
7/7 [=====] - ETA: 0s - loss: 0.5512 - accuracy: 0.6123  
Epoch 71: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 8s 1s/step - loss: 0.5512 - accuracy: 0.6123 - val\_loss: 0.6260 - val\_accuracy: 0.6736  
Epoch 72/300  
7/7 [=====] - ETA: 0s - loss: 0.5099 - accuracy: 0.7196  
Epoch 72: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 837ms/step - loss: 0.5099 - accuracy: 0.7196 - val\_loss: 0.9681 - val\_accuracy: 0.5026  
Epoch 73/300  
7/7 [=====] - ETA: 0s - loss: 0.5633 - accuracy: 0.6235  
Epoch 73: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 8s 1s/step - loss: 0.5633 - accuracy: 0.6235 - val\_loss: 0.7418 - val\_accuracy: 0.6062



Epoch 74/300  
7/7 [=====] - ETA: 0s - loss: 0.5407 - accuracy: 0.6313  
Epoch 74: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 9s 1s/step - loss: 0.5407 - accuracy: 0.6313 - val\_loss: 0.6878 - val\_accuracy: 0.6736  
Epoch 75/300  
7/7 [=====] - ETA: 0s - loss: 0.5119 - accuracy: 0.6559  
Epoch 75: val\_accuracy did not improve from 0.73575  
7/7 [=====] - 6s 925ms/step - loss: 0.5119 - accuracy: 0.6559 - val\_loss: 0.5857 - val\_accuracy: 0.7306  
Epoch 76/300  
7/7 [=====] - ETA: 0s - loss: 0.4874 - accuracy: 0.6346  
Epoch 76: val\_accuracy improved from 0.73575 to 0.76166, saving model to /content/weights.best.hdf5  
7/7 [=====] - 7s 1s/step - loss: 0.4874 - accuracy: 0.6346 - val\_loss: 0.5774 - val\_accuracy: 0.7617  
Epoch 77/300  
7/7 [=====] - ETA: 0s - loss: 0.4843 - accuracy: 0.7296  
Epoch 77: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 8s 1s/step - loss: 0.4843 - accuracy: 0.7296 - val\_loss: 0.7391 - val\_accuracy: 0.6373  
Epoch 78/300  
7/7 [=====] - ETA: 0s - loss: 0.4712 - accuracy: 0.6939  
Epoch 78: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 9s 1s/step - loss: 0.4712 - accuracy: 0.6939 - val\_loss: 0.6197 - val\_accuracy: 0.7047  
Epoch 79/300  
7/7 [=====] - ETA: 0s - loss: 0.4712 - accuracy: 0.6860  
Epoch 79: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 824ms/step - loss: 0.4712 - accuracy: 0.6860 - val\_loss: 0.7016 - val\_accuracy: 0.6528  
Epoch 80/300  
7/7 [=====] - ETA: 0s - loss: 0.4600 - accuracy: 0.7307  
Epoch 80: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 5s 773ms/step - loss: 0.4600 - accuracy: 0.7307 - val\_loss: 0.7214 - val\_accuracy: 0.6477  
Epoch 81/300  
7/7 [=====] - ETA: 0s - loss: 0.4868 - accuracy: 0.6693  
Epoch 81: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 5s 788ms/step - loss: 0.4868 - accuracy: 0.6693 - val\_loss: 0.6450 - val\_accuracy: 0.6891  
Epoch 82/300  
7/7 [=====] - ETA: 0s - loss: 0.4538 - accuracy: 0.7318  
Epoch 82: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 792ms/step - loss: 0.4538 - accuracy: 0.7318 - val\_loss: 0.6720 - val\_accuracy: 0.6891  
Epoch 83/300  
7/7 [=====] - ETA: 0s - loss: 0.4593 - accuracy: 0.6883  
Epoch 83: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 810ms/step - loss: 0.4593 - accuracy: 0.6883 - val\_loss: 0.6074 - val\_accuracy: 0.6995  
Epoch 84/300  
7/7 [=====] - ETA: 0s - loss: 0.4528 - accuracy: 0.6939  
Epoch 84: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 5s 785ms/step - loss: 0.4528 - accuracy: 0.6939 - val\_loss: 0.7620 - val\_accuracy: 0.6269  
Epoch 85/300  
7/7 [=====] - ETA: 0s - loss: 0.4647 - accuracy: 0.6994  
Epoch 85: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 5s 782ms/step - loss: 0.4647 - accuracy: 0.6994 - val\_loss: 0.7602 - val\_accuracy: 0.6218  
Epoch 86/300  
7/7 [=====] - ETA: 0s - loss: 0.4501 - accuracy: 0.6994  
Epoch 86: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 792ms/step - loss: 0.4501 - accuracy: 0.6994 - val\_loss: 0.7014 - val\_accuracy: 0.6477  
Epoch 87/300  
7/7 [=====] - ETA: 0s - loss: 0.4580 - accuracy: 0.6872  
Epoch 87: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 806ms/step - loss: 0.4580 - accuracy: 0.6872 - val\_loss: 0.6732 - val\_accuracy: 0.6632  
Epoch 88/300  
7/7 [=====] - ETA: 0s - loss: 0.4717 - accuracy: 0.7006  
Epoch 88: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 803ms/step - loss: 0.4717 - accuracy: 0.7006 - val\_loss: 0.6503 - val\_accuracy: 0.6943  
Epoch 89/300  
7/7 [=====] - ETA: 0s - loss: 0.4287 - accuracy: 0.7318  
Epoch 89: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 5s 776ms/step - loss: 0.4287 - accuracy: 0.7318 - val\_loss: 0.6586 - val\_accuracy: 0.7150  
Epoch 90/300  
7/7 [=====] - ETA: 0s - loss: 0.4248 - accuracy: 0.7363  
Epoch 90: val\_accuracy did not improve from 0.76166

7/7 [=====] - 5s 795ms/step - loss: 0.4248 - accuracy: 0.7363 - val\_loss: 0.7483 - val\_accuracy: 0.6425  
Epoch 91/300  
7/7 [=====] - ETA: 0s - loss: 0.4418 - accuracy: 0.6983  
Epoch 91: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 800ms/step - loss: 0.4418 - accuracy: 0.6983 - val\_loss: 0.6839 - val\_accuracy: 0.6528  
Epoch 92/300  
7/7 [=====] - ETA: 0s - loss: 0.4411 - accuracy: 0.7095  
Epoch 92: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 7s 1s/step - loss: 0.4411 - accuracy: 0.7095 - val\_loss: 0.6643 - val\_accuracy: 0.7150  
Epoch 93/300  
7/7 [=====] - ETA: 0s - loss: 0.4506 - accuracy: 0.6972  
Epoch 93: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 6s 954ms/step - loss: 0.4506 - accuracy: 0.6972 - val\_loss: 0.5414 - val\_accuracy: 0.7565  
Epoch 94/300  
7/7 [=====] - ETA: 0s - loss: 0.4379 - accuracy: 0.7296  
Epoch 94: val\_accuracy did not improve from 0.76166  
7/7 [=====] - 5s 782ms/step - loss: 0.4379 - accuracy: 0.7296 - val\_loss: 0.7573 - val\_accuracy: 0.6373  
Epoch 95/300  
7/7 [=====] - ETA: 0s - loss: 0.4295 - accuracy: 0.7374  
Epoch 95: val\_accuracy improved from 0.76166 to 0.77202, saving model to /content/weights.best.hdf5  
7/7 [=====] - 9s 1s/step - loss: 0.4295 - accuracy: 0.7374 - val\_loss: 0.5021 - val\_accuracy: 0.7720  
Epoch 96/300  
7/7 [=====] - ETA: 0s - loss: 0.4035 - accuracy: 0.7184  
Epoch 96: val\_accuracy improved from 0.77202 to 0.83420, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 840ms/step - loss: 0.4035 - accuracy: 0.7184 - val\_loss: 0.4164 - val\_accuracy: 0.8342  
Epoch 97/300  
7/7 [=====] - ETA: 0s - loss: 0.4420 - accuracy: 0.7598  
Epoch 97: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 794ms/step - loss: 0.4420 - accuracy: 0.7598 - val\_loss: 0.9016 - val\_accuracy: 0.5907  
Epoch 98/300  
7/7 [=====] - ETA: 0s - loss: 0.4921 - accuracy: 0.7006  
Epoch 98: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 814ms/step - loss: 0.4921 - accuracy: 0.7006 - val\_loss: 0.4243 - val\_accuracy: 0.8290  
Epoch 99/300  
7/7 [=====] - ETA: 0s - loss: 0.4641 - accuracy: 0.6883  
Epoch 99: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 796ms/step - loss: 0.4641 - accuracy: 0.6883 - val\_loss: 0.6702 - val\_accuracy: 0.6788  
Epoch 100/300  
7/7 [=====] - ETA: 0s - loss: 0.4528 - accuracy: 0.7564  
Epoch 100: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 9s 1s/step - loss: 0.4528 - accuracy: 0.7564 - val\_loss: 0.5515 - val\_accuracy: 0.7513  
Epoch 101/300  
7/7 [=====] - ETA: 0s - loss: 0.3821 - accuracy: 0.7296  
Epoch 101: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 7s 1s/step - loss: 0.3821 - accuracy: 0.7296 - val\_loss: 0.5242 - val\_accuracy: 0.7565  
Epoch 102/300  
7/7 [=====] - ETA: 0s - loss: 0.4159 - accuracy: 0.7475  
Epoch 102: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 858ms/step - loss: 0.4159 - accuracy: 0.7475 - val\_loss: 0.6591 - val\_accuracy: 0.7047  
Epoch 103/300  
7/7 [=====] - ETA: 0s - loss: 0.3880 - accuracy: 0.7486  
Epoch 103: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 809ms/step - loss: 0.3880 - accuracy: 0.7486 - val\_loss: 0.6228 - val\_accuracy: 0.7150  
Epoch 104/300  
7/7 [=====] - ETA: 0s - loss: 0.3906 - accuracy: 0.7274  
Epoch 104: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 808ms/step - loss: 0.3906 - accuracy: 0.7274 - val\_loss: 0.5690 - val\_accuracy: 0.7202  
Epoch 105/300  
7/7 [=====] - ETA: 0s - loss: 0.3653 - accuracy: 0.7642  
Epoch 105: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 8s 1s/step - loss: 0.3653 - accuracy: 0.7642 - val\_loss: 0.5638 - val\_accuracy: 0.7202  
Epoch 106/300  
7/7 [=====] - ETA: 0s - loss: 0.3750 - accuracy: 0.7553  
Epoch 106: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 912ms/step - loss: 0.3750 - accuracy: 0.7553 - val\_loss: 0.5604 - val\_accuracy: 0.7150  
Epoch 107/300

7/7 [=====] - ETA: 0s - loss: 0.3833 - accuracy: 0.7464  
Epoch 107: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 8s 1s/step - loss: 0.3833 - accuracy: 0.7464 - val\_loss: 0.5733 - val\_accuracy: 0.7617  
Epoch 108/300  
7/7 [=====] - ETA: 0s - loss: 0.3785 - accuracy: 0.7520  
Epoch 108: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 793ms/step - loss: 0.3785 - accuracy: 0.7520 - val\_loss: 0.5381 - val\_accuracy: 0.7720  
Epoch 109/300  
7/7 [=====] - ETA: 0s - loss: 0.3618 - accuracy: 0.7620  
Epoch 109: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 779ms/step - loss: 0.3618 - accuracy: 0.7620 - val\_loss: 0.4790 - val\_accuracy: 0.7668  
Epoch 110/300  
7/7 [=====] - ETA: 0s - loss: 0.3394 - accuracy: 0.7464  
Epoch 110: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 758ms/step - loss: 0.3394 - accuracy: 0.7464 - val\_loss: 0.4283 - val\_accuracy: 0.8135  
Epoch 111/300  
7/7 [=====] - ETA: 0s - loss: 0.3686 - accuracy: 0.7698  
Epoch 111: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 807ms/step - loss: 0.3686 - accuracy: 0.7698 - val\_loss: 0.5916 - val\_accuracy: 0.7306  
Epoch 112/300  
7/7 [=====] - ETA: 0s - loss: 0.3839 - accuracy: 0.7765  
Epoch 112: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 795ms/step - loss: 0.3839 - accuracy: 0.7765 - val\_loss: 0.5357 - val\_accuracy: 0.7824  
Epoch 113/300  
7/7 [=====] - ETA: 0s - loss: 0.4179 - accuracy: 0.7307  
Epoch 113: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 803ms/step - loss: 0.4179 - accuracy: 0.7307 - val\_loss: 0.5504 - val\_accuracy: 0.7513  
Epoch 114/300  
7/7 [=====] - ETA: 0s - loss: 0.3626 - accuracy: 0.7676  
Epoch 114: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 768ms/step - loss: 0.3626 - accuracy: 0.7676 - val\_loss: 0.4791 - val\_accuracy: 0.7772  
Epoch 115/300  
7/7 [=====] - ETA: 0s - loss: 0.3790 - accuracy: 0.7676  
Epoch 115: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 6s 810ms/step - loss: 0.3790 - accuracy: 0.7676 - val\_loss: 0.5532 - val\_accuracy: 0.7565  
Epoch 116/300  
7/7 [=====] - ETA: 0s - loss: 0.3758 - accuracy: 0.7687  
Epoch 116: val\_accuracy did not improve from 0.83420  
7/7 [=====] - 5s 781ms/step - loss: 0.3758 - accuracy: 0.7687 - val\_loss: 0.4625 - val\_accuracy: 0.8031  
Epoch 117/300  
7/7 [=====] - ETA: 0s - loss: 0.3562 - accuracy: 0.7408  
Epoch 117: val\_accuracy improved from 0.83420 to 0.83938, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 787ms/step - loss: 0.3562 - accuracy: 0.7408 - val\_loss: 0.3833 - val\_accuracy: 0.8394  
Epoch 118/300  
7/7 [=====] - ETA: 0s - loss: 0.3927 - accuracy: 0.7788  
Epoch 118: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 783ms/step - loss: 0.3927 - accuracy: 0.7788 - val\_loss: 0.5472 - val\_accuracy: 0.7824  
Epoch 119/300  
7/7 [=====] - ETA: 0s - loss: 0.3597 - accuracy: 0.7654  
Epoch 119: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 793ms/step - loss: 0.3597 - accuracy: 0.7654 - val\_loss: 0.4302 - val\_accuracy: 0.8187  
Epoch 120/300  
7/7 [=====] - ETA: 0s - loss: 0.3507 - accuracy: 0.7944  
Epoch 120: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 781ms/step - loss: 0.3507 - accuracy: 0.7944 - val\_loss: 0.4669 - val\_accuracy: 0.8135  
Epoch 121/300  
7/7 [=====] - ETA: 0s - loss: 0.3199 - accuracy: 0.7732  
Epoch 121: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 808ms/step - loss: 0.3199 - accuracy: 0.7732 - val\_loss: 0.4340 - val\_accuracy: 0.8187  
Epoch 122/300  
7/7 [=====] - ETA: 0s - loss: 0.3362 - accuracy: 0.7642  
Epoch 122: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 787ms/step - loss: 0.3362 - accuracy: 0.7642 - val\_loss: 0.4910 - val\_accuracy: 0.7979  
Epoch 123/300  
7/7 [=====] - ETA: 0s - loss: 0.3360 - accuracy: 0.7799  
Epoch 123: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 792ms/step - loss: 0.3360 - accuracy: 0.7799 - val\_loss: 0

.4451 - val\_accuracy: 0.7927  
Epoch 124/300  
7/7 [=====] - ETA: 0s - loss: 0.3195 - accuracy: 0.7866  
Epoch 124: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 7s 1s/step - loss: 0.3195 - accuracy: 0.7866 - val\_loss: 0.46  
51 - val\_accuracy: 0.7772  
Epoch 125/300  
7/7 [=====] - ETA: 0s - loss: 0.3234 - accuracy: 0.7911  
Epoch 125: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 777ms/step - loss: 0.3234 - accuracy: 0.7911 - val\_loss: 0  
.4460 - val\_accuracy: 0.7876  
Epoch 126/300  
7/7 [=====] - ETA: 0s - loss: 0.3388 - accuracy: 0.8022  
Epoch 126: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 7s 1s/step - loss: 0.3388 - accuracy: 0.8022 - val\_loss: 0.69  
79 - val\_accuracy: 0.6891  
Epoch 127/300  
7/7 [=====] - ETA: 0s - loss: 0.3369 - accuracy: 0.7922  
Epoch 127: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 827ms/step - loss: 0.3369 - accuracy: 0.7922 - val\_loss: 0  
.4614 - val\_accuracy: 0.7720  
Epoch 128/300  
7/7 [=====] - ETA: 0s - loss: 0.3500 - accuracy: 0.7732  
Epoch 128: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 9s 1s/step - loss: 0.3500 - accuracy: 0.7732 - val\_loss: 0.47  
19 - val\_accuracy: 0.7668  
Epoch 129/300  
7/7 [=====] - ETA: 0s - loss: 0.3306 - accuracy: 0.8101  
Epoch 129: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 9s 1s/step - loss: 0.3306 - accuracy: 0.8101 - val\_loss: 0.47  
55 - val\_accuracy: 0.8187  
Epoch 130/300  
7/7 [=====] - ETA: 0s - loss: 0.3224 - accuracy: 0.8045  
Epoch 130: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 8s 1s/step - loss: 0.3224 - accuracy: 0.8045 - val\_loss: 0.46  
54 - val\_accuracy: 0.7927  
Epoch 131/300  
7/7 [=====] - ETA: 0s - loss: 0.2962 - accuracy: 0.8078  
Epoch 131: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 7s 937ms/step - loss: 0.2962 - accuracy: 0.8078 - val\_loss: 0  
.3982 - val\_accuracy: 0.8290  
Epoch 132/300  
7/7 [=====] - ETA: 0s - loss: 0.2872 - accuracy: 0.8078  
Epoch 132: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 778ms/step - loss: 0.2872 - accuracy: 0.8078 - val\_loss: 0  
.4102 - val\_accuracy: 0.8187  
Epoch 133/300  
7/7 [=====] - ETA: 0s - loss: 0.2647 - accuracy: 0.8346  
Epoch 133: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 7s 980ms/step - loss: 0.2647 - accuracy: 0.8346 - val\_loss: 0  
.5470 - val\_accuracy: 0.7617  
Epoch 134/300  
7/7 [=====] - ETA: 0s - loss: 0.2688 - accuracy: 0.8212  
Epoch 134: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 8s 1s/step - loss: 0.2688 - accuracy: 0.8212 - val\_loss: 0.45  
88 - val\_accuracy: 0.7772  
Epoch 135/300  
7/7 [=====] - ETA: 0s - loss: 0.2995 - accuracy: 0.7911  
Epoch 135: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 10s 1s/step - loss: 0.2995 - accuracy: 0.7911 - val\_loss: 0.5  
277 - val\_accuracy: 0.7513  
Epoch 136/300  
7/7 [=====] - ETA: 0s - loss: 0.3041 - accuracy: 0.8101  
Epoch 136: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 7s 1s/step - loss: 0.3041 - accuracy: 0.8101 - val\_loss: 0.46  
08 - val\_accuracy: 0.8135  
Epoch 137/300  
7/7 [=====] - ETA: 0s - loss: 0.2784 - accuracy: 0.8201  
Epoch 137: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 792ms/step - loss: 0.2784 - accuracy: 0.8201 - val\_loss: 0  
.3916 - val\_accuracy: 0.8187  
Epoch 138/300  
7/7 [=====] - ETA: 0s - loss: 0.2574 - accuracy: 0.8101  
Epoch 138: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 790ms/step - loss: 0.2574 - accuracy: 0.8101 - val\_loss: 0  
.4679 - val\_accuracy: 0.7772  
Epoch 139/300  
7/7 [=====] - ETA: 0s - loss: 0.2679 - accuracy: 0.8324  
Epoch 139: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 7s 986ms/step - loss: 0.2679 - accuracy: 0.8324 - val\_loss: 0  
.5737 - val\_accuracy: 0.7461  
Epoch 140/300  
7/7 [=====] - ETA: 0s - loss: 0.2726 - accuracy: 0.8067

Epoch 140: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 770ms/step - loss: 0.2726 - accuracy: 0.8067 - val\_loss: 0.4941 - val\_accuracy: 0.7668  
Epoch 141/300  
7/7 [=====] - ETA: 0s - loss: 0.2630 - accuracy: 0.8101  
Epoch 141: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 838ms/step - loss: 0.2630 - accuracy: 0.8101 - val\_loss: 0.4337 - val\_accuracy: 0.8031  
Epoch 142/300  
7/7 [=====] - ETA: 0s - loss: 0.2343 - accuracy: 0.8637  
Epoch 142: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 9s 1s/step - loss: 0.2343 - accuracy: 0.8637 - val\_loss: 0.4122 - val\_accuracy: 0.8342  
Epoch 143/300  
7/7 [=====] - ETA: 0s - loss: 0.2771 - accuracy: 0.8123  
Epoch 143: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 783ms/step - loss: 0.2771 - accuracy: 0.8123 - val\_loss: 0.4324 - val\_accuracy: 0.8083  
Epoch 144/300  
7/7 [=====] - ETA: 0s - loss: 0.3528 - accuracy: 0.7955  
Epoch 144: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 5s 779ms/step - loss: 0.3528 - accuracy: 0.7955 - val\_loss: 0.5066 - val\_accuracy: 0.7876  
Epoch 145/300  
7/7 [=====] - ETA: 0s - loss: 0.3249 - accuracy: 0.8123  
Epoch 145: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 808ms/step - loss: 0.3249 - accuracy: 0.8123 - val\_loss: 0.6141 - val\_accuracy: 0.7098  
Epoch 146/300  
7/7 [=====] - ETA: 0s - loss: 0.2765 - accuracy: 0.8346  
Epoch 146: val\_accuracy improved from 0.83938 to 0.84456, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 802ms/step - loss: 0.2765 - accuracy: 0.8346 - val\_loss: 0.4187 - val\_accuracy: 0.8446  
Epoch 147/300  
7/7 [=====] - ETA: 0s - loss: 0.2887 - accuracy: 0.7933  
Epoch 147: val\_accuracy improved from 0.84456 to 0.84974, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 810ms/step - loss: 0.2887 - accuracy: 0.7933 - val\_loss: 0.3692 - val\_accuracy: 0.8497  
Epoch 148/300  
7/7 [=====] - ETA: 0s - loss: 0.2821 - accuracy: 0.8145  
Epoch 148: val\_accuracy improved from 0.84974 to 0.86010, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 806ms/step - loss: 0.2821 - accuracy: 0.8145 - val\_loss: 0.3503 - val\_accuracy: 0.8601  
Epoch 149/300  
7/7 [=====] - ETA: 0s - loss: 0.2499 - accuracy: 0.8480  
Epoch 149: val\_accuracy did not improve from 0.86010  
7/7 [=====] - 6s 799ms/step - loss: 0.2499 - accuracy: 0.8480 - val\_loss: 0.4003 - val\_accuracy: 0.8394  
Epoch 150/300  
7/7 [=====] - ETA: 0s - loss: 0.2291 - accuracy: 0.8335  
Epoch 150: val\_accuracy improved from 0.86010 to 0.87047, saving model to /content/weights.best.hdf5  
7/7 [=====] - 7s 995ms/step - loss: 0.2291 - accuracy: 0.8335 - val\_loss: 0.3485 - val\_accuracy: 0.8705  
Epoch 151/300  
7/7 [=====] - ETA: 0s - loss: 0.2660 - accuracy: 0.8212  
Epoch 151: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 837ms/step - loss: 0.2660 - accuracy: 0.8212 - val\_loss: 0.4083 - val\_accuracy: 0.8394  
Epoch 152/300  
7/7 [=====] - ETA: 0s - loss: 0.2368 - accuracy: 0.8682  
Epoch 152: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 5s 763ms/step - loss: 0.2368 - accuracy: 0.8682 - val\_loss: 0.5069 - val\_accuracy: 0.7565  
Epoch 153/300  
7/7 [=====] - ETA: 0s - loss: 0.2408 - accuracy: 0.8313  
Epoch 153: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 940ms/step - loss: 0.2408 - accuracy: 0.8313 - val\_loss: 0.3875 - val\_accuracy: 0.8290  
Epoch 154/300  
7/7 [=====] - ETA: 0s - loss: 0.2249 - accuracy: 0.8447  
Epoch 154: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 792ms/step - loss: 0.2249 - accuracy: 0.8447 - val\_loss: 0.3594 - val\_accuracy: 0.8549  
Epoch 155/300  
7/7 [=====] - ETA: 0s - loss: 0.2674 - accuracy: 0.8436  
Epoch 155: val\_accuracy did not improve from 0.87047  
7/7 [=====] - 6s 806ms/step - loss: 0.2674 - accuracy: 0.8436 - val\_loss: 0.3758 - val\_accuracy: 0.8497  
Epoch 156/300  
7/7 [=====] - ETA: 0s - loss: 0.2612 - accuracy: 0.8257  
Epoch 156: val\_accuracy improved from 0.87047 to 0.88601, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 800ms/step - loss: 0.2612 - accuracy: 0.8257 - val\_loss: 0.3500 - val\_accuracy: 0.8860

Epoch 157/300  
7/7 [=====] - ETA: 0s - loss: 0.2227 - accuracy: 0.8570  
Epoch 157: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 796ms/step - loss: 0.2227 - accuracy: 0.8570 - val\_loss: 0.3964 - val\_accuracy: 0.8187  
Epoch 158/300  
7/7 [=====] - ETA: 0s - loss: 0.2315 - accuracy: 0.8659  
Epoch 158: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 802ms/step - loss: 0.2315 - accuracy: 0.8659 - val\_loss: 0.3855 - val\_accuracy: 0.8446  
Epoch 159/300  
7/7 [=====] - ETA: 0s - loss: 0.2569 - accuracy: 0.8302  
Epoch 159: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 784ms/step - loss: 0.2569 - accuracy: 0.8302 - val\_loss: 0.3664 - val\_accuracy: 0.8497  
Epoch 160/300  
7/7 [=====] - ETA: 0s - loss: 0.2314 - accuracy: 0.8503  
Epoch 160: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 807ms/step - loss: 0.2314 - accuracy: 0.8503 - val\_loss: 0.4556 - val\_accuracy: 0.8446  
Epoch 161/300  
7/7 [=====] - ETA: 0s - loss: 0.2624 - accuracy: 0.8413  
Epoch 161: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 811ms/step - loss: 0.2624 - accuracy: 0.8413 - val\_loss: 0.4767 - val\_accuracy: 0.8187  
Epoch 162/300  
7/7 [=====] - ETA: 0s - loss: 0.2403 - accuracy: 0.8458  
Epoch 162: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 773ms/step - loss: 0.2403 - accuracy: 0.8458 - val\_loss: 0.3602 - val\_accuracy: 0.8549  
Epoch 163/300  
7/7 [=====] - ETA: 0s - loss: 0.2152 - accuracy: 0.8693  
Epoch 163: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 779ms/step - loss: 0.2152 - accuracy: 0.8693 - val\_loss: 0.3594 - val\_accuracy: 0.8653  
Epoch 164/300  
7/7 [=====] - ETA: 0s - loss: 0.2107 - accuracy: 0.8570  
Epoch 164: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 782ms/step - loss: 0.2107 - accuracy: 0.8570 - val\_loss: 0.3818 - val\_accuracy: 0.8394  
Epoch 165/300  
7/7 [=====] - ETA: 0s - loss: 0.2144 - accuracy: 0.8637  
Epoch 165: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 800ms/step - loss: 0.2144 - accuracy: 0.8637 - val\_loss: 0.3145 - val\_accuracy: 0.8808  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.2274 - accuracy: 0.8503  
Epoch 166: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 789ms/step - loss: 0.2274 - accuracy: 0.8503 - val\_loss: 0.3443 - val\_accuracy: 0.8497  
Epoch 167/300  
7/7 [=====] - ETA: 0s - loss: 0.2162 - accuracy: 0.8726  
Epoch 167: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 793ms/step - loss: 0.2162 - accuracy: 0.8726 - val\_loss: 0.4502 - val\_accuracy: 0.8031  
Epoch 168/300  
7/7 [=====] - ETA: 0s - loss: 0.2179 - accuracy: 0.8581  
Epoch 168: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 815ms/step - loss: 0.2179 - accuracy: 0.8581 - val\_loss: 0.4819 - val\_accuracy: 0.7979  
Epoch 169/300  
7/7 [=====] - ETA: 0s - loss: 0.2274 - accuracy: 0.8480  
Epoch 169: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 789ms/step - loss: 0.2274 - accuracy: 0.8480 - val\_loss: 0.3979 - val\_accuracy: 0.8290  
Epoch 170/300  
7/7 [=====] - ETA: 0s - loss: 0.2362 - accuracy: 0.8358  
Epoch 170: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 814ms/step - loss: 0.2362 - accuracy: 0.8358 - val\_loss: 0.3549 - val\_accuracy: 0.8342  
Epoch 171/300  
7/7 [=====] - ETA: 0s - loss: 0.1984 - accuracy: 0.8682  
Epoch 171: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 791ms/step - loss: 0.1984 - accuracy: 0.8682 - val\_loss: 0.4588 - val\_accuracy: 0.7979  
Epoch 172/300  
7/7 [=====] - ETA: 0s - loss: 0.1906 - accuracy: 0.8749  
Epoch 172: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 957ms/step - loss: 0.1906 - accuracy: 0.8749 - val\_loss: 0.4381 - val\_accuracy: 0.7979  
Epoch 173/300  
7/7 [=====] - ETA: 0s - loss: 0.1927 - accuracy: 0.8771  
Epoch 173: val\_accuracy did not improve from 0.88601

7/7 [=====] - 5s 783ms/step - loss: 0.1927 - accuracy: 0.8771 - val\_loss: 0.3539 - val\_accuracy: 0.8394  
Epoch 174/300  
7/7 [=====] - ETA: 0s - loss: 0.1762 - accuracy: 0.8682  
Epoch 174: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 785ms/step - loss: 0.1762 - accuracy: 0.8682 - val\_loss: 0.3300 - val\_accuracy: 0.8653  
Epoch 175/300  
7/7 [=====] - ETA: 0s - loss: 0.1886 - accuracy: 0.8972  
Epoch 175: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 790ms/step - loss: 0.1886 - accuracy: 0.8972 - val\_loss: 0.3713 - val\_accuracy: 0.8549  
Epoch 176/300  
7/7 [=====] - ETA: 0s - loss: 0.2026 - accuracy: 0.8872  
Epoch 176: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 779ms/step - loss: 0.2026 - accuracy: 0.8872 - val\_loss: 0.4132 - val\_accuracy: 0.8549  
Epoch 177/300  
7/7 [=====] - ETA: 0s - loss: 0.1860 - accuracy: 0.8726  
Epoch 177: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 769ms/step - loss: 0.1860 - accuracy: 0.8726 - val\_loss: 0.3188 - val\_accuracy: 0.8446  
Epoch 178/300  
7/7 [=====] - ETA: 0s - loss: 0.1824 - accuracy: 0.8827  
Epoch 178: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 8s 1s/step - loss: 0.1824 - accuracy: 0.8827 - val\_loss: 0.3389 - val\_accuracy: 0.8446  
Epoch 179/300  
7/7 [=====] - ETA: 0s - loss: 0.1903 - accuracy: 0.8838  
Epoch 179: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 804ms/step - loss: 0.1903 - accuracy: 0.8838 - val\_loss: 0.4598 - val\_accuracy: 0.7927  
Epoch 180/300  
7/7 [=====] - ETA: 0s - loss: 0.1790 - accuracy: 0.8994  
Epoch 180: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 814ms/step - loss: 0.1790 - accuracy: 0.8994 - val\_loss: 0.4991 - val\_accuracy: 0.7927  
Epoch 181/300  
7/7 [=====] - ETA: 0s - loss: 0.2077 - accuracy: 0.8592  
Epoch 181: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 797ms/step - loss: 0.2077 - accuracy: 0.8592 - val\_loss: 0.4255 - val\_accuracy: 0.7979  
Epoch 182/300  
7/7 [=====] - ETA: 0s - loss: 0.1726 - accuracy: 0.8905  
Epoch 182: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 808ms/step - loss: 0.1726 - accuracy: 0.8905 - val\_loss: 0.3859 - val\_accuracy: 0.8446  
Epoch 183/300  
7/7 [=====] - ETA: 0s - loss: 0.1736 - accuracy: 0.8849  
Epoch 183: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 800ms/step - loss: 0.1736 - accuracy: 0.8849 - val\_loss: 0.3427 - val\_accuracy: 0.8653  
Epoch 184/300  
7/7 [=====] - ETA: 0s - loss: 0.1583 - accuracy: 0.8860  
Epoch 184: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 785ms/step - loss: 0.1583 - accuracy: 0.8860 - val\_loss: 0.3570 - val\_accuracy: 0.8860  
Epoch 185/300  
7/7 [=====] - ETA: 0s - loss: 0.1869 - accuracy: 0.8693  
Epoch 185: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 777ms/step - loss: 0.1869 - accuracy: 0.8693 - val\_loss: 0.3760 - val\_accuracy: 0.8756  
Epoch 186/300  
7/7 [=====] - ETA: 0s - loss: 0.1767 - accuracy: 0.9039  
Epoch 186: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 818ms/step - loss: 0.1767 - accuracy: 0.9039 - val\_loss: 0.3640 - val\_accuracy: 0.8549  
Epoch 187/300  
7/7 [=====] - ETA: 0s - loss: 0.1611 - accuracy: 0.8894  
Epoch 187: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 809ms/step - loss: 0.1611 - accuracy: 0.8894 - val\_loss: 0.2883 - val\_accuracy: 0.8860  
Epoch 188/300  
7/7 [=====] - ETA: 0s - loss: 0.1622 - accuracy: 0.8983  
Epoch 188: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 812ms/step - loss: 0.1622 - accuracy: 0.8983 - val\_loss: 0.3246 - val\_accuracy: 0.8653  
Epoch 189/300  
7/7 [=====] - ETA: 0s - loss: 0.1496 - accuracy: 0.9084  
Epoch 189: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 769ms/step - loss: 0.1496 - accuracy: 0.9084 - val\_loss: 0.4101 - val\_accuracy: 0.8187  
Epoch 190/300

7/7 [=====] - ETA: 0s - loss: 0.1537 - accuracy: 0.9006  
Epoch 190: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 808ms/step - loss: 0.1537 - accuracy: 0.9006 - val\_loss: 0.3585 - val\_accuracy: 0.8705  
Epoch 191/300  
7/7 [=====] - ETA: 0s - loss: 0.1405 - accuracy: 0.9095  
Epoch 191: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 5s 773ms/step - loss: 0.1405 - accuracy: 0.9095 - val\_loss: 0.3263 - val\_accuracy: 0.8808  
Epoch 192/300  
7/7 [=====] - ETA: 0s - loss: 0.1509 - accuracy: 0.9039  
Epoch 192: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 799ms/step - loss: 0.1509 - accuracy: 0.9039 - val\_loss: 0.3105 - val\_accuracy: 0.8705  
Epoch 193/300  
7/7 [=====] - ETA: 0s - loss: 0.1384 - accuracy: 0.9151  
Epoch 193: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 819ms/step - loss: 0.1384 - accuracy: 0.9151 - val\_loss: 0.3728 - val\_accuracy: 0.8653  
Epoch 194/300  
7/7 [=====] - ETA: 0s - loss: 0.1346 - accuracy: 0.9140  
Epoch 194: val\_accuracy improved from 0.88601 to 0.91192, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 823ms/step - loss: 0.1346 - accuracy: 0.9140 - val\_loss: 0.2850 - val\_accuracy: 0.9119  
Epoch 195/300  
7/7 [=====] - ETA: 0s - loss: 0.1295 - accuracy: 0.9050  
Epoch 195: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 807ms/step - loss: 0.1295 - accuracy: 0.9050 - val\_loss: 0.3314 - val\_accuracy: 0.8549  
Epoch 196/300  
7/7 [=====] - ETA: 0s - loss: 0.1248 - accuracy: 0.9229  
Epoch 196: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 815ms/step - loss: 0.1248 - accuracy: 0.9229 - val\_loss: 0.3159 - val\_accuracy: 0.8601  
Epoch 197/300  
7/7 [=====] - ETA: 0s - loss: 0.1444 - accuracy: 0.9140  
Epoch 197: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 798ms/step - loss: 0.1444 - accuracy: 0.9140 - val\_loss: 0.3972 - val\_accuracy: 0.8756  
Epoch 198/300  
7/7 [=====] - ETA: 0s - loss: 0.1633 - accuracy: 0.9095  
Epoch 198: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 803ms/step - loss: 0.1633 - accuracy: 0.9095 - val\_loss: 0.5548 - val\_accuracy: 0.7513  
Epoch 199/300  
7/7 [=====] - ETA: 0s - loss: 0.2508 - accuracy: 0.8279  
Epoch 199: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 814ms/step - loss: 0.2508 - accuracy: 0.8279 - val\_loss: 0.5131 - val\_accuracy: 0.7876  
Epoch 200/300  
7/7 [=====] - ETA: 0s - loss: 0.1999 - accuracy: 0.8793  
Epoch 200: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 811ms/step - loss: 0.1999 - accuracy: 0.8793 - val\_loss: 0.3619 - val\_accuracy: 0.8549  
Epoch 201/300  
7/7 [=====] - ETA: 0s - loss: 0.1930 - accuracy: 0.8827  
Epoch 201: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 765ms/step - loss: 0.1930 - accuracy: 0.8827 - val\_loss: 0.3614 - val\_accuracy: 0.8756  
Epoch 202/300  
7/7 [=====] - ETA: 0s - loss: 0.1944 - accuracy: 0.8737  
Epoch 202: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 805ms/step - loss: 0.1944 - accuracy: 0.8737 - val\_loss: 0.2911 - val\_accuracy: 0.8756  
Epoch 203/300  
7/7 [=====] - ETA: 0s - loss: 0.1343 - accuracy: 0.9207  
Epoch 203: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 810ms/step - loss: 0.1343 - accuracy: 0.9207 - val\_loss: 0.3527 - val\_accuracy: 0.8808  
Epoch 204/300  
7/7 [=====] - ETA: 0s - loss: 0.1271 - accuracy: 0.9240  
Epoch 204: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 790ms/step - loss: 0.1271 - accuracy: 0.9240 - val\_loss: 0.3311 - val\_accuracy: 0.8549  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.1391 - accuracy: 0.9240  
Epoch 205: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 806ms/step - loss: 0.1391 - accuracy: 0.9240 - val\_loss: 0.3091 - val\_accuracy: 0.8964  
Epoch 206/300  
7/7 [=====] - ETA: 0s - loss: 0.1425 - accuracy: 0.9207  
Epoch 206: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 7s 1s/step - loss: 0.1425 - accuracy: 0.9207 - val\_loss: 0.28



39 - val accuracy: 0.8808  
Epoch 207/300  
7/7 [=====] - ETA: 0s - loss: 0.1244 - accuracy: 0.9307  
Epoch 207: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 825ms/step - loss: 0.1244 - accuracy: 0.9307 - val\_loss: 0.2774 - val\_accuracy: 0.8653  
Epoch 208/300  
7/7 [=====] - ETA: 0s - loss: 0.1282 - accuracy: 0.9296  
Epoch 208: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 789ms/step - loss: 0.1282 - accuracy: 0.9296 - val\_loss: 0.3295 - val\_accuracy: 0.8653  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.1313 - accuracy: 0.9173  
Epoch 209: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 789ms/step - loss: 0.1313 - accuracy: 0.9173 - val\_loss: 0.3437 - val\_accuracy: 0.8808  
Epoch 210/300  
7/7 [=====] - ETA: 0s - loss: 0.1763 - accuracy: 0.9028  
Epoch 210: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 800ms/step - loss: 0.1763 - accuracy: 0.9028 - val\_loss: 0.4217 - val\_accuracy: 0.8549  
Epoch 211/300  
7/7 [=====] - ETA: 0s - loss: 0.1807 - accuracy: 0.9028  
Epoch 211: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 783ms/step - loss: 0.1807 - accuracy: 0.9028 - val\_loss: 0.3533 - val\_accuracy: 0.8549  
Epoch 212/300  
7/7 [=====] - ETA: 0s - loss: 0.1593 - accuracy: 0.8883  
Epoch 212: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 765ms/step - loss: 0.1593 - accuracy: 0.8883 - val\_loss: 0.3684 - val\_accuracy: 0.8756  
Epoch 213/300  
7/7 [=====] - ETA: 0s - loss: 0.1134 - accuracy: 0.9341  
Epoch 213: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 776ms/step - loss: 0.1134 - accuracy: 0.9341 - val\_loss: 0.4316 - val\_accuracy: 0.8808  
Epoch 214/300  
7/7 [=====] - ETA: 0s - loss: 0.1371 - accuracy: 0.9140  
Epoch 214: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 782ms/step - loss: 0.1371 - accuracy: 0.9140 - val\_loss: 0.3376 - val\_accuracy: 0.8964  
Epoch 215/300  
7/7 [=====] - ETA: 0s - loss: 0.1322 - accuracy: 0.9140  
Epoch 215: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 803ms/step - loss: 0.1322 - accuracy: 0.9140 - val\_loss: 0.2875 - val\_accuracy: 0.8756  
Epoch 216/300  
7/7 [=====] - ETA: 0s - loss: 0.1294 - accuracy: 0.9240  
Epoch 216: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 792ms/step - loss: 0.1294 - accuracy: 0.9240 - val\_loss: 0.3775 - val\_accuracy: 0.8549  
Epoch 217/300  
7/7 [=====] - ETA: 0s - loss: 0.1216 - accuracy: 0.9251  
Epoch 217: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 772ms/step - loss: 0.1216 - accuracy: 0.9251 - val\_loss: 0.3408 - val\_accuracy: 0.8705  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.1234 - accuracy: 0.9285  
Epoch 218: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 786ms/step - loss: 0.1234 - accuracy: 0.9285 - val\_loss: 0.3322 - val\_accuracy: 0.8964  
Epoch 219/300  
7/7 [=====] - ETA: 0s - loss: 0.1466 - accuracy: 0.9106  
Epoch 219: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 764ms/step - loss: 0.1466 - accuracy: 0.9106 - val\_loss: 0.3074 - val\_accuracy: 0.8912  
Epoch 220/300  
7/7 [=====] - ETA: 0s - loss: 0.1100 - accuracy: 0.9330  
Epoch 220: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 810ms/step - loss: 0.1100 - accuracy: 0.9330 - val\_loss: 0.3144 - val\_accuracy: 0.8912  
Epoch 221/300  
7/7 [=====] - ETA: 0s - loss: 0.0997 - accuracy: 0.9419  
Epoch 221: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 794ms/step - loss: 0.0997 - accuracy: 0.9419 - val\_loss: 0.3514 - val\_accuracy: 0.8705  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.0949 - accuracy: 0.9520  
Epoch 222: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 808ms/step - loss: 0.0949 - accuracy: 0.9520 - val\_loss: 0.3240 - val\_accuracy: 0.8601  
Epoch 223/300  
7/7 [=====] - ETA: 0s - loss: 0.0954 - accuracy: 0.9341

Epoch 223: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 790ms/step - loss: 0.0954 - accuracy: 0.9341 - val\_loss: 0.3085 - val\_accuracy: 0.8756  
Epoch 224/300  
7/7 [=====] - ETA: 0s - loss: 0.1202 - accuracy: 0.9196  
Epoch 224: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 771ms/step - loss: 0.1202 - accuracy: 0.9196 - val\_loss: 0.3208 - val\_accuracy: 0.9016  
Epoch 225/300  
7/7 [=====] - ETA: 0s - loss: 0.1261 - accuracy: 0.9341  
Epoch 225: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 788ms/step - loss: 0.1261 - accuracy: 0.9341 - val\_loss: 0.4149 - val\_accuracy: 0.8756  
Epoch 226/300  
7/7 [=====] - ETA: 0s - loss: 0.1219 - accuracy: 0.9352  
Epoch 226: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 789ms/step - loss: 0.1219 - accuracy: 0.9352 - val\_loss: 0.3333 - val\_accuracy: 0.8912  
Epoch 227/300  
7/7 [=====] - ETA: 0s - loss: 0.1126 - accuracy: 0.9240  
Epoch 227: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 809ms/step - loss: 0.1126 - accuracy: 0.9240 - val\_loss: 0.3343 - val\_accuracy: 0.8446  
Epoch 228/300  
7/7 [=====] - ETA: 0s - loss: 0.1012 - accuracy: 0.9464  
Epoch 228: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 817ms/step - loss: 0.1012 - accuracy: 0.9464 - val\_loss: 0.3898 - val\_accuracy: 0.8497  
Epoch 229/300  
7/7 [=====] - ETA: 0s - loss: 0.1158 - accuracy: 0.9318  
Epoch 229: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 777ms/step - loss: 0.1158 - accuracy: 0.9318 - val\_loss: 0.3982 - val\_accuracy: 0.8705  
Epoch 230/300  
7/7 [=====] - ETA: 0s - loss: 0.0916 - accuracy: 0.9453  
Epoch 230: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 807ms/step - loss: 0.0916 - accuracy: 0.9453 - val\_loss: 0.3526 - val\_accuracy: 0.8549  
Epoch 231/300  
7/7 [=====] - ETA: 0s - loss: 0.0928 - accuracy: 0.9475  
Epoch 231: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 797ms/step - loss: 0.0928 - accuracy: 0.9475 - val\_loss: 0.3289 - val\_accuracy: 0.8756  
Epoch 232/300  
7/7 [=====] - ETA: 0s - loss: 0.0788 - accuracy: 0.9508  
Epoch 232: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 813ms/step - loss: 0.0788 - accuracy: 0.9508 - val\_loss: 0.2792 - val\_accuracy: 0.8964  
Epoch 233/300  
7/7 [=====] - ETA: 0s - loss: 0.0903 - accuracy: 0.9430  
Epoch 233: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 797ms/step - loss: 0.0903 - accuracy: 0.9430 - val\_loss: 0.3222 - val\_accuracy: 0.8860  
Epoch 234/300  
7/7 [=====] - ETA: 0s - loss: 0.0921 - accuracy: 0.9363  
Epoch 234: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 7s 1s/step - loss: 0.0921 - accuracy: 0.9363 - val\_loss: 0.4241 - val\_accuracy: 0.8756  
Epoch 235/300  
7/7 [=====] - ETA: 0s - loss: 0.0957 - accuracy: 0.9408  
Epoch 235: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 778ms/step - loss: 0.0957 - accuracy: 0.9408 - val\_loss: 0.3037 - val\_accuracy: 0.8860  
Epoch 236/300  
7/7 [=====] - ETA: 0s - loss: 0.1212 - accuracy: 0.9307  
Epoch 236: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 798ms/step - loss: 0.1212 - accuracy: 0.9307 - val\_loss: 0.2997 - val\_accuracy: 0.8808  
Epoch 237/300  
7/7 [=====] - ETA: 0s - loss: 0.0949 - accuracy: 0.9587  
Epoch 237: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 803ms/step - loss: 0.0949 - accuracy: 0.9587 - val\_loss: 0.3212 - val\_accuracy: 0.8808  
Epoch 238/300  
7/7 [=====] - ETA: 0s - loss: 0.0923 - accuracy: 0.9441  
Epoch 238: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 808ms/step - loss: 0.0923 - accuracy: 0.9441 - val\_loss: 0.3186 - val\_accuracy: 0.8705  
Epoch 239/300  
7/7 [=====] - ETA: 0s - loss: 0.1023 - accuracy: 0.9374  
Epoch 239: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 783ms/step - loss: 0.1023 - accuracy: 0.9374 - val\_loss: 0.3321 - val\_accuracy: 0.8705

Epoch 240/300  
7/7 [=====] - ETA: 0s - loss: 0.0835 - accuracy: 0.9486  
Epoch 240: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 813ms/step - loss: 0.0835 - accuracy: 0.9486 - val\_loss: 0.4006 - val\_accuracy: 0.8549  
Epoch 241/300  
7/7 [=====] - ETA: 0s - loss: 0.1244 - accuracy: 0.9453  
Epoch 241: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 825ms/step - loss: 0.1244 - accuracy: 0.9453 - val\_loss: 0.3842 - val\_accuracy: 0.8601  
Epoch 242/300  
7/7 [=====] - ETA: 0s - loss: 0.1139 - accuracy: 0.9307  
Epoch 242: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 827ms/step - loss: 0.1139 - accuracy: 0.9307 - val\_loss: 0.3804 - val\_accuracy: 0.8394  
Epoch 243/300  
7/7 [=====] - ETA: 0s - loss: 0.0944 - accuracy: 0.9486  
Epoch 243: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 779ms/step - loss: 0.0944 - accuracy: 0.9486 - val\_loss: 0.3804 - val\_accuracy: 0.8601  
Epoch 244/300  
7/7 [=====] - ETA: 0s - loss: 0.2183 - accuracy: 0.9017  
Epoch 244: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 824ms/step - loss: 0.2183 - accuracy: 0.9017 - val\_loss: 0.4692 - val\_accuracy: 0.8549  
Epoch 245/300  
7/7 [=====] - ETA: 0s - loss: 0.1422 - accuracy: 0.9073  
Epoch 245: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 828ms/step - loss: 0.1422 - accuracy: 0.9073 - val\_loss: 0.4060 - val\_accuracy: 0.8808  
Epoch 246/300  
7/7 [=====] - ETA: 0s - loss: 0.1126 - accuracy: 0.9196  
Epoch 246: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 10s 2s/step - loss: 0.1126 - accuracy: 0.9196 - val\_loss: 0.3630 - val\_accuracy: 0.8756  
Epoch 247/300  
7/7 [=====] - ETA: 0s - loss: 0.1083 - accuracy: 0.9330  
Epoch 247: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 12s 2s/step - loss: 0.1083 - accuracy: 0.9330 - val\_loss: 0.4028 - val\_accuracy: 0.8860  
Epoch 248/300  
7/7 [=====] - ETA: 0s - loss: 0.0965 - accuracy: 0.9363  
Epoch 248: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 10s 1s/step - loss: 0.0965 - accuracy: 0.9363 - val\_loss: 0.3064 - val\_accuracy: 0.8912  
Epoch 249/300  
7/7 [=====] - ETA: 0s - loss: 0.1234 - accuracy: 0.9285  
Epoch 249: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 9s 1s/step - loss: 0.1234 - accuracy: 0.9285 - val\_loss: 0.4227 - val\_accuracy: 0.8756  
Epoch 250/300  
7/7 [=====] - ETA: 0s - loss: 0.1020 - accuracy: 0.9464  
Epoch 250: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 10s 1s/step - loss: 0.1020 - accuracy: 0.9464 - val\_loss: 0.4473 - val\_accuracy: 0.8290  
Epoch 251/300  
7/7 [=====] - ETA: 0s - loss: 0.1207 - accuracy: 0.9263  
Epoch 251: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 7s 892ms/step - loss: 0.1207 - accuracy: 0.9263 - val\_loss: 0.3698 - val\_accuracy: 0.8756  
Epoch 252/300  
7/7 [=====] - ETA: 0s - loss: 0.1048 - accuracy: 0.9419  
Epoch 252: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 794ms/step - loss: 0.1048 - accuracy: 0.9419 - val\_loss: 0.4439 - val\_accuracy: 0.8290  
Epoch 253/300  
7/7 [=====] - ETA: 0s - loss: 0.1213 - accuracy: 0.9307  
Epoch 253: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 795ms/step - loss: 0.1213 - accuracy: 0.9307 - val\_loss: 0.3776 - val\_accuracy: 0.8497  
Epoch 254/300  
7/7 [=====] - ETA: 0s - loss: 0.1014 - accuracy: 0.9263  
Epoch 254: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 820ms/step - loss: 0.1014 - accuracy: 0.9263 - val\_loss: 0.3664 - val\_accuracy: 0.9016  
Epoch 255/300  
7/7 [=====] - ETA: 0s - loss: 0.0828 - accuracy: 0.9542  
Epoch 255: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 777ms/step - loss: 0.0828 - accuracy: 0.9542 - val\_loss: 0.3114 - val\_accuracy: 0.8912  
Epoch 256/300  
7/7 [=====] - ETA: 0s - loss: 0.0882 - accuracy: 0.9486  
Epoch 256: val\_accuracy did not improve from 0.91192

7/7 [=====] - 6s 812ms/step - loss: 0.0882 - accuracy: 0.9486 - val\_loss: 0.3180 - val\_accuracy: 0.8756  
Epoch 257/300  
7/7 [=====] - ETA: 0s - loss: 0.0897 - accuracy: 0.9497  
Epoch 257: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 838ms/step - loss: 0.0897 - accuracy: 0.9497 - val\_loss: 0.3281 - val\_accuracy: 0.8756  
Epoch 258/300  
7/7 [=====] - ETA: 0s - loss: 0.0751 - accuracy: 0.9598  
Epoch 258: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 7s 1s/step - loss: 0.0751 - accuracy: 0.9598 - val\_loss: 0.3619 - val\_accuracy: 0.8601  
Epoch 259/300  
7/7 [=====] - ETA: 0s - loss: 0.0642 - accuracy: 0.9698  
Epoch 259: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 815ms/step - loss: 0.0642 - accuracy: 0.9698 - val\_loss: 0.3233 - val\_accuracy: 0.8860  
Epoch 260/300  
7/7 [=====] - ETA: 0s - loss: 0.0600 - accuracy: 0.9709  
Epoch 260: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 807ms/step - loss: 0.0600 - accuracy: 0.9709 - val\_loss: 0.3648 - val\_accuracy: 0.8860  
Epoch 261/300  
7/7 [=====] - ETA: 0s - loss: 0.0701 - accuracy: 0.9631  
Epoch 261: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 807ms/step - loss: 0.0701 - accuracy: 0.9631 - val\_loss: 0.3700 - val\_accuracy: 0.8964  
Epoch 262/300  
7/7 [=====] - ETA: 0s - loss: 0.0519 - accuracy: 0.9676  
Epoch 262: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 819ms/step - loss: 0.0519 - accuracy: 0.9676 - val\_loss: 0.3329 - val\_accuracy: 0.9016  
Epoch 263/300  
7/7 [=====] - ETA: 0s - loss: 0.0785 - accuracy: 0.9620  
Epoch 263: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 806ms/step - loss: 0.0785 - accuracy: 0.9620 - val\_loss: 0.3739 - val\_accuracy: 0.8705  
Epoch 264/300  
7/7 [=====] - ETA: 0s - loss: 0.0707 - accuracy: 0.9598  
Epoch 264: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 793ms/step - loss: 0.0707 - accuracy: 0.9598 - val\_loss: 0.3706 - val\_accuracy: 0.8653  
Epoch 265/300  
7/7 [=====] - ETA: 0s - loss: 0.0912 - accuracy: 0.9464  
Epoch 265: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 810ms/step - loss: 0.0912 - accuracy: 0.9464 - val\_loss: 0.3310 - val\_accuracy: 0.8808  
Epoch 266/300  
7/7 [=====] - ETA: 0s - loss: 0.0788 - accuracy: 0.9441  
Epoch 266: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 818ms/step - loss: 0.0788 - accuracy: 0.9441 - val\_loss: 0.3490 - val\_accuracy: 0.8912  
Epoch 267/300  
7/7 [=====] - ETA: 0s - loss: 0.0645 - accuracy: 0.9665  
Epoch 267: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 819ms/step - loss: 0.0645 - accuracy: 0.9665 - val\_loss: 0.3259 - val\_accuracy: 0.8808  
Epoch 268/300  
7/7 [=====] - ETA: 0s - loss: 0.0525 - accuracy: 0.9765  
Epoch 268: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 801ms/step - loss: 0.0525 - accuracy: 0.9765 - val\_loss: 0.3181 - val\_accuracy: 0.8808  
Epoch 269/300  
7/7 [=====] - ETA: 0s - loss: 0.0736 - accuracy: 0.9520  
Epoch 269: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 801ms/step - loss: 0.0736 - accuracy: 0.9520 - val\_loss: 0.3790 - val\_accuracy: 0.8601  
Epoch 270/300  
7/7 [=====] - ETA: 0s - loss: 0.0771 - accuracy: 0.9654  
Epoch 270: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 819ms/step - loss: 0.0771 - accuracy: 0.9654 - val\_loss: 0.3461 - val\_accuracy: 0.8912  
Epoch 271/300  
7/7 [=====] - ETA: 0s - loss: 0.0858 - accuracy: 0.9542  
Epoch 271: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 809ms/step - loss: 0.0858 - accuracy: 0.9542 - val\_loss: 0.4053 - val\_accuracy: 0.8653  
Epoch 272/300  
7/7 [=====] - ETA: 0s - loss: 0.0671 - accuracy: 0.9654  
Epoch 272: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 812ms/step - loss: 0.0671 - accuracy: 0.9654 - val\_loss: 0.3698 - val\_accuracy: 0.8964  
Epoch 273/300

7/7 [=====] - ETA: 0s - loss: 0.0675 - accuracy: 0.9642  
Epoch 273: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 826ms/step - loss: 0.0675 - accuracy: 0.9642 - val\_loss: 0.3074 - val\_accuracy: 0.9067  
Epoch 274/300  
7/7 [=====] - ETA: 0s - loss: 0.0711 - accuracy: 0.9553  
Epoch 274: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 811ms/step - loss: 0.0711 - accuracy: 0.9553 - val\_loss: 0.3646 - val\_accuracy: 0.8756  
Epoch 275/300  
7/7 [=====] - ETA: 0s - loss: 0.0938 - accuracy: 0.9575  
Epoch 275: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 811ms/step - loss: 0.0938 - accuracy: 0.9575 - val\_loss: 0.4584 - val\_accuracy: 0.8342  
Epoch 276/300  
7/7 [=====] - ETA: 0s - loss: 0.1008 - accuracy: 0.9419  
Epoch 276: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 817ms/step - loss: 0.1008 - accuracy: 0.9419 - val\_loss: 0.3612 - val\_accuracy: 0.8497  
Epoch 277/300  
7/7 [=====] - ETA: 0s - loss: 0.0916 - accuracy: 0.9318  
Epoch 277: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 802ms/step - loss: 0.0916 - accuracy: 0.9318 - val\_loss: 0.3356 - val\_accuracy: 0.8653  
Epoch 278/300  
7/7 [=====] - ETA: 0s - loss: 0.0575 - accuracy: 0.9732  
Epoch 278: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 814ms/step - loss: 0.0575 - accuracy: 0.9732 - val\_loss: 0.3523 - val\_accuracy: 0.8912  
Epoch 279/300  
7/7 [=====] - ETA: 0s - loss: 0.0593 - accuracy: 0.9654  
Epoch 279: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 810ms/step - loss: 0.0593 - accuracy: 0.9654 - val\_loss: 0.3039 - val\_accuracy: 0.8964  
Epoch 280/300  
7/7 [=====] - ETA: 0s - loss: 0.0582 - accuracy: 0.9631  
Epoch 280: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 795ms/step - loss: 0.0582 - accuracy: 0.9631 - val\_loss: 0.3294 - val\_accuracy: 0.8808  
Epoch 281/300  
7/7 [=====] - ETA: 0s - loss: 0.0583 - accuracy: 0.9676  
Epoch 281: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 805ms/step - loss: 0.0583 - accuracy: 0.9676 - val\_loss: 0.3425 - val\_accuracy: 0.8808  
Epoch 282/300  
7/7 [=====] - ETA: 0s - loss: 0.0516 - accuracy: 0.9698  
Epoch 282: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 804ms/step - loss: 0.0516 - accuracy: 0.9698 - val\_loss: 0.3575 - val\_accuracy: 0.8653  
Epoch 283/300  
7/7 [=====] - ETA: 0s - loss: 0.0575 - accuracy: 0.9709  
Epoch 283: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 798ms/step - loss: 0.0575 - accuracy: 0.9709 - val\_loss: 0.4301 - val\_accuracy: 0.8290  
Epoch 284/300  
7/7 [=====] - ETA: 0s - loss: 0.0607 - accuracy: 0.9564  
Epoch 284: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 808ms/step - loss: 0.0607 - accuracy: 0.9564 - val\_loss: 0.2930 - val\_accuracy: 0.8964  
Epoch 285/300  
7/7 [=====] - ETA: 0s - loss: 0.0551 - accuracy: 0.9654  
Epoch 285: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 8s 1s/step - loss: 0.0551 - accuracy: 0.9654 - val\_loss: 0.3450 - val\_accuracy: 0.8964  
Epoch 286/300  
7/7 [=====] - ETA: 0s - loss: 0.0497 - accuracy: 0.9698  
Epoch 286: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 812ms/step - loss: 0.0497 - accuracy: 0.9698 - val\_loss: 0.4148 - val\_accuracy: 0.8446  
Epoch 287/300  
7/7 [=====] - ETA: 0s - loss: 0.0654 - accuracy: 0.9631  
Epoch 287: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 810ms/step - loss: 0.0654 - accuracy: 0.9631 - val\_loss: 0.4084 - val\_accuracy: 0.8912  
Epoch 288/300  
7/7 [=====] - ETA: 0s - loss: 0.0651 - accuracy: 0.9631  
Epoch 288: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 812ms/step - loss: 0.0651 - accuracy: 0.9631 - val\_loss: 0.4526 - val\_accuracy: 0.8756  
Epoch 289/300  
7/7 [=====] - ETA: 0s - loss: 0.0487 - accuracy: 0.9732  
Epoch 289: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 5s 785ms/step - loss: 0.0487 - accuracy: 0.9732 - val\_loss: 0

```
.3122 - val_accuracy: 0.9067
Epoch 290/300
7/7 [=====] - ETA: 0s - loss: 0.1105 - accuracy: 0.9609
Epoch 290: val_accuracy did not improve from 0.91192
7/7 [=====] - 5s 789ms/step - loss: 0.1105 - accuracy: 0.9609 - val_loss: 0
.4716 - val_accuracy: 0.8808
Epoch 291/300
7/7 [=====] - ETA: 0s - loss: 0.0913 - accuracy: 0.9531
Epoch 291: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 818ms/step - loss: 0.0913 - accuracy: 0.9531 - val_loss: 0
.4148 - val_accuracy: 0.8705
Epoch 292/300
7/7 [=====] - ETA: 0s - loss: 0.0792 - accuracy: 0.9564
Epoch 292: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 809ms/step - loss: 0.0792 - accuracy: 0.9564 - val_loss: 0
.4139 - val_accuracy: 0.8653
Epoch 293/300
7/7 [=====] - ETA: 0s - loss: 0.0697 - accuracy: 0.9598
Epoch 293: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 820ms/step - loss: 0.0697 - accuracy: 0.9598 - val_loss: 0
.3391 - val_accuracy: 0.8653
Epoch 294/300
7/7 [=====] - ETA: 0s - loss: 0.0544 - accuracy: 0.9687
Epoch 294: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 823ms/step - loss: 0.0544 - accuracy: 0.9687 - val_loss: 0
.3702 - val_accuracy: 0.8756
Epoch 295/300
7/7 [=====] - ETA: 0s - loss: 0.0586 - accuracy: 0.9709
Epoch 295: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 818ms/step - loss: 0.0586 - accuracy: 0.9709 - val_loss: 0
.4226 - val_accuracy: 0.8964
Epoch 296/300
7/7 [=====] - ETA: 0s - loss: 0.0509 - accuracy: 0.9754
Epoch 296: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 806ms/step - loss: 0.0509 - accuracy: 0.9754 - val_loss: 0
.3961 - val_accuracy: 0.8705
Epoch 297/300
7/7 [=====] - ETA: 0s - loss: 0.0378 - accuracy: 0.9777
Epoch 297: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 816ms/step - loss: 0.0378 - accuracy: 0.9777 - val_loss: 0
.3883 - val_accuracy: 0.8446
Epoch 298/300
7/7 [=====] - ETA: 0s - loss: 0.0528 - accuracy: 0.9799
Epoch 298: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 815ms/step - loss: 0.0528 - accuracy: 0.9799 - val_loss: 0
.3112 - val_accuracy: 0.8912
Epoch 299/300
7/7 [=====] - ETA: 0s - loss: 0.0512 - accuracy: 0.9754
Epoch 299: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 818ms/step - loss: 0.0512 - accuracy: 0.9754 - val_loss: 0
.3271 - val_accuracy: 0.8653
Epoch 300/300
7/7 [=====] - ETA: 0s - loss: 0.0431 - accuracy: 0.9799
Epoch 300: val_accuracy did not improve from 0.91192
7/7 [=====] - 6s 815ms/step - loss: 0.0431 - accuracy: 0.9799 - val_loss: 0
.3843 - val_accuracy: 0.8860
Created model and loaded weights from file
```

In [204]:

```
results.loc[index,['Architecture','Dropout','Loss Fn', 'LR']] = ['CNN 2D',0.2, 'KL divergence',0.0001]
```

#### Evaluation: Training and Validation

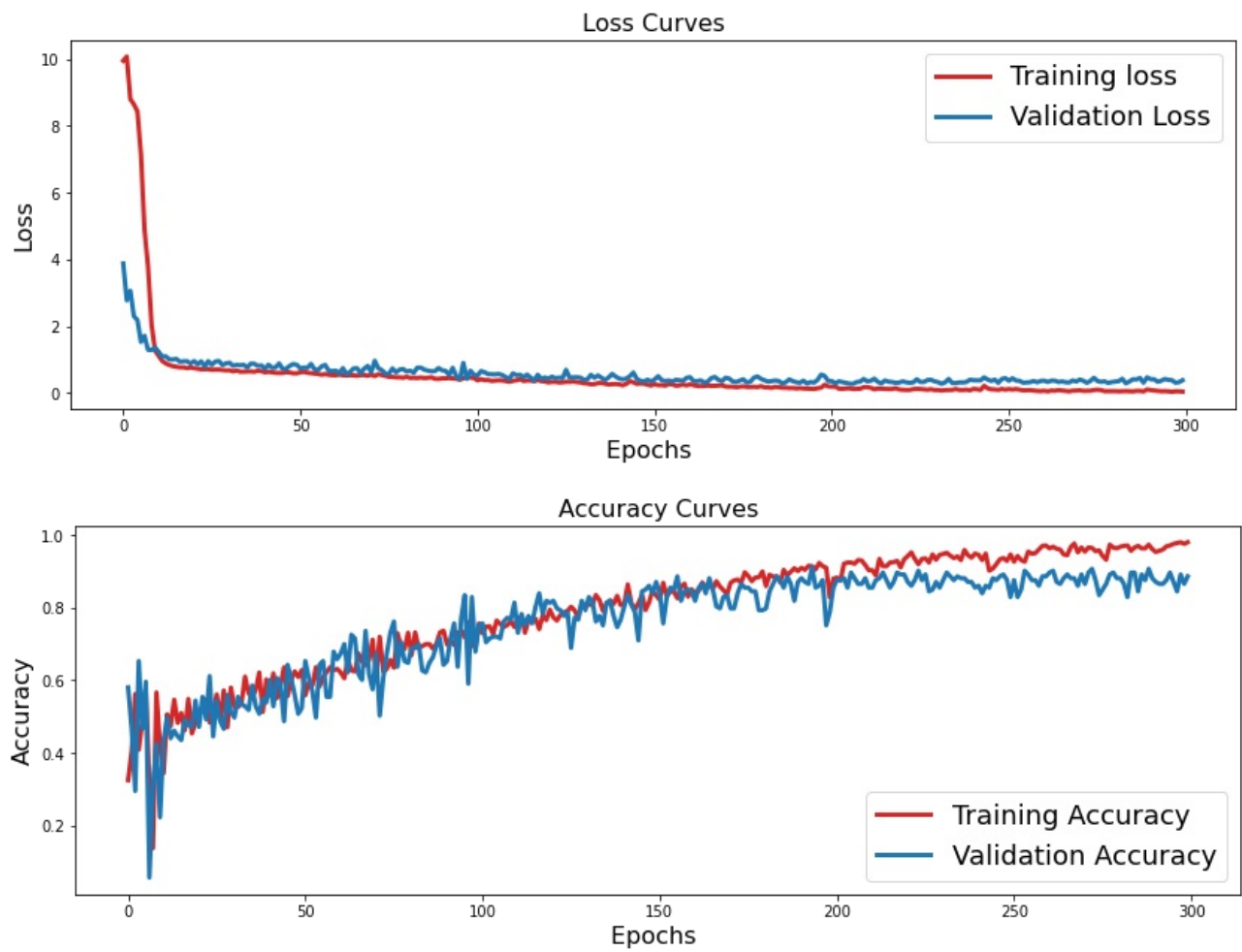
In [205]:

```
evaluation_train_val(model,x_train,y_train,x_val,y_val,results,index)
```

```
Training Accuracy:  0.9843575358390808
Training Loss:      0.07990801334381104
Validation Accuracy: 0.9119170904159546
Validation Loss:     0.28500333428382874
```

In [195]:

```
plotfn(history)
```



Evaluation: Testing

In [206]:

```
evaluation_test(model,x_test,y_test,results,index)
```

7/7 [=====] - 0s 49ms/step - loss: 0.5086 - accuracy: 0.7979  
Test accuracy: 0.7979274392127991  
Test loss: 0.508575439453125

Evaluation Metrics

F1 score

In [207]:

```
_ , _ , _ , val_f1 = predictfn(model, x_val,y_val)
```

7/7 [=====] - 0s 48ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.94	0.97	16
extrastole	0.91	0.67	0.77	15
murmur	0.84	0.96	0.89	48
normal	0.94	0.92	0.93	114
accuracy			0.91	193
macro avg	0.92	0.87	0.89	193
weighted avg	0.92	0.91	0.91	193

In [208]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model,x_test,y_test)
```

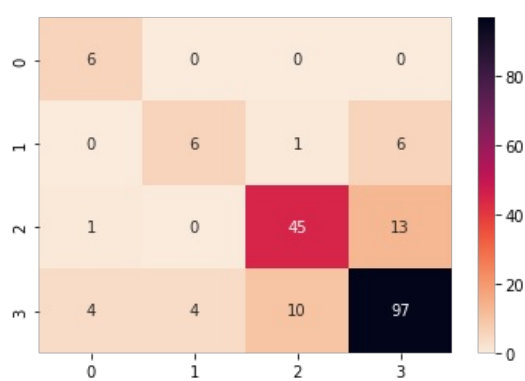
7/7 [=====] - 0s 51ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.55	0.71	11
extrastole	0.46	0.60	0.52	10
murmur	0.76	0.80	0.78	56
normal	0.84	0.84	0.84	116
accuracy			0.80	193
macro avg	0.77	0.70	0.71	193
weighted avg	0.81	0.80	0.80	193

Confusion Matrix

In [209]:

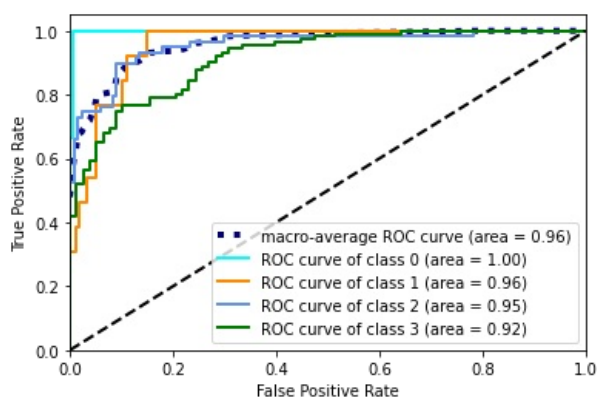
```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

In [210]:

```
roc = plot_ROC(y_test,predictions)
```





In [211]:

```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

Out[211]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547
3	CNN 2D	0.0001	0.2	KL divergence	0.984358	0.079908	0.911917	0.285003	0.797927	0.508575	0.911012	0.799109	0.958595

Predicting a sample's label

In [212]:

```
model_name = "heartbeat_classifierLoss2.h5"
model.save(model_name)
```

Predicting a Murmur sample

In [ ]:

```
test.iloc[5]
```

Out[ ]:

```
filename      /content/set_b/murmur__281_1311165683454_D.wav
label                                     murmur
offset                                              3
Name: 997, dtype: object
```

In [ ]:

```
sample_predict(model_name,5)
```

```
1/1 [=====] - 0s 115ms/step
Label Prediction Probabilities: [[4.8394353e-14 3.7032809e-08 9.9999821e-01 1.7589922e-06]]
-----
Label:
Murmur heartbeat
confidence: 0.9999982
```

Predicting a Normal sample

In [ ]:

```
test.iloc[50]
```

Out[ ]:

```
filename      /content/set_a/normal__201101151127.wav
label                                     normal
offset                                              3
Name: 165, dtype: object
```

In [ ]:

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 0s 138ms/step
Label Prediction Probabilities: [[9.8032991e-11 6.7754503e-04 1.0603091e-02 9.8871940e-01]]
-----
Label:
Normal heartbeat
confidence: 0.9887194
```

Predicting an Extrahls sample

In [ ]:

```
test.iloc[77]
```

Out[ ]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [ ]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 107ms/step
Label Prediction Probabilities: [[9.9960083e-01 2.2478001e-17 3.9711951e-05 3.5947931e-04]]
-----
Label:
Extrahls heartbeat
confidence: 0.9996008
```

#### ***Predicting a Extrasystole sample***

In [ ]:

```
test.iloc[24]
```

Out[ ]:

```
filename    /content/set_b/extrastole__191_1308077299430_A...
label                               extrastole
offset                                           7
Name: 626, dtype: object
```

In [ ]:

```
sample_predict(model_name,24)
```

```
1/1 [=====] - 0s 157ms/step
Label Prediction Probabilities: [[4.8668443e-09 7.7158499e-01 7.7761692e-04 2.2763738e-01]]
-----
Label:
Extrasystole heartbeat
confidence: 0.771585
```

## **CNN Experiment 4:**

**Change in Learning Rate:**

In [266]:

```
model = Sequential()  
Conv2Dmodel(model,0.2)
```

Model: "sequential\_9"

Layer (type)	Output Shape	Param #
conv2d_36 (Conv2D)	(None, 40, 130, 16)	160
max_pooling2d_36 (MaxPoolin g2D)	(None, 20, 65, 16)	0
dropout_28 (Dropout)	(None, 20, 65, 16)	0
conv2d_37 (Conv2D)	(None, 20, 65, 32)	4640
max_pooling2d_37 (MaxPoolin g2D)	(None, 10, 32, 32)	0
dropout_29 (Dropout)	(None, 10, 32, 32)	0
conv2d_38 (Conv2D)	(None, 10, 32, 64)	18496
max_pooling2d_38 (MaxPoolin g2D)	(None, 5, 16, 64)	0
dropout_30 (Dropout)	(None, 5, 16, 64)	0
conv2d_39 (Conv2D)	(None, 5, 16, 128)	73856
max_pooling2d_39 (MaxPoolin g2D)	(None, 2, 8, 128)	0
global_average_pooling2d_9 (GlobalAveragePooling2D)	(None, 128)	0
dense_9 (Dense)	(None, 4)	516

```
=====  
Total params: 97,668  
Trainable params: 97,668  
Non-trainable params: 0
```

In [267]:

```
history, model = compile_fit(model,LR = 0.001)
```

Epoch 1/300

```
7/7 [=====] - ETA: 0s - loss: 11.0827 - accuracy: 0.2078  
Epoch 1: val_accuracy improved from -inf to 0.12435, saving model to /content/weights.best.hdf5  
7/7 [=====] - 8s 1s/step - loss: 11.0827 - accuracy: 0.2078 - val_loss: 2.8  
751 - val_accuracy: 0.1244
```

Epoch 2/300

```
7/7 [=====] - ETA: 0s - loss: 2.4317 - accuracy: 0.3397  
Epoch 2: val_accuracy improved from 0.12435 to 0.58031, saving model to /content/weights.best.hdf5  
7/7 [=====] - 7s 1s/step - loss: 2.4317 - accuracy: 0.3397 - val_loss: 1.18  
36 - val_accuracy: 0.5803
```

Epoch 3/300

```
7/7 [=====] - ETA: 0s - loss: 1.4037 - accuracy: 0.4402  
Epoch 3: val_accuracy did not improve from 0.58031  
7/7 [=====] - 9s 1s/step - loss: 1.4037 - accuracy: 0.4402 - val_loss: 1.41  
56 - val_accuracy: 0.2953
```

Epoch 4/300

```
7/7 [=====] - ETA: 0s - loss: 1.2013 - accuracy: 0.2816  
Epoch 4: val_accuracy did not improve from 0.58031  
7/7 [=====] - 8s 1s/step - loss: 1.2013 - accuracy: 0.2816 - val_loss: 1.38  
01 - val_accuracy: 0.2280
```

Epoch 5/300

```
7/7 [=====] - ETA: 0s - loss: 1.0905 - accuracy: 0.2101  
Epoch 5: val_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 795ms/step - loss: 1.0905 - accuracy: 0.2101 - val_loss: 1  
.3056 - val_accuracy: 0.2176
```

Epoch 6/300

```
7/7 [=====] - ETA: 0s - loss: 1.0034 - accuracy: 0.3017  
Epoch 6: val_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 813ms/step - loss: 1.0034 - accuracy: 0.3017 - val_loss: 1  
.1984 - val_accuracy: 0.3834
```

Epoch 7/300

```
7/7 [=====] - ETA: 0s - loss: 0.9510 - accuracy: 0.5006  
Epoch 7: val_accuracy did not improve from 0.58031
```

7/7 [=====] - 6s 823ms/step - loss: 0.9510 - accuracy: 0.5006 - val\_loss: 1.1292 - val\_accuracy: 0.4767  
Epoch 8/300  
7/7 [=====] - ETA: 0s - loss: 0.8894 - accuracy: 0.4492  
Epoch 8: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 813ms/step - loss: 0.8894 - accuracy: 0.4492 - val\_loss: 1.1554 - val\_accuracy: 0.3368  
Epoch 9/300  
7/7 [=====] - ETA: 0s - loss: 0.8558 - accuracy: 0.4279  
Epoch 9: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 948ms/step - loss: 0.8558 - accuracy: 0.4279 - val\_loss: 1.1403 - val\_accuracy: 0.3264  
Epoch 10/300  
7/7 [=====] - ETA: 0s - loss: 0.8456 - accuracy: 0.4168  
Epoch 10: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 8s 1s/step - loss: 0.8456 - accuracy: 0.4168 - val\_loss: 1.0336 - val\_accuracy: 0.4508  
Epoch 11/300  
7/7 [=====] - ETA: 0s - loss: 0.8236 - accuracy: 0.4771  
Epoch 11: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 825ms/step - loss: 0.8236 - accuracy: 0.4771 - val\_loss: 1.1182 - val\_accuracy: 0.3472  
Epoch 12/300  
7/7 [=====] - ETA: 0s - loss: 0.8107 - accuracy: 0.4615  
Epoch 12: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 8s 1s/step - loss: 0.8107 - accuracy: 0.4615 - val\_loss: 1.0793 - val\_accuracy: 0.3834  
Epoch 13/300  
7/7 [=====] - ETA: 0s - loss: 0.7868 - accuracy: 0.4715  
Epoch 13: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 851ms/step - loss: 0.7868 - accuracy: 0.4715 - val\_loss: 1.0719 - val\_accuracy: 0.3679  
Epoch 14/300  
7/7 [=====] - ETA: 0s - loss: 0.7573 - accuracy: 0.4458  
Epoch 14: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 793ms/step - loss: 0.7573 - accuracy: 0.4458 - val\_loss: 0.9396 - val\_accuracy: 0.4870  
Epoch 15/300  
7/7 [=====] - ETA: 0s - loss: 0.7700 - accuracy: 0.4849  
Epoch 15: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 815ms/step - loss: 0.7700 - accuracy: 0.4849 - val\_loss: 1.0355 - val\_accuracy: 0.4197  
Epoch 16/300  
7/7 [=====] - ETA: 0s - loss: 0.7567 - accuracy: 0.4570  
Epoch 16: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 821ms/step - loss: 0.7567 - accuracy: 0.4570 - val\_loss: 1.0105 - val\_accuracy: 0.4197  
Epoch 17/300  
7/7 [=====] - ETA: 0s - loss: 0.7260 - accuracy: 0.5050  
Epoch 17: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 813ms/step - loss: 0.7260 - accuracy: 0.5050 - val\_loss: 1.0235 - val\_accuracy: 0.4249  
Epoch 18/300  
7/7 [=====] - ETA: 0s - loss: 0.7309 - accuracy: 0.4983  
Epoch 18: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 855ms/step - loss: 0.7309 - accuracy: 0.4983 - val\_loss: 1.0569 - val\_accuracy: 0.4041  
Epoch 19/300  
7/7 [=====] - ETA: 0s - loss: 0.7316 - accuracy: 0.4961  
Epoch 19: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 910ms/step - loss: 0.7316 - accuracy: 0.4961 - val\_loss: 1.0518 - val\_accuracy: 0.4197  
Epoch 20/300  
7/7 [=====] - ETA: 0s - loss: 0.7274 - accuracy: 0.4994  
Epoch 20: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 7s 954ms/step - loss: 0.7274 - accuracy: 0.4994 - val\_loss: 0.9472 - val\_accuracy: 0.4922  
Epoch 21/300  
7/7 [=====] - ETA: 0s - loss: 0.6926 - accuracy: 0.5408  
Epoch 21: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 810ms/step - loss: 0.6926 - accuracy: 0.5408 - val\_loss: 1.0699 - val\_accuracy: 0.4093  
Epoch 22/300  
7/7 [=====] - ETA: 0s - loss: 0.7058 - accuracy: 0.5106  
Epoch 22: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 810ms/step - loss: 0.7058 - accuracy: 0.5106 - val\_loss: 1.0212 - val\_accuracy: 0.4352  
Epoch 23/300  
7/7 [=====] - ETA: 0s - loss: 0.6925 - accuracy: 0.5520  
Epoch 23: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 7s 984ms/step - loss: 0.6925 - accuracy: 0.5520 - val\_loss: 0.9715 - val\_accuracy: 0.4508  
Epoch 24/300

7/7 [=====] - ETA: 0s - loss: 0.6935 - accuracy: 0.4961  
Epoch 24: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 7s 946ms/step - loss: 0.6935 - accuracy: 0.4961 - val\_loss: 0.8361 - val\_accuracy: 0.5440  
Epoch 25/300  
7/7 [=====] - ETA: 0s - loss: 0.6920 - accuracy: 0.5531  
Epoch 25: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 9s 1s/step - loss: 0.6920 - accuracy: 0.5531 - val\_loss: 0.9629 - val\_accuracy: 0.4663  
Epoch 26/300  
7/7 [=====] - ETA: 0s - loss: 0.6855 - accuracy: 0.5665  
Epoch 26: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 8s 1s/step - loss: 0.6855 - accuracy: 0.5665 - val\_loss: 0.8493 - val\_accuracy: 0.5544  
Epoch 27/300  
7/7 [=====] - ETA: 0s - loss: 0.6684 - accuracy: 0.5397  
Epoch 27: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 8s 1s/step - loss: 0.6684 - accuracy: 0.5397 - val\_loss: 1.0067 - val\_accuracy: 0.4456  
Epoch 28/300  
7/7 [=====] - ETA: 0s - loss: 0.6962 - accuracy: 0.5475  
Epoch 28: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 8s 1s/step - loss: 0.6962 - accuracy: 0.5475 - val\_loss: 0.9425 - val\_accuracy: 0.5026  
Epoch 29/300  
7/7 [=====] - ETA: 0s - loss: 0.6686 - accuracy: 0.5263  
Epoch 29: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 826ms/step - loss: 0.6686 - accuracy: 0.5263 - val\_loss: 0.8501 - val\_accuracy: 0.5440  
Epoch 30/300  
7/7 [=====] - ETA: 0s - loss: 0.6717 - accuracy: 0.5363  
Epoch 30: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 828ms/step - loss: 0.6717 - accuracy: 0.5363 - val\_loss: 0.8662 - val\_accuracy: 0.5389  
Epoch 31/300  
7/7 [=====] - ETA: 0s - loss: 0.6479 - accuracy: 0.6011  
Epoch 31: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 819ms/step - loss: 0.6479 - accuracy: 0.6011 - val\_loss: 0.8724 - val\_accuracy: 0.5440  
Epoch 32/300  
7/7 [=====] - ETA: 0s - loss: 0.6804 - accuracy: 0.5307  
Epoch 32: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 6s 843ms/step - loss: 0.6804 - accuracy: 0.5307 - val\_loss: 0.9009 - val\_accuracy: 0.5440  
Epoch 33/300  
7/7 [=====] - ETA: 0s - loss: 0.6713 - accuracy: 0.5665  
Epoch 33: val\_accuracy did not improve from 0.58031  
7/7 [=====] - 5s 788ms/step - loss: 0.6713 - accuracy: 0.5665 - val\_loss: 0.9190 - val\_accuracy: 0.5078  
Epoch 34/300  
7/7 [=====] - ETA: 0s - loss: 0.6852 - accuracy: 0.5620  
Epoch 34: val\_accuracy improved from 0.58031 to 0.64249, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 930ms/step - loss: 0.6852 - accuracy: 0.5620 - val\_loss: 0.7156 - val\_accuracy: 0.6425  
Epoch 35/300  
7/7 [=====] - ETA: 0s - loss: 0.6622 - accuracy: 0.5609  
Epoch 35: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 8s 1s/step - loss: 0.6622 - accuracy: 0.5609 - val\_loss: 0.8183 - val\_accuracy: 0.5907  
Epoch 36/300  
7/7 [=====] - ETA: 0s - loss: 0.6402 - accuracy: 0.5821  
Epoch 36: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 813ms/step - loss: 0.6402 - accuracy: 0.5821 - val\_loss: 0.8129 - val\_accuracy: 0.5699  
Epoch 37/300  
7/7 [=====] - ETA: 0s - loss: 0.6399 - accuracy: 0.5363  
Epoch 37: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 808ms/step - loss: 0.6399 - accuracy: 0.5363 - val\_loss: 0.7173 - val\_accuracy: 0.6218  
Epoch 38/300  
7/7 [=====] - ETA: 0s - loss: 0.6270 - accuracy: 0.6246  
Epoch 38: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 803ms/step - loss: 0.6270 - accuracy: 0.6246 - val\_loss: 0.8203 - val\_accuracy: 0.6062  
Epoch 39/300  
7/7 [=====] - ETA: 0s - loss: 0.6369 - accuracy: 0.5553  
Epoch 39: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 820ms/step - loss: 0.6369 - accuracy: 0.5553 - val\_loss: 0.7522 - val\_accuracy: 0.6114  
Epoch 40/300  
7/7 [=====] - ETA: 0s - loss: 0.6296 - accuracy: 0.5709  
Epoch 40: val\_accuracy did not improve from 0.64249  
7/7 [=====] - 6s 821ms/step - loss: 0.6296 - accuracy: 0.5709 - val\_loss: 0

.7341 - val\_accuracy: 0.6166  
Epoch 41/300  
7/7 [=====] - ETA: 0s - loss: 0.6183 - accuracy: 0.5911  
Epoch 41: val\_accuracy improved from 0.64249 to 0.67358, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 848ms/step - loss: 0.6183 - accuracy: 0.5911 - val\_loss: 0.6769 - val\_accuracy: 0.6736  
Epoch 42/300  
7/7 [=====] - ETA: 0s - loss: 0.6271 - accuracy: 0.5844  
Epoch 42: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 6s 819ms/step - loss: 0.6271 - accuracy: 0.5844 - val\_loss: 0.8215 - val\_accuracy: 0.5596  
Epoch 43/300  
7/7 [=====] - ETA: 0s - loss: 0.6257 - accuracy: 0.5899  
Epoch 43: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 8s 1s/step - loss: 0.6257 - accuracy: 0.5899 - val\_loss: 0.8192 - val\_accuracy: 0.5751  
Epoch 44/300  
7/7 [=====] - ETA: 0s - loss: 0.6346 - accuracy: 0.5598  
Epoch 44: val\_accuracy improved from 0.67358 to 0.67876, saving model to /content/weights.best.hdf5  
7/7 [=====] - 9s 1s/step - loss: 0.6346 - accuracy: 0.5598 - val\_loss: 0.6465 - val\_accuracy: 0.6788  
Epoch 45/300  
7/7 [=====] - ETA: 0s - loss: 0.6252 - accuracy: 0.5978  
Epoch 45: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 880ms/step - loss: 0.6252 - accuracy: 0.5978 - val\_loss: 0.7371 - val\_accuracy: 0.6477  
Epoch 46/300  
7/7 [=====] - ETA: 0s - loss: 0.6031 - accuracy: 0.5855  
Epoch 46: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 5s 784ms/step - loss: 0.6031 - accuracy: 0.5855 - val\_loss: 0.6866 - val\_accuracy: 0.6632  
Epoch 47/300  
7/7 [=====] - ETA: 0s - loss: 0.6111 - accuracy: 0.5888  
Epoch 47: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 813ms/step - loss: 0.6111 - accuracy: 0.5888 - val\_loss: 0.7100 - val\_accuracy: 0.6218  
Epoch 48/300  
7/7 [=====] - ETA: 0s - loss: 0.5721 - accuracy: 0.5687  
Epoch 48: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 797ms/step - loss: 0.5721 - accuracy: 0.5687 - val\_loss: 0.6482 - val\_accuracy: 0.6580  
Epoch 49/300  
7/7 [=====] - ETA: 0s - loss: 0.5816 - accuracy: 0.6402  
Epoch 49: val\_accuracy did not improve from 0.67876  
7/7 [=====] - 6s 810ms/step - loss: 0.5816 - accuracy: 0.6402 - val\_loss: 0.8470 - val\_accuracy: 0.5699  
Epoch 50/300  
7/7 [=====] - ETA: 0s - loss: 0.5990 - accuracy: 0.5866  
Epoch 50: val\_accuracy improved from 0.67876 to 0.74611, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 816ms/step - loss: 0.5990 - accuracy: 0.5866 - val\_loss: 0.5981 - val\_accuracy: 0.7461  
Epoch 51/300  
7/7 [=====] - ETA: 0s - loss: 0.6420 - accuracy: 0.5631  
Epoch 51: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 811ms/step - loss: 0.6420 - accuracy: 0.5631 - val\_loss: 0.6275 - val\_accuracy: 0.6943  
Epoch 52/300  
7/7 [=====] - ETA: 0s - loss: 0.6167 - accuracy: 0.6022  
Epoch 52: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 805ms/step - loss: 0.6167 - accuracy: 0.6022 - val\_loss: 0.7514 - val\_accuracy: 0.6477  
Epoch 53/300  
7/7 [=====] - ETA: 0s - loss: 0.5996 - accuracy: 0.6257  
Epoch 53: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 5s 786ms/step - loss: 0.5996 - accuracy: 0.6257 - val\_loss: 0.6536 - val\_accuracy: 0.6788  
Epoch 54/300  
7/7 [=====] - ETA: 0s - loss: 0.6006 - accuracy: 0.5464  
Epoch 54: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 801ms/step - loss: 0.6006 - accuracy: 0.5464 - val\_loss: 0.5916 - val\_accuracy: 0.7358  
Epoch 55/300  
7/7 [=====] - ETA: 0s - loss: 0.5977 - accuracy: 0.6670  
Epoch 55: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 809ms/step - loss: 0.5977 - accuracy: 0.6670 - val\_loss: 0.7338 - val\_accuracy: 0.6477  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.5928 - accuracy: 0.5966  
Epoch 56: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 814ms/step - loss: 0.5928 - accuracy: 0.5966 - val\_loss: 0.6447 - val\_accuracy: 0.6788  
Epoch 57/300  
7/7 [=====] - ETA: 0s - loss: 0.6038 - accuracy: 0.5687

Epoch 57: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 797ms/step - loss: 0.6038 - accuracy: 0.5687 - val\_loss: 0.6755 - val\_accuracy: 0.6943  
Epoch 58/300  
7/7 [=====] - ETA: 0s - loss: 0.5941 - accuracy: 0.6525  
Epoch 58: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 5s 784ms/step - loss: 0.5941 - accuracy: 0.6525 - val\_loss: 0.7769 - val\_accuracy: 0.6269  
Epoch 59/300  
7/7 [=====] - ETA: 0s - loss: 0.5979 - accuracy: 0.5899  
Epoch 59: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 807ms/step - loss: 0.5979 - accuracy: 0.5899 - val\_loss: 0.6532 - val\_accuracy: 0.6839  
Epoch 60/300  
7/7 [=====] - ETA: 0s - loss: 0.5711 - accuracy: 0.6268  
Epoch 60: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 809ms/step - loss: 0.5711 - accuracy: 0.6268 - val\_loss: 0.6677 - val\_accuracy: 0.6684  
Epoch 61/300  
7/7 [=====] - ETA: 0s - loss: 0.5595 - accuracy: 0.6279  
Epoch 61: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 806ms/step - loss: 0.5595 - accuracy: 0.6279 - val\_loss: 0.6806 - val\_accuracy: 0.6788  
Epoch 62/300  
7/7 [=====] - ETA: 0s - loss: 0.5464 - accuracy: 0.6067  
Epoch 62: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 831ms/step - loss: 0.5464 - accuracy: 0.6067 - val\_loss: 0.6154 - val\_accuracy: 0.6995  
Epoch 63/300  
7/7 [=====] - ETA: 0s - loss: 0.5384 - accuracy: 0.6492  
Epoch 63: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 813ms/step - loss: 0.5384 - accuracy: 0.6492 - val\_loss: 0.6274 - val\_accuracy: 0.7306  
Epoch 64/300  
7/7 [=====] - ETA: 0s - loss: 0.5450 - accuracy: 0.6000  
Epoch 64: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 809ms/step - loss: 0.5450 - accuracy: 0.6000 - val\_loss: 0.5673 - val\_accuracy: 0.7150  
Epoch 65/300  
7/7 [=====] - ETA: 0s - loss: 0.5645 - accuracy: 0.6626  
Epoch 65: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 815ms/step - loss: 0.5645 - accuracy: 0.6626 - val\_loss: 0.8039 - val\_accuracy: 0.6062  
Epoch 66/300  
7/7 [=====] - ETA: 0s - loss: 0.5588 - accuracy: 0.6123  
Epoch 66: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 809ms/step - loss: 0.5588 - accuracy: 0.6123 - val\_loss: 0.5691 - val\_accuracy: 0.7358  
Epoch 67/300  
7/7 [=====] - ETA: 0s - loss: 0.5276 - accuracy: 0.6469  
Epoch 67: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 813ms/step - loss: 0.5276 - accuracy: 0.6469 - val\_loss: 0.6536 - val\_accuracy: 0.6891  
Epoch 68/300  
7/7 [=====] - ETA: 0s - loss: 0.5405 - accuracy: 0.6648  
Epoch 68: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 806ms/step - loss: 0.5405 - accuracy: 0.6648 - val\_loss: 0.6462 - val\_accuracy: 0.6839  
Epoch 69/300  
7/7 [=====] - ETA: 0s - loss: 0.5690 - accuracy: 0.5899  
Epoch 69: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 7s 1s/step - loss: 0.5690 - accuracy: 0.5899 - val\_loss: 0.6011 - val\_accuracy: 0.7047  
Epoch 70/300  
7/7 [=====] - ETA: 0s - loss: 0.5505 - accuracy: 0.6201  
Epoch 70: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 804ms/step - loss: 0.5505 - accuracy: 0.6201 - val\_loss: 0.7637 - val\_accuracy: 0.6218  
Epoch 71/300  
7/7 [=====] - ETA: 0s - loss: 0.5378 - accuracy: 0.6525  
Epoch 71: val\_accuracy did not improve from 0.74611  
7/7 [=====] - 6s 805ms/step - loss: 0.5378 - accuracy: 0.6525 - val\_loss: 0.6483 - val\_accuracy: 0.6528  
Epoch 72/300  
7/7 [=====] - ETA: 0s - loss: 0.5393 - accuracy: 0.6212  
Epoch 72: val\_accuracy improved from 0.74611 to 0.75130, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 816ms/step - loss: 0.5393 - accuracy: 0.6212 - val\_loss: 0.5548 - val\_accuracy: 0.7513  
Epoch 73/300  
7/7 [=====] - ETA: 0s - loss: 0.5303 - accuracy: 0.6648  
Epoch 73: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 797ms/step - loss: 0.5303 - accuracy: 0.6648 - val\_loss: 0.6237 - val\_accuracy: 0.6943

Epoch 74/300  
7/7 [=====] - ETA: 0s - loss: 0.5054 - accuracy: 0.6659  
Epoch 74: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 810ms/step - loss: 0.5054 - accuracy: 0.6659 - val\_loss: 0.5852 - val\_accuracy: 0.7306  
Epoch 75/300  
7/7 [=====] - ETA: 0s - loss: 0.5427 - accuracy: 0.6648  
Epoch 75: val\_accuracy did not improve from 0.75130  
7/7 [=====] - 6s 807ms/step - loss: 0.5427 - accuracy: 0.6648 - val\_loss: 0.6399 - val\_accuracy: 0.7047  
Epoch 76/300  
7/7 [=====] - ETA: 0s - loss: 0.5463 - accuracy: 0.6358  
Epoch 76: val\_accuracy improved from 0.75130 to 0.77720, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 814ms/step - loss: 0.5463 - accuracy: 0.6358 - val\_loss: 0.5304 - val\_accuracy: 0.7772  
Epoch 77/300  
7/7 [=====] - ETA: 0s - loss: 0.5122 - accuracy: 0.6793  
Epoch 77: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 805ms/step - loss: 0.5122 - accuracy: 0.6793 - val\_loss: 0.6282 - val\_accuracy: 0.7150  
Epoch 78/300  
7/7 [=====] - ETA: 0s - loss: 0.5114 - accuracy: 0.6860  
Epoch 78: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 875ms/step - loss: 0.5114 - accuracy: 0.6860 - val\_loss: 0.5553 - val\_accuracy: 0.7668  
Epoch 79/300  
7/7 [=====] - ETA: 0s - loss: 0.5231 - accuracy: 0.6380  
Epoch 79: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 810ms/step - loss: 0.5231 - accuracy: 0.6380 - val\_loss: 0.5859 - val\_accuracy: 0.7047  
Epoch 80/300  
7/7 [=====] - ETA: 0s - loss: 0.4931 - accuracy: 0.6983  
Epoch 80: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 808ms/step - loss: 0.4931 - accuracy: 0.6983 - val\_loss: 0.6808 - val\_accuracy: 0.6321  
Epoch 81/300  
7/7 [=====] - ETA: 0s - loss: 0.4931 - accuracy: 0.6670  
Epoch 81: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 808ms/step - loss: 0.4931 - accuracy: 0.6670 - val\_loss: 0.6091 - val\_accuracy: 0.7202  
Epoch 82/300  
7/7 [=====] - ETA: 0s - loss: 0.4632 - accuracy: 0.6849  
Epoch 82: val\_accuracy did not improve from 0.77720  
7/7 [=====] - 6s 802ms/step - loss: 0.4632 - accuracy: 0.6849 - val\_loss: 0.5723 - val\_accuracy: 0.7254  
Epoch 83/300  
7/7 [=====] - ETA: 0s - loss: 0.4966 - accuracy: 0.6883  
Epoch 83: val\_accuracy improved from 0.77720 to 0.78238, saving model to /content/weights.best.hdf5  
7/7 [=====] - 5s 788ms/step - loss: 0.4966 - accuracy: 0.6883 - val\_loss: 0.5156 - val\_accuracy: 0.7824  
Epoch 84/300  
7/7 [=====] - ETA: 0s - loss: 0.4892 - accuracy: 0.6704  
Epoch 84: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 5s 785ms/step - loss: 0.4892 - accuracy: 0.6704 - val\_loss: 0.5600 - val\_accuracy: 0.7565  
Epoch 85/300  
7/7 [=====] - ETA: 0s - loss: 0.4872 - accuracy: 0.7061  
Epoch 85: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 804ms/step - loss: 0.4872 - accuracy: 0.7061 - val\_loss: 0.5572 - val\_accuracy: 0.7565  
Epoch 86/300  
7/7 [=====] - ETA: 0s - loss: 0.4521 - accuracy: 0.7151  
Epoch 86: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 798ms/step - loss: 0.4521 - accuracy: 0.7151 - val\_loss: 0.6740 - val\_accuracy: 0.7047  
Epoch 87/300  
7/7 [=====] - ETA: 0s - loss: 0.4625 - accuracy: 0.6905  
Epoch 87: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 818ms/step - loss: 0.4625 - accuracy: 0.6905 - val\_loss: 0.5110 - val\_accuracy: 0.7617  
Epoch 88/300  
7/7 [=====] - ETA: 0s - loss: 0.4564 - accuracy: 0.7095  
Epoch 88: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 804ms/step - loss: 0.4564 - accuracy: 0.7095 - val\_loss: 0.5925 - val\_accuracy: 0.7306  
Epoch 89/300  
7/7 [=====] - ETA: 0s - loss: 0.4392 - accuracy: 0.6972  
Epoch 89: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 814ms/step - loss: 0.4392 - accuracy: 0.6972 - val\_loss: 0.6084 - val\_accuracy: 0.6995  
Epoch 90/300  
7/7 [=====] - ETA: 0s - loss: 0.4328 - accuracy: 0.7151  
Epoch 90: val\_accuracy did not improve from 0.78238



7/7 [=====] - 6s 801ms/step - loss: 0.4328 - accuracy: 0.7151 - val\_loss: 0.6064 - val\_accuracy: 0.7306  
Epoch 91/300  
7/7 [=====] - ETA: 0s - loss: 0.4715 - accuracy: 0.7240  
Epoch 91: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 815ms/step - loss: 0.4715 - accuracy: 0.7240 - val\_loss: 0.5258 - val\_accuracy: 0.7617  
Epoch 92/300  
7/7 [=====] - ETA: 0s - loss: 0.4535 - accuracy: 0.7263  
Epoch 92: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 819ms/step - loss: 0.4535 - accuracy: 0.7263 - val\_loss: 0.6005 - val\_accuracy: 0.6943  
Epoch 93/300  
7/7 [=====] - ETA: 0s - loss: 0.4403 - accuracy: 0.6983  
Epoch 93: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 811ms/step - loss: 0.4403 - accuracy: 0.6983 - val\_loss: 0.5297 - val\_accuracy: 0.7306  
Epoch 94/300  
7/7 [=====] - ETA: 0s - loss: 0.4426 - accuracy: 0.7263  
Epoch 94: val\_accuracy did not improve from 0.78238  
7/7 [=====] - 6s 819ms/step - loss: 0.4426 - accuracy: 0.7263 - val\_loss: 0.5078 - val\_accuracy: 0.7617  
Epoch 95/300  
7/7 [=====] - ETA: 0s - loss: 0.4212 - accuracy: 0.7307  
Epoch 95: val\_accuracy improved from 0.78238 to 0.80311, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 842ms/step - loss: 0.4212 - accuracy: 0.7307 - val\_loss: 0.4976 - val\_accuracy: 0.8031  
Epoch 96/300  
7/7 [=====] - ETA: 0s - loss: 0.4356 - accuracy: 0.7251  
Epoch 96: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 7s 1s/step - loss: 0.4356 - accuracy: 0.7251 - val\_loss: 0.4899 - val\_accuracy: 0.7772  
Epoch 97/300  
7/7 [=====] - ETA: 0s - loss: 0.4847 - accuracy: 0.7006  
Epoch 97: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 795ms/step - loss: 0.4847 - accuracy: 0.7006 - val\_loss: 0.4922 - val\_accuracy: 0.7461  
Epoch 98/300  
7/7 [=====] - ETA: 0s - loss: 0.4409 - accuracy: 0.7140  
Epoch 98: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 813ms/step - loss: 0.4409 - accuracy: 0.7140 - val\_loss: 0.5617 - val\_accuracy: 0.7306  
Epoch 99/300  
7/7 [=====] - ETA: 0s - loss: 0.4203 - accuracy: 0.7162  
Epoch 99: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.4203 - accuracy: 0.7162 - val\_loss: 0.5247 - val\_accuracy: 0.7565  
Epoch 100/300  
7/7 [=====] - ETA: 0s - loss: 0.4069 - accuracy: 0.7453  
Epoch 100: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 811ms/step - loss: 0.4069 - accuracy: 0.7453 - val\_loss: 0.4999 - val\_accuracy: 0.7306  
Epoch 101/300  
7/7 [=====] - ETA: 0s - loss: 0.4567 - accuracy: 0.6793  
Epoch 101: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 806ms/step - loss: 0.4567 - accuracy: 0.6793 - val\_loss: 0.4463 - val\_accuracy: 0.7927  
Epoch 102/300  
7/7 [=====] - ETA: 0s - loss: 0.4328 - accuracy: 0.7184  
Epoch 102: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 791ms/step - loss: 0.4328 - accuracy: 0.7184 - val\_loss: 0.5091 - val\_accuracy: 0.7668  
Epoch 103/300  
7/7 [=====] - ETA: 0s - loss: 0.3868 - accuracy: 0.7508  
Epoch 103: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 809ms/step - loss: 0.3868 - accuracy: 0.7508 - val\_loss: 0.4900 - val\_accuracy: 0.7927  
Epoch 104/300  
7/7 [=====] - ETA: 0s - loss: 0.4066 - accuracy: 0.7385  
Epoch 104: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 792ms/step - loss: 0.4066 - accuracy: 0.7385 - val\_loss: 0.5851 - val\_accuracy: 0.6943  
Epoch 105/300  
7/7 [=====] - ETA: 0s - loss: 0.3865 - accuracy: 0.7520  
Epoch 105: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 798ms/step - loss: 0.3865 - accuracy: 0.7520 - val\_loss: 0.4581 - val\_accuracy: 0.7720  
Epoch 106/300  
7/7 [=====] - ETA: 0s - loss: 0.4088 - accuracy: 0.7318  
Epoch 106: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 797ms/step - loss: 0.4088 - accuracy: 0.7318 - val\_loss: 0.4463 - val\_accuracy: 0.7876  
Epoch 107/300

7/7 [=====] - ETA: 0s - loss: 0.4315 - accuracy: 0.7184  
Epoch 107: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 807ms/step - loss: 0.4315 - accuracy: 0.7184 - val\_loss: 0.4852 - val\_accuracy: 0.7513  
Epoch 108/300  
7/7 [=====] - ETA: 0s - loss: 0.4644 - accuracy: 0.7006  
Epoch 108: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 812ms/step - loss: 0.4644 - accuracy: 0.7006 - val\_loss: 0.5483 - val\_accuracy: 0.7720  
Epoch 109/300  
7/7 [=====] - ETA: 0s - loss: 0.4409 - accuracy: 0.7464  
Epoch 109: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 807ms/step - loss: 0.4409 - accuracy: 0.7464 - val\_loss: 0.6353 - val\_accuracy: 0.7047  
Epoch 110/300  
7/7 [=====] - ETA: 0s - loss: 0.4746 - accuracy: 0.7061  
Epoch 110: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 809ms/step - loss: 0.4746 - accuracy: 0.7061 - val\_loss: 0.6403 - val\_accuracy: 0.6632  
Epoch 111/300  
7/7 [=====] - ETA: 0s - loss: 0.4013 - accuracy: 0.7151  
Epoch 111: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 820ms/step - loss: 0.4013 - accuracy: 0.7151 - val\_loss: 0.5535 - val\_accuracy: 0.7306  
Epoch 112/300  
7/7 [=====] - ETA: 0s - loss: 0.3950 - accuracy: 0.7654  
Epoch 112: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 809ms/step - loss: 0.3950 - accuracy: 0.7654 - val\_loss: 0.4858 - val\_accuracy: 0.7668  
Epoch 113/300  
7/7 [=====] - ETA: 0s - loss: 0.3683 - accuracy: 0.7721  
Epoch 113: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 816ms/step - loss: 0.3683 - accuracy: 0.7721 - val\_loss: 0.4583 - val\_accuracy: 0.7876  
Epoch 114/300  
7/7 [=====] - ETA: 0s - loss: 0.3798 - accuracy: 0.7642  
Epoch 114: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 812ms/step - loss: 0.3798 - accuracy: 0.7642 - val\_loss: 0.4882 - val\_accuracy: 0.7513  
Epoch 115/300  
7/7 [=====] - ETA: 0s - loss: 0.3664 - accuracy: 0.7598  
Epoch 115: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 802ms/step - loss: 0.3664 - accuracy: 0.7598 - val\_loss: 0.5273 - val\_accuracy: 0.7409  
Epoch 116/300  
7/7 [=====] - ETA: 0s - loss: 0.3860 - accuracy: 0.7553  
Epoch 116: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 5s 787ms/step - loss: 0.3860 - accuracy: 0.7553 - val\_loss: 0.6228 - val\_accuracy: 0.7202  
Epoch 117/300  
7/7 [=====] - ETA: 0s - loss: 0.4695 - accuracy: 0.7318  
Epoch 117: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 808ms/step - loss: 0.4695 - accuracy: 0.7318 - val\_loss: 0.4968 - val\_accuracy: 0.7513  
Epoch 118/300  
7/7 [=====] - ETA: 0s - loss: 0.4074 - accuracy: 0.7441  
Epoch 118: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 808ms/step - loss: 0.4074 - accuracy: 0.7441 - val\_loss: 0.5999 - val\_accuracy: 0.7150  
Epoch 119/300  
7/7 [=====] - ETA: 0s - loss: 0.3919 - accuracy: 0.7609  
Epoch 119: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 815ms/step - loss: 0.3919 - accuracy: 0.7609 - val\_loss: 0.7039 - val\_accuracy: 0.6528  
Epoch 120/300  
7/7 [=====] - ETA: 0s - loss: 0.3772 - accuracy: 0.7564  
Epoch 120: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 813ms/step - loss: 0.3772 - accuracy: 0.7564 - val\_loss: 0.4313 - val\_accuracy: 0.7979  
Epoch 121/300  
7/7 [=====] - ETA: 0s - loss: 0.3669 - accuracy: 0.7475  
Epoch 121: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 798ms/step - loss: 0.3669 - accuracy: 0.7475 - val\_loss: 0.5195 - val\_accuracy: 0.7358  
Epoch 122/300  
7/7 [=====] - ETA: 0s - loss: 0.3845 - accuracy: 0.7721  
Epoch 122: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 8s 1s/step - loss: 0.3845 - accuracy: 0.7721 - val\_loss: 0.4546 - val\_accuracy: 0.7979  
Epoch 123/300  
7/7 [=====] - ETA: 0s - loss: 0.3596 - accuracy: 0.7877  
Epoch 123: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 814ms/step - loss: 0.3596 - accuracy: 0.7877 - val\_loss: 0

.5408 - val\_accuracy: 0.7409  
Epoch 124/300  
7/7 [=====] - ETA: 0s - loss: 0.3856 - accuracy: 0.7520  
Epoch 124: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 814ms/step - loss: 0.3856 - accuracy: 0.7520 - val\_loss: 0  
.5142 - val\_accuracy: 0.7409  
Epoch 125/300  
7/7 [=====] - ETA: 0s - loss: 0.3599 - accuracy: 0.7654  
Epoch 125: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 811ms/step - loss: 0.3599 - accuracy: 0.7654 - val\_loss: 0  
.6141 - val\_accuracy: 0.6891  
Epoch 126/300  
7/7 [=====] - ETA: 0s - loss: 0.3751 - accuracy: 0.7408  
Epoch 126: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 795ms/step - loss: 0.3751 - accuracy: 0.7408 - val\_loss: 0  
.4746 - val\_accuracy: 0.7461  
Epoch 127/300  
7/7 [=====] - ETA: 0s - loss: 0.3449 - accuracy: 0.7844  
Epoch 127: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 822ms/step - loss: 0.3449 - accuracy: 0.7844 - val\_loss: 0  
.4834 - val\_accuracy: 0.7720  
Epoch 128/300  
7/7 [=====] - ETA: 0s - loss: 0.3530 - accuracy: 0.7855  
Epoch 128: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 817ms/step - loss: 0.3530 - accuracy: 0.7855 - val\_loss: 0  
.4592 - val\_accuracy: 0.7668  
Epoch 129/300  
7/7 [=====] - ETA: 0s - loss: 0.3416 - accuracy: 0.7777  
Epoch 129: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 816ms/step - loss: 0.3416 - accuracy: 0.7777 - val\_loss: 0  
.5418 - val\_accuracy: 0.7306  
Epoch 130/300  
7/7 [=====] - ETA: 0s - loss: 0.3333 - accuracy: 0.7788  
Epoch 130: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 795ms/step - loss: 0.3333 - accuracy: 0.7788 - val\_loss: 0  
.5640 - val\_accuracy: 0.7202  
Epoch 131/300  
7/7 [=====] - ETA: 0s - loss: 0.3163 - accuracy: 0.7944  
Epoch 131: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.3163 - accuracy: 0.7944 - val\_loss: 0  
.4618 - val\_accuracy: 0.7824  
Epoch 132/300  
7/7 [=====] - ETA: 0s - loss: 0.3139 - accuracy: 0.8134  
Epoch 132: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 827ms/step - loss: 0.3139 - accuracy: 0.8134 - val\_loss: 0  
.4928 - val\_accuracy: 0.7617  
Epoch 133/300  
7/7 [=====] - ETA: 0s - loss: 0.3189 - accuracy: 0.7989  
Epoch 133: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 804ms/step - loss: 0.3189 - accuracy: 0.7989 - val\_loss: 0  
.4883 - val\_accuracy: 0.7461  
Epoch 134/300  
7/7 [=====] - ETA: 0s - loss: 0.3034 - accuracy: 0.8022  
Epoch 134: val\_accuracy did not improve from 0.80311  
7/7 [=====] - 6s 816ms/step - loss: 0.3034 - accuracy: 0.8022 - val\_loss: 0  
.5144 - val\_accuracy: 0.7358  
Epoch 135/300  
7/7 [=====] - ETA: 0s - loss: 0.3548 - accuracy: 0.7598  
Epoch 135: val\_accuracy improved from 0.80311 to 0.83938, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 816ms/step - loss: 0.3548 - accuracy: 0.7598 - val\_loss: 0  
.4011 - val\_accuracy: 0.8394  
Epoch 136/300  
7/7 [=====] - ETA: 0s - loss: 0.3236 - accuracy: 0.8123  
Epoch 136: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 816ms/step - loss: 0.3236 - accuracy: 0.8123 - val\_loss: 0  
.4819 - val\_accuracy: 0.7824  
Epoch 137/300  
7/7 [=====] - ETA: 0s - loss: 0.5005 - accuracy: 0.7631  
Epoch 137: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 807ms/step - loss: 0.5005 - accuracy: 0.7631 - val\_loss: 0  
.6098 - val\_accuracy: 0.7461  
Epoch 138/300  
7/7 [=====] - ETA: 0s - loss: 0.4628 - accuracy: 0.7408  
Epoch 138: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 815ms/step - loss: 0.4628 - accuracy: 0.7408 - val\_loss: 0  
.5320 - val\_accuracy: 0.7513  
Epoch 139/300  
7/7 [=====] - ETA: 0s - loss: 0.3556 - accuracy: 0.7687  
Epoch 139: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 790ms/step - loss: 0.3556 - accuracy: 0.7687 - val\_loss: 0  
.5368 - val\_accuracy: 0.7202  
Epoch 140/300  
7/7 [=====] - ETA: 0s - loss: 0.3701 - accuracy: 0.7765

Epoch 140: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 802ms/step - loss: 0.3701 - accuracy: 0.7765 - val\_loss: 0.5188 - val\_accuracy: 0.7979  
Epoch 141/300  
7/7 [=====] - ETA: 0s - loss: 0.3263 - accuracy: 0.8056  
Epoch 141: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 808ms/step - loss: 0.3263 - accuracy: 0.8056 - val\_loss: 0.4695 - val\_accuracy: 0.7461  
Epoch 142/300  
7/7 [=====] - ETA: 0s - loss: 0.3277 - accuracy: 0.7866  
Epoch 142: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 812ms/step - loss: 0.3277 - accuracy: 0.7866 - val\_loss: 0.4637 - val\_accuracy: 0.7409  
Epoch 143/300  
7/7 [=====] - ETA: 0s - loss: 0.2997 - accuracy: 0.7877  
Epoch 143: val\_accuracy did not improve from 0.83938  
7/7 [=====] - 6s 816ms/step - loss: 0.2997 - accuracy: 0.7877 - val\_loss: 0.3933 - val\_accuracy: 0.8290  
Epoch 144/300  
7/7 [=====] - ETA: 0s - loss: 0.2897 - accuracy: 0.8156  
Epoch 144: val\_accuracy improved from 0.83938 to 0.84974, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 814ms/step - loss: 0.2897 - accuracy: 0.8156 - val\_loss: 0.3722 - val\_accuracy: 0.8497  
Epoch 145/300  
7/7 [=====] - ETA: 0s - loss: 0.2801 - accuracy: 0.8000  
Epoch 145: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 823ms/step - loss: 0.2801 - accuracy: 0.8000 - val\_loss: 0.4143 - val\_accuracy: 0.7927  
Epoch 146/300  
7/7 [=====] - ETA: 0s - loss: 0.2562 - accuracy: 0.8279  
Epoch 146: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 804ms/step - loss: 0.2562 - accuracy: 0.8279 - val\_loss: 0.4924 - val\_accuracy: 0.7254  
Epoch 147/300  
7/7 [=====] - ETA: 0s - loss: 0.2471 - accuracy: 0.8570  
Epoch 147: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 797ms/step - loss: 0.2471 - accuracy: 0.8570 - val\_loss: 0.4426 - val\_accuracy: 0.7772  
Epoch 148/300  
7/7 [=====] - ETA: 0s - loss: 0.2709 - accuracy: 0.8413  
Epoch 148: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 8s 1s/step - loss: 0.2709 - accuracy: 0.8413 - val\_loss: 0.5659 - val\_accuracy: 0.7358  
Epoch 149/300  
7/7 [=====] - ETA: 0s - loss: 0.3325 - accuracy: 0.7944  
Epoch 149: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 825ms/step - loss: 0.3325 - accuracy: 0.7944 - val\_loss: 0.6821 - val\_accuracy: 0.6943  
Epoch 150/300  
7/7 [=====] - ETA: 0s - loss: 0.3990 - accuracy: 0.7799  
Epoch 150: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 823ms/step - loss: 0.3990 - accuracy: 0.7799 - val\_loss: 0.5099 - val\_accuracy: 0.7617  
Epoch 151/300  
7/7 [=====] - ETA: 0s - loss: 0.3235 - accuracy: 0.8022  
Epoch 151: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 807ms/step - loss: 0.3235 - accuracy: 0.8022 - val\_loss: 0.4232 - val\_accuracy: 0.8083  
Epoch 152/300  
7/7 [=====] - ETA: 0s - loss: 0.2947 - accuracy: 0.8380  
Epoch 152: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 811ms/step - loss: 0.2947 - accuracy: 0.8380 - val\_loss: 0.4472 - val\_accuracy: 0.8083  
Epoch 153/300  
7/7 [=====] - ETA: 0s - loss: 0.2911 - accuracy: 0.8000  
Epoch 153: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 800ms/step - loss: 0.2911 - accuracy: 0.8000 - val\_loss: 0.4039 - val\_accuracy: 0.8135  
Epoch 154/300  
7/7 [=====] - ETA: 0s - loss: 0.2657 - accuracy: 0.8223  
Epoch 154: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 799ms/step - loss: 0.2657 - accuracy: 0.8223 - val\_loss: 0.3534 - val\_accuracy: 0.8446  
Epoch 155/300  
7/7 [=====] - ETA: 0s - loss: 0.2482 - accuracy: 0.8492  
Epoch 155: val\_accuracy did not improve from 0.84974  
7/7 [=====] - 6s 804ms/step - loss: 0.2482 - accuracy: 0.8492 - val\_loss: 0.4156 - val\_accuracy: 0.8083  
Epoch 156/300  
7/7 [=====] - ETA: 0s - loss: 0.2554 - accuracy: 0.8201  
Epoch 156: val\_accuracy improved from 0.84974 to 0.85492, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 817ms/step - loss: 0.2554 - accuracy: 0.8201 - val\_loss: 0.3387 - val\_accuracy: 0.8549

Epoch 157/300  
7/7 [=====] - ETA: 0s - loss: 0.2571 - accuracy: 0.8525  
Epoch 157: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 797ms/step - loss: 0.2571 - accuracy: 0.8525 - val\_loss: 0.3668 - val\_accuracy: 0.8446  
Epoch 158/300  
7/7 [=====] - ETA: 0s - loss: 0.2254 - accuracy: 0.8626  
Epoch 158: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 811ms/step - loss: 0.2254 - accuracy: 0.8626 - val\_loss: 0.4723 - val\_accuracy: 0.7565  
Epoch 159/300  
7/7 [=====] - ETA: 0s - loss: 0.2542 - accuracy: 0.8335  
Epoch 159: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 800ms/step - loss: 0.2542 - accuracy: 0.8335 - val\_loss: 0.5365 - val\_accuracy: 0.7358  
Epoch 160/300  
7/7 [=====] - ETA: 0s - loss: 0.2491 - accuracy: 0.8559  
Epoch 160: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 804ms/step - loss: 0.2491 - accuracy: 0.8559 - val\_loss: 0.4408 - val\_accuracy: 0.7979  
Epoch 161/300  
7/7 [=====] - ETA: 0s - loss: 0.2623 - accuracy: 0.8469  
Epoch 161: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 807ms/step - loss: 0.2623 - accuracy: 0.8469 - val\_loss: 0.3665 - val\_accuracy: 0.8446  
Epoch 162/300  
7/7 [=====] - ETA: 0s - loss: 0.2489 - accuracy: 0.8436  
Epoch 162: val\_accuracy did not improve from 0.85492  
7/7 [=====] - 6s 854ms/step - loss: 0.2489 - accuracy: 0.8436 - val\_loss: 0.3810 - val\_accuracy: 0.8394  
Epoch 163/300  
7/7 [=====] - ETA: 0s - loss: 0.2702 - accuracy: 0.8324  
Epoch 163: val\_accuracy improved from 0.85492 to 0.86010, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 823ms/step - loss: 0.2702 - accuracy: 0.8324 - val\_loss: 0.3472 - val\_accuracy: 0.8601  
Epoch 164/300  
7/7 [=====] - ETA: 0s - loss: 0.2115 - accuracy: 0.8704  
Epoch 164: val\_accuracy did not improve from 0.86010  
7/7 [=====] - 5s 798ms/step - loss: 0.2115 - accuracy: 0.8704 - val\_loss: 0.3456 - val\_accuracy: 0.8290  
Epoch 165/300  
7/7 [=====] - ETA: 0s - loss: 0.2195 - accuracy: 0.8480  
Epoch 165: val\_accuracy improved from 0.86010 to 0.87565, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 821ms/step - loss: 0.2195 - accuracy: 0.8480 - val\_loss: 0.3339 - val\_accuracy: 0.8756  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.2150 - accuracy: 0.8715  
Epoch 166: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 808ms/step - loss: 0.2150 - accuracy: 0.8715 - val\_loss: 0.4052 - val\_accuracy: 0.7979  
Epoch 167/300  
7/7 [=====] - ETA: 0s - loss: 0.2406 - accuracy: 0.8447  
Epoch 167: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 813ms/step - loss: 0.2406 - accuracy: 0.8447 - val\_loss: 0.3494 - val\_accuracy: 0.8549  
Epoch 168/300  
7/7 [=====] - ETA: 0s - loss: 0.2443 - accuracy: 0.8492  
Epoch 168: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 803ms/step - loss: 0.2443 - accuracy: 0.8492 - val\_loss: 0.4533 - val\_accuracy: 0.7617  
Epoch 169/300  
7/7 [=====] - ETA: 0s - loss: 0.2230 - accuracy: 0.8592  
Epoch 169: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 812ms/step - loss: 0.2230 - accuracy: 0.8592 - val\_loss: 0.4017 - val\_accuracy: 0.8290  
Epoch 170/300  
7/7 [=====] - ETA: 0s - loss: 0.2546 - accuracy: 0.8413  
Epoch 170: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 799ms/step - loss: 0.2546 - accuracy: 0.8413 - val\_loss: 0.5617 - val\_accuracy: 0.7254  
Epoch 171/300  
7/7 [=====] - ETA: 0s - loss: 0.2843 - accuracy: 0.8145  
Epoch 171: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 5s 797ms/step - loss: 0.2843 - accuracy: 0.8145 - val\_loss: 0.4386 - val\_accuracy: 0.7876  
Epoch 172/300  
7/7 [=====] - ETA: 0s - loss: 0.2105 - accuracy: 0.8905  
Epoch 172: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 810ms/step - loss: 0.2105 - accuracy: 0.8905 - val\_loss: 0.3918 - val\_accuracy: 0.8031  
Epoch 173/300  
7/7 [=====] - ETA: 0s - loss: 0.2144 - accuracy: 0.8648  
Epoch 173: val\_accuracy did not improve from 0.87565

7/7 [=====] - 6s 798ms/step - loss: 0.2144 - accuracy: 0.8648 - val\_loss: 0.3425 - val\_accuracy: 0.8394  
Epoch 174/300  
7/7 [=====] - ETA: 0s - loss: 0.2206 - accuracy: 0.8927  
Epoch 174: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 817ms/step - loss: 0.2206 - accuracy: 0.8927 - val\_loss: 0.3664 - val\_accuracy: 0.8083  
Epoch 175/300  
7/7 [=====] - ETA: 0s - loss: 0.2369 - accuracy: 0.8425  
Epoch 175: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 8s 1s/step - loss: 0.2369 - accuracy: 0.8425 - val\_loss: 0.3589 - val\_accuracy: 0.8394  
Epoch 176/300  
7/7 [=====] - ETA: 0s - loss: 0.2267 - accuracy: 0.8603  
Epoch 176: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 799ms/step - loss: 0.2267 - accuracy: 0.8603 - val\_loss: 0.3882 - val\_accuracy: 0.8549  
Epoch 177/300  
7/7 [=====] - ETA: 0s - loss: 0.2742 - accuracy: 0.8335  
Epoch 177: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 5s 792ms/step - loss: 0.2742 - accuracy: 0.8335 - val\_loss: 0.3816 - val\_accuracy: 0.8497  
Epoch 178/300  
7/7 [=====] - ETA: 0s - loss: 0.3176 - accuracy: 0.8279  
Epoch 178: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 812ms/step - loss: 0.3176 - accuracy: 0.8279 - val\_loss: 0.5222 - val\_accuracy: 0.7358  
Epoch 179/300  
7/7 [=====] - ETA: 0s - loss: 0.2572 - accuracy: 0.8380  
Epoch 179: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 801ms/step - loss: 0.2572 - accuracy: 0.8380 - val\_loss: 0.7033 - val\_accuracy: 0.6788  
Epoch 180/300  
7/7 [=====] - ETA: 0s - loss: 0.2299 - accuracy: 0.8458  
Epoch 180: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 798ms/step - loss: 0.2299 - accuracy: 0.8458 - val\_loss: 0.3917 - val\_accuracy: 0.7927  
Epoch 181/300  
7/7 [=====] - ETA: 0s - loss: 0.2608 - accuracy: 0.8268  
Epoch 181: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 815ms/step - loss: 0.2608 - accuracy: 0.8268 - val\_loss: 0.3265 - val\_accuracy: 0.8653  
Epoch 182/300  
7/7 [=====] - ETA: 0s - loss: 0.2221 - accuracy: 0.8346  
Epoch 182: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 810ms/step - loss: 0.2221 - accuracy: 0.8346 - val\_loss: 0.3454 - val\_accuracy: 0.8497  
Epoch 183/300  
7/7 [=====] - ETA: 0s - loss: 0.1985 - accuracy: 0.8849  
Epoch 183: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 792ms/step - loss: 0.1985 - accuracy: 0.8849 - val\_loss: 0.3894 - val\_accuracy: 0.8238  
Epoch 184/300  
7/7 [=====] - ETA: 0s - loss: 0.1643 - accuracy: 0.9039  
Epoch 184: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 798ms/step - loss: 0.1643 - accuracy: 0.9039 - val\_loss: 0.3594 - val\_accuracy: 0.8342  
Epoch 185/300  
7/7 [=====] - ETA: 0s - loss: 0.2006 - accuracy: 0.8715  
Epoch 185: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 805ms/step - loss: 0.2006 - accuracy: 0.8715 - val\_loss: 0.2990 - val\_accuracy: 0.8705  
Epoch 186/300  
7/7 [=====] - ETA: 0s - loss: 0.1816 - accuracy: 0.8749  
Epoch 186: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 812ms/step - loss: 0.1816 - accuracy: 0.8749 - val\_loss: 0.3136 - val\_accuracy: 0.8653  
Epoch 187/300  
7/7 [=====] - ETA: 0s - loss: 0.2408 - accuracy: 0.8682  
Epoch 187: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 817ms/step - loss: 0.2408 - accuracy: 0.8682 - val\_loss: 0.3616 - val\_accuracy: 0.8705  
Epoch 188/300  
7/7 [=====] - ETA: 0s - loss: 0.2311 - accuracy: 0.8916  
Epoch 188: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 808ms/step - loss: 0.2311 - accuracy: 0.8916 - val\_loss: 0.4740 - val\_accuracy: 0.7720  
Epoch 189/300  
7/7 [=====] - ETA: 0s - loss: 0.2280 - accuracy: 0.8704  
Epoch 189: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 810ms/step - loss: 0.2280 - accuracy: 0.8704 - val\_loss: 0.4162 - val\_accuracy: 0.8031  
Epoch 190/300

7/7 [=====] - ETA: 0s - loss: 0.1877 - accuracy: 0.8838  
Epoch 190: val\_accuracy did not improve from 0.87565  
7/7 [=====] - 6s 813ms/step - loss: 0.1877 - accuracy: 0.8838 - val\_loss: 0.3530 - val\_accuracy: 0.8601  
Epoch 191/300  
7/7 [=====] - ETA: 0s - loss: 0.1774 - accuracy: 0.8872  
Epoch 191: val\_accuracy improved from 0.87565 to 0.88083, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 819ms/step - loss: 0.1774 - accuracy: 0.8872 - val\_loss: 0.2907 - val\_accuracy: 0.8808  
Epoch 192/300  
7/7 [=====] - ETA: 0s - loss: 0.1775 - accuracy: 0.8872  
Epoch 192: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 812ms/step - loss: 0.1775 - accuracy: 0.8872 - val\_loss: 0.2988 - val\_accuracy: 0.8653  
Epoch 193/300  
7/7 [=====] - ETA: 0s - loss: 0.1736 - accuracy: 0.8994  
Epoch 193: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 809ms/step - loss: 0.1736 - accuracy: 0.8994 - val\_loss: 0.3444 - val\_accuracy: 0.8497  
Epoch 194/300  
7/7 [=====] - ETA: 0s - loss: 0.1695 - accuracy: 0.9017  
Epoch 194: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 811ms/step - loss: 0.1695 - accuracy: 0.9017 - val\_loss: 0.3587 - val\_accuracy: 0.8601  
Epoch 195/300  
7/7 [=====] - ETA: 0s - loss: 0.1577 - accuracy: 0.9128  
Epoch 195: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 815ms/step - loss: 0.1577 - accuracy: 0.9128 - val\_loss: 0.3259 - val\_accuracy: 0.8497  
Epoch 196/300  
7/7 [=====] - ETA: 0s - loss: 0.1630 - accuracy: 0.8972  
Epoch 196: val\_accuracy did not improve from 0.88083  
7/7 [=====] - 6s 824ms/step - loss: 0.1630 - accuracy: 0.8972 - val\_loss: 0.3241 - val\_accuracy: 0.8497  
Epoch 197/300  
7/7 [=====] - ETA: 0s - loss: 0.1654 - accuracy: 0.9017  
Epoch 197: val\_accuracy improved from 0.88083 to 0.88601, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 824ms/step - loss: 0.1654 - accuracy: 0.9017 - val\_loss: 0.3091 - val\_accuracy: 0.8860  
Epoch 198/300  
7/7 [=====] - ETA: 0s - loss: 0.1548 - accuracy: 0.9073  
Epoch 198: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 812ms/step - loss: 0.1548 - accuracy: 0.9073 - val\_loss: 0.2818 - val\_accuracy: 0.8808  
Epoch 199/300  
7/7 [=====] - ETA: 0s - loss: 0.1673 - accuracy: 0.8883  
Epoch 199: val\_accuracy did not improve from 0.88601  
7/7 [=====] - 6s 814ms/step - loss: 0.1673 - accuracy: 0.8883 - val\_loss: 0.2915 - val\_accuracy: 0.8860  
Epoch 200/300  
7/7 [=====] - ETA: 0s - loss: 0.1703 - accuracy: 0.8950  
Epoch 200: val\_accuracy improved from 0.88601 to 0.89637, saving model to /content/weights.best.hdf5  
7/7 [=====] - 7s 1s/step - loss: 0.1703 - accuracy: 0.8950 - val\_loss: 0.2914 - val\_accuracy: 0.8964  
Epoch 201/300  
7/7 [=====] - ETA: 0s - loss: 0.1400 - accuracy: 0.9128  
Epoch 201: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 827ms/step - loss: 0.1400 - accuracy: 0.9128 - val\_loss: 0.3278 - val\_accuracy: 0.8238  
Epoch 202/300  
7/7 [=====] - ETA: 0s - loss: 0.1520 - accuracy: 0.8983  
Epoch 202: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 802ms/step - loss: 0.1520 - accuracy: 0.8983 - val\_loss: 0.3984 - val\_accuracy: 0.7824  
Epoch 203/300  
7/7 [=====] - ETA: 0s - loss: 0.1412 - accuracy: 0.9151  
Epoch 203: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 807ms/step - loss: 0.1412 - accuracy: 0.9151 - val\_loss: 0.3653 - val\_accuracy: 0.8394  
Epoch 204/300  
7/7 [=====] - ETA: 0s - loss: 0.1480 - accuracy: 0.8972  
Epoch 204: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 809ms/step - loss: 0.1480 - accuracy: 0.8972 - val\_loss: 0.3559 - val\_accuracy: 0.8394  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.1367 - accuracy: 0.9173  
Epoch 205: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 797ms/step - loss: 0.1367 - accuracy: 0.9173 - val\_loss: 0.3509 - val\_accuracy: 0.8238  
Epoch 206/300  
7/7 [=====] - ETA: 0s - loss: 0.1353 - accuracy: 0.9106  
Epoch 206: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 813ms/step - loss: 0.1353 - accuracy: 0.9106 - val\_loss: 0

.3803 - val\_accuracy: 0.8187  
Epoch 207/300  
7/7 [=====] - ETA: 0s - loss: 0.1499 - accuracy: 0.9028  
Epoch 207: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 818ms/step - loss: 0.1499 - accuracy: 0.9028 - val\_loss: 0  
.2876 - val\_accuracy: 0.8756  
Epoch 208/300  
7/7 [=====] - ETA: 0s - loss: 0.1314 - accuracy: 0.9285  
Epoch 208: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 802ms/step - loss: 0.1314 - accuracy: 0.9285 - val\_loss: 0  
.3363 - val\_accuracy: 0.8446  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.1439 - accuracy: 0.9095  
Epoch 209: val\_accuracy did not improve from 0.89637  
7/7 [=====] - 6s 813ms/step - loss: 0.1439 - accuracy: 0.9095 - val\_loss: 0  
.2921 - val\_accuracy: 0.8912  
Epoch 210/300  
7/7 [=====] - ETA: 0s - loss: 0.1429 - accuracy: 0.9084  
Epoch 210: val\_accuracy improved from 0.89637 to 0.90155, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 804ms/step - loss: 0.1429 - accuracy: 0.9084 - val\_loss: 0  
.2850 - val\_accuracy: 0.9016  
Epoch 211/300  
7/7 [=====] - ETA: 0s - loss: 0.1341 - accuracy: 0.9218  
Epoch 211: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 798ms/step - loss: 0.1341 - accuracy: 0.9218 - val\_loss: 0  
.3207 - val\_accuracy: 0.8705  
Epoch 212/300  
7/7 [=====] - ETA: 0s - loss: 0.1287 - accuracy: 0.9207  
Epoch 212: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 801ms/step - loss: 0.1287 - accuracy: 0.9207 - val\_loss: 0  
.2537 - val\_accuracy: 0.8912  
Epoch 213/300  
7/7 [=====] - ETA: 0s - loss: 0.1068 - accuracy: 0.9453  
Epoch 213: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 813ms/step - loss: 0.1068 - accuracy: 0.9453 - val\_loss: 0  
.2993 - val\_accuracy: 0.8860  
Epoch 214/300  
7/7 [=====] - ETA: 0s - loss: 0.1224 - accuracy: 0.9173  
Epoch 214: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 812ms/step - loss: 0.1224 - accuracy: 0.9173 - val\_loss: 0  
.3154 - val\_accuracy: 0.8653  
Epoch 215/300  
7/7 [=====] - ETA: 0s - loss: 0.1295 - accuracy: 0.9274  
Epoch 215: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 824ms/step - loss: 0.1295 - accuracy: 0.9274 - val\_loss: 0  
.4188 - val\_accuracy: 0.8238  
Epoch 216/300  
7/7 [=====] - ETA: 0s - loss: 0.1429 - accuracy: 0.9207  
Epoch 216: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 820ms/step - loss: 0.1429 - accuracy: 0.9207 - val\_loss: 0  
.3932 - val\_accuracy: 0.8446  
Epoch 217/300  
7/7 [=====] - ETA: 0s - loss: 0.1511 - accuracy: 0.9039  
Epoch 217: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 799ms/step - loss: 0.1511 - accuracy: 0.9039 - val\_loss: 0  
.4248 - val\_accuracy: 0.8238  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.1367 - accuracy: 0.9240  
Epoch 218: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 815ms/step - loss: 0.1367 - accuracy: 0.9240 - val\_loss: 0  
.3452 - val\_accuracy: 0.8653  
Epoch 219/300  
7/7 [=====] - ETA: 0s - loss: 0.1515 - accuracy: 0.9140  
Epoch 219: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 810ms/step - loss: 0.1515 - accuracy: 0.9140 - val\_loss: 0  
.3094 - val\_accuracy: 0.8601  
Epoch 220/300  
7/7 [=====] - ETA: 0s - loss: 0.1306 - accuracy: 0.9095  
Epoch 220: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 816ms/step - loss: 0.1306 - accuracy: 0.9095 - val\_loss: 0  
.3209 - val\_accuracy: 0.8756  
Epoch 221/300  
7/7 [=====] - ETA: 0s - loss: 0.1039 - accuracy: 0.9385  
Epoch 221: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 794ms/step - loss: 0.1039 - accuracy: 0.9385 - val\_loss: 0  
.2953 - val\_accuracy: 0.8705  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.1102 - accuracy: 0.9408  
Epoch 222: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 802ms/step - loss: 0.1102 - accuracy: 0.9408 - val\_loss: 0  
.3469 - val\_accuracy: 0.8290  
Epoch 223/300  
7/7 [=====] - ETA: 0s - loss: 0.1299 - accuracy: 0.9330



Epoch 223: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 809ms/step - loss: 0.1299 - accuracy: 0.9330 - val\_loss: 0.3232 - val\_accuracy: 0.8601  
Epoch 224/300  
7/7 [=====] - ETA: 0s - loss: 0.1430 - accuracy: 0.9229  
Epoch 224: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 806ms/step - loss: 0.1430 - accuracy: 0.9229 - val\_loss: 0.3279 - val\_accuracy: 0.8601  
Epoch 225/300  
7/7 [=====] - ETA: 0s - loss: 0.1218 - accuracy: 0.9296  
Epoch 225: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 806ms/step - loss: 0.1218 - accuracy: 0.9296 - val\_loss: 0.2925 - val\_accuracy: 0.9016  
Epoch 226/300  
7/7 [=====] - ETA: 0s - loss: 0.0867 - accuracy: 0.9441  
Epoch 226: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 824ms/step - loss: 0.0867 - accuracy: 0.9441 - val\_loss: 0.2803 - val\_accuracy: 0.8860  
Epoch 227/300  
7/7 [=====] - ETA: 0s - loss: 0.0867 - accuracy: 0.9453  
Epoch 227: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 8s 1s/step - loss: 0.0867 - accuracy: 0.9453 - val\_loss: 0.2750 - val\_accuracy: 0.8860  
Epoch 228/300  
7/7 [=====] - ETA: 0s - loss: 0.0850 - accuracy: 0.9497  
Epoch 228: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 814ms/step - loss: 0.0850 - accuracy: 0.9497 - val\_loss: 0.2606 - val\_accuracy: 0.8860  
Epoch 229/300  
7/7 [=====] - ETA: 0s - loss: 0.0925 - accuracy: 0.9430  
Epoch 229: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 819ms/step - loss: 0.0925 - accuracy: 0.9430 - val\_loss: 0.2703 - val\_accuracy: 0.8860  
Epoch 230/300  
7/7 [=====] - ETA: 0s - loss: 0.0730 - accuracy: 0.9564  
Epoch 230: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 805ms/step - loss: 0.0730 - accuracy: 0.9564 - val\_loss: 0.2771 - val\_accuracy: 0.8860  
Epoch 231/300  
7/7 [=====] - ETA: 0s - loss: 0.0926 - accuracy: 0.9508  
Epoch 231: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 816ms/step - loss: 0.0926 - accuracy: 0.9508 - val\_loss: 0.3016 - val\_accuracy: 0.8808  
Epoch 232/300  
7/7 [=====] - ETA: 0s - loss: 0.1071 - accuracy: 0.9352  
Epoch 232: val\_accuracy did not improve from 0.90155  
7/7 [=====] - 6s 810ms/step - loss: 0.1071 - accuracy: 0.9352 - val\_loss: 0.3058 - val\_accuracy: 0.8756  
Epoch 233/300  
7/7 [=====] - ETA: 0s - loss: 0.1110 - accuracy: 0.9341  
Epoch 233: val\_accuracy improved from 0.90155 to 0.90674, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 824ms/step - loss: 0.1110 - accuracy: 0.9341 - val\_loss: 0.2554 - val\_accuracy: 0.9067  
Epoch 234/300  
7/7 [=====] - ETA: 0s - loss: 0.0928 - accuracy: 0.9464  
Epoch 234: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 812ms/step - loss: 0.0928 - accuracy: 0.9464 - val\_loss: 0.3163 - val\_accuracy: 0.8653  
Epoch 235/300  
7/7 [=====] - ETA: 0s - loss: 0.0949 - accuracy: 0.9419  
Epoch 235: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 814ms/step - loss: 0.0949 - accuracy: 0.9419 - val\_loss: 0.2910 - val\_accuracy: 0.8705  
Epoch 236/300  
7/7 [=====] - ETA: 0s - loss: 0.0847 - accuracy: 0.9520  
Epoch 236: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 811ms/step - loss: 0.0847 - accuracy: 0.9520 - val\_loss: 0.3229 - val\_accuracy: 0.8497  
Epoch 237/300  
7/7 [=====] - ETA: 0s - loss: 0.0817 - accuracy: 0.9587  
Epoch 237: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 818ms/step - loss: 0.0817 - accuracy: 0.9587 - val\_loss: 0.3509 - val\_accuracy: 0.8394  
Epoch 238/300  
7/7 [=====] - ETA: 0s - loss: 0.1095 - accuracy: 0.9352  
Epoch 238: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 823ms/step - loss: 0.1095 - accuracy: 0.9352 - val\_loss: 0.2927 - val\_accuracy: 0.8549  
Epoch 239/300  
7/7 [=====] - ETA: 0s - loss: 0.1048 - accuracy: 0.9307  
Epoch 239: val\_accuracy did not improve from 0.90674  
7/7 [=====] - 6s 813ms/step - loss: 0.1048 - accuracy: 0.9307 - val\_loss: 0.2931 - val\_accuracy: 0.8756

Epoch 240/300  
7/7 [=====] - ETA: 0s - loss: 0.0789 - accuracy: 0.9486  
Epoch 240: val\_accuracy improved from 0.90674 to 0.91192, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 823ms/step - loss: 0.0789 - accuracy: 0.9486 - val\_loss: 0.2610 - val\_accuracy: 0.9119  
Epoch 241/300  
7/7 [=====] - ETA: 0s - loss: 0.1359 - accuracy: 0.9251  
Epoch 241: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 822ms/step - loss: 0.1359 - accuracy: 0.9251 - val\_loss: 0.3252 - val\_accuracy: 0.8705  
Epoch 242/300  
7/7 [=====] - ETA: 0s - loss: 0.1105 - accuracy: 0.9151  
Epoch 242: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 805ms/step - loss: 0.1105 - accuracy: 0.9151 - val\_loss: 0.3935 - val\_accuracy: 0.8342  
Epoch 243/300  
7/7 [=====] - ETA: 0s - loss: 0.0914 - accuracy: 0.9531  
Epoch 243: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 822ms/step - loss: 0.0914 - accuracy: 0.9531 - val\_loss: 0.3005 - val\_accuracy: 0.8808  
Epoch 244/300  
7/7 [=====] - ETA: 0s - loss: 0.1032 - accuracy: 0.9374  
Epoch 244: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 817ms/step - loss: 0.1032 - accuracy: 0.9374 - val\_loss: 0.3238 - val\_accuracy: 0.8808  
Epoch 245/300  
7/7 [=====] - ETA: 0s - loss: 0.1052 - accuracy: 0.9285  
Epoch 245: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 817ms/step - loss: 0.1052 - accuracy: 0.9285 - val\_loss: 0.2817 - val\_accuracy: 0.8808  
Epoch 246/300  
7/7 [=====] - ETA: 0s - loss: 0.1069 - accuracy: 0.9285  
Epoch 246: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 808ms/step - loss: 0.1069 - accuracy: 0.9285 - val\_loss: 0.2644 - val\_accuracy: 0.8912  
Epoch 247/300  
7/7 [=====] - ETA: 0s - loss: 0.1085 - accuracy: 0.9318  
Epoch 247: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 824ms/step - loss: 0.1085 - accuracy: 0.9318 - val\_loss: 0.3031 - val\_accuracy: 0.8446  
Epoch 248/300  
7/7 [=====] - ETA: 0s - loss: 0.0951 - accuracy: 0.9441  
Epoch 248: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 803ms/step - loss: 0.0951 - accuracy: 0.9441 - val\_loss: 0.3895 - val\_accuracy: 0.8238  
Epoch 249/300  
7/7 [=====] - ETA: 0s - loss: 0.1434 - accuracy: 0.9106  
Epoch 249: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 814ms/step - loss: 0.1434 - accuracy: 0.9106 - val\_loss: 0.4866 - val\_accuracy: 0.7772  
Epoch 250/300  
7/7 [=====] - ETA: 0s - loss: 0.1083 - accuracy: 0.9408  
Epoch 250: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 820ms/step - loss: 0.1083 - accuracy: 0.9408 - val\_loss: 0.3540 - val\_accuracy: 0.8446  
Epoch 251/300  
7/7 [=====] - ETA: 0s - loss: 0.0947 - accuracy: 0.9374  
Epoch 251: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 799ms/step - loss: 0.0947 - accuracy: 0.9374 - val\_loss: 0.3289 - val\_accuracy: 0.8446  
Epoch 252/300  
7/7 [=====] - ETA: 0s - loss: 0.0824 - accuracy: 0.9564  
Epoch 252: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 8s 1s/step - loss: 0.0824 - accuracy: 0.9564 - val\_loss: 0.3366 - val\_accuracy: 0.8394  
Epoch 253/300  
7/7 [=====] - ETA: 0s - loss: 0.0834 - accuracy: 0.9419  
Epoch 253: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 815ms/step - loss: 0.0834 - accuracy: 0.9419 - val\_loss: 0.3066 - val\_accuracy: 0.8808  
Epoch 254/300  
7/7 [=====] - ETA: 0s - loss: 0.0586 - accuracy: 0.9721  
Epoch 254: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 820ms/step - loss: 0.0586 - accuracy: 0.9721 - val\_loss: 0.3114 - val\_accuracy: 0.8964  
Epoch 255/300  
7/7 [=====] - ETA: 0s - loss: 0.0660 - accuracy: 0.9665  
Epoch 255: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 815ms/step - loss: 0.0660 - accuracy: 0.9665 - val\_loss: 0.3156 - val\_accuracy: 0.8705  
Epoch 256/300  
7/7 [=====] - ETA: 0s - loss: 0.0784 - accuracy: 0.9486  
Epoch 256: val\_accuracy did not improve from 0.91192

7/7 [=====] - 6s 820ms/step - loss: 0.0784 - accuracy: 0.9486 - val\_loss: 0  
.2712 - val\_accuracy: 0.8860  
Epoch 257/300  
7/7 [=====] - ETA: 0s - loss: 0.0794 - accuracy: 0.9553  
Epoch 257: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 807ms/step - loss: 0.0794 - accuracy: 0.9553 - val\_loss: 0  
.3026 - val\_accuracy: 0.9016  
Epoch 258/300  
7/7 [=====] - ETA: 0s - loss: 0.1021 - accuracy: 0.9285  
Epoch 258: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 807ms/step - loss: 0.1021 - accuracy: 0.9285 - val\_loss: 0  
.2906 - val\_accuracy: 0.8808  
Epoch 259/300  
7/7 [=====] - ETA: 0s - loss: 0.0689 - accuracy: 0.9531  
Epoch 259: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 811ms/step - loss: 0.0689 - accuracy: 0.9531 - val\_loss: 0  
.3181 - val\_accuracy: 0.8549  
Epoch 260/300  
7/7 [=====] - ETA: 0s - loss: 0.0727 - accuracy: 0.9620  
Epoch 260: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 814ms/step - loss: 0.0727 - accuracy: 0.9620 - val\_loss: 0  
.3159 - val\_accuracy: 0.8653  
Epoch 261/300  
7/7 [=====] - ETA: 0s - loss: 0.0682 - accuracy: 0.9642  
Epoch 261: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 818ms/step - loss: 0.0682 - accuracy: 0.9642 - val\_loss: 0  
.3417 - val\_accuracy: 0.8653  
Epoch 262/300  
7/7 [=====] - ETA: 0s - loss: 0.0768 - accuracy: 0.9587  
Epoch 262: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 809ms/step - loss: 0.0768 - accuracy: 0.9587 - val\_loss: 0  
.3934 - val\_accuracy: 0.8238  
Epoch 263/300  
7/7 [=====] - ETA: 0s - loss: 0.1001 - accuracy: 0.9385  
Epoch 263: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 822ms/step - loss: 0.1001 - accuracy: 0.9385 - val\_loss: 0  
.2874 - val\_accuracy: 0.8912  
Epoch 264/300  
7/7 [=====] - ETA: 0s - loss: 0.0885 - accuracy: 0.9520  
Epoch 264: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 816ms/step - loss: 0.0885 - accuracy: 0.9520 - val\_loss: 0  
.3500 - val\_accuracy: 0.8497  
Epoch 265/300  
7/7 [=====] - ETA: 0s - loss: 0.0576 - accuracy: 0.9665  
Epoch 265: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 818ms/step - loss: 0.0576 - accuracy: 0.9665 - val\_loss: 0  
.3130 - val\_accuracy: 0.8601  
Epoch 266/300  
7/7 [=====] - ETA: 0s - loss: 0.0583 - accuracy: 0.9654  
Epoch 266: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 816ms/step - loss: 0.0583 - accuracy: 0.9654 - val\_loss: 0  
.3303 - val\_accuracy: 0.8601  
Epoch 267/300  
7/7 [=====] - ETA: 0s - loss: 0.0552 - accuracy: 0.9732  
Epoch 267: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 806ms/step - loss: 0.0552 - accuracy: 0.9732 - val\_loss: 0  
.3004 - val\_accuracy: 0.8756  
Epoch 268/300  
7/7 [=====] - ETA: 0s - loss: 0.0522 - accuracy: 0.9676  
Epoch 268: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 813ms/step - loss: 0.0522 - accuracy: 0.9676 - val\_loss: 0  
.2720 - val\_accuracy: 0.8964  
Epoch 269/300  
7/7 [=====] - ETA: 0s - loss: 0.0520 - accuracy: 0.9743  
Epoch 269: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 826ms/step - loss: 0.0520 - accuracy: 0.9743 - val\_loss: 0  
.2421 - val\_accuracy: 0.8860  
Epoch 270/300  
7/7 [=====] - ETA: 0s - loss: 0.0639 - accuracy: 0.9687  
Epoch 270: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 815ms/step - loss: 0.0639 - accuracy: 0.9687 - val\_loss: 0  
.2821 - val\_accuracy: 0.9016  
Epoch 271/300  
7/7 [=====] - ETA: 0s - loss: 0.0435 - accuracy: 0.9821  
Epoch 271: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 806ms/step - loss: 0.0435 - accuracy: 0.9821 - val\_loss: 0  
.3159 - val\_accuracy: 0.8756  
Epoch 272/300  
7/7 [=====] - ETA: 0s - loss: 0.0851 - accuracy: 0.9441  
Epoch 272: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 801ms/step - loss: 0.0851 - accuracy: 0.9441 - val\_loss: 0  
.3663 - val\_accuracy: 0.8653  
Epoch 273/300

7/7 [=====] - ETA: 0s - loss: 0.0727 - accuracy: 0.9575  
Epoch 273: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 811ms/step - loss: 0.0727 - accuracy: 0.9575 - val\_loss: 0.4286 - val\_accuracy: 0.8342  
Epoch 274/300  
7/7 [=====] - ETA: 0s - loss: 0.0720 - accuracy: 0.9542  
Epoch 274: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 821ms/step - loss: 0.0720 - accuracy: 0.9542 - val\_loss: 0.3785 - val\_accuracy: 0.8290  
Epoch 275/300  
7/7 [=====] - ETA: 0s - loss: 0.0714 - accuracy: 0.9620  
Epoch 275: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 806ms/step - loss: 0.0714 - accuracy: 0.9620 - val\_loss: 0.3209 - val\_accuracy: 0.8601  
Epoch 276/300  
7/7 [=====] - ETA: 0s - loss: 0.0919 - accuracy: 0.9374  
Epoch 276: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 824ms/step - loss: 0.0919 - accuracy: 0.9374 - val\_loss: 0.3032 - val\_accuracy: 0.8860  
Epoch 277/300  
7/7 [=====] - ETA: 0s - loss: 0.0869 - accuracy: 0.9430  
Epoch 277: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 823ms/step - loss: 0.0869 - accuracy: 0.9430 - val\_loss: 0.2727 - val\_accuracy: 0.9016  
Epoch 278/300  
7/7 [=====] - ETA: 0s - loss: 0.0823 - accuracy: 0.9520  
Epoch 278: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 8s 1s/step - loss: 0.0823 - accuracy: 0.9520 - val\_loss: 0.2626 - val\_accuracy: 0.8912  
Epoch 279/300  
7/7 [=====] - ETA: 0s - loss: 0.0683 - accuracy: 0.9598  
Epoch 279: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 820ms/step - loss: 0.0683 - accuracy: 0.9598 - val\_loss: 0.3252 - val\_accuracy: 0.8808  
Epoch 280/300  
7/7 [=====] - ETA: 0s - loss: 0.0580 - accuracy: 0.9575  
Epoch 280: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 813ms/step - loss: 0.0580 - accuracy: 0.9575 - val\_loss: 0.4261 - val\_accuracy: 0.8342  
Epoch 281/300  
7/7 [=====] - ETA: 0s - loss: 0.0647 - accuracy: 0.9587  
Epoch 281: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 818ms/step - loss: 0.0647 - accuracy: 0.9587 - val\_loss: 0.3076 - val\_accuracy: 0.8808  
Epoch 282/300  
7/7 [=====] - ETA: 0s - loss: 0.0700 - accuracy: 0.9609  
Epoch 282: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 815ms/step - loss: 0.0700 - accuracy: 0.9609 - val\_loss: 0.2711 - val\_accuracy: 0.9067  
Epoch 283/300  
7/7 [=====] - ETA: 0s - loss: 0.0547 - accuracy: 0.9609  
Epoch 283: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 793ms/step - loss: 0.0547 - accuracy: 0.9609 - val\_loss: 0.3323 - val\_accuracy: 0.8808  
Epoch 284/300  
7/7 [=====] - ETA: 0s - loss: 0.0569 - accuracy: 0.9654  
Epoch 284: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 820ms/step - loss: 0.0569 - accuracy: 0.9654 - val\_loss: 0.3358 - val\_accuracy: 0.8601  
Epoch 285/300  
7/7 [=====] - ETA: 0s - loss: 0.0569 - accuracy: 0.9709  
Epoch 285: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 819ms/step - loss: 0.0569 - accuracy: 0.9709 - val\_loss: 0.2854 - val\_accuracy: 0.8860  
Epoch 286/300  
7/7 [=====] - ETA: 0s - loss: 0.0714 - accuracy: 0.9654  
Epoch 286: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 816ms/step - loss: 0.0714 - accuracy: 0.9654 - val\_loss: 0.3630 - val\_accuracy: 0.8756  
Epoch 287/300  
7/7 [=====] - ETA: 0s - loss: 0.0665 - accuracy: 0.9609  
Epoch 287: val\_accuracy did not improve from 0.91192  
7/7 [=====] - 6s 821ms/step - loss: 0.0665 - accuracy: 0.9609 - val\_loss: 0.3905 - val\_accuracy: 0.8549  
Epoch 288/300  
7/7 [=====] - ETA: 0s - loss: 0.0725 - accuracy: 0.9464  
Epoch 288: val\_accuracy improved from 0.91192 to 0.91710, saving model to /content/weights.best.hdf5  
7/7 [=====] - 6s 832ms/step - loss: 0.0725 - accuracy: 0.9464 - val\_loss: 0.2732 - val\_accuracy: 0.9171  
Epoch 289/300  
7/7 [=====] - ETA: 0s - loss: 0.1042 - accuracy: 0.9352  
Epoch 289: val\_accuracy did not improve from 0.91710  
7/7 [=====] - 6s 791ms/step - loss: 0.1042 - accuracy: 0.9352 - val\_loss: 0

```
.3407 - val_accuracy: 0.8964
Epoch 290/300
7/7 [=====] - ETA: 0s - loss: 0.0594 - accuracy: 0.9598
Epoch 290: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 823ms/step - loss: 0.0594 - accuracy: 0.9598 - val_loss: 0
.2562 - val_accuracy: 0.8912
Epoch 291/300
7/7 [=====] - ETA: 0s - loss: 0.0689 - accuracy: 0.9698
Epoch 291: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 815ms/step - loss: 0.0689 - accuracy: 0.9698 - val_loss: 0
.3843 - val_accuracy: 0.8290
Epoch 292/300
7/7 [=====] - ETA: 0s - loss: 0.0645 - accuracy: 0.9620
Epoch 292: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 819ms/step - loss: 0.0645 - accuracy: 0.9620 - val_loss: 0
.2982 - val_accuracy: 0.8756
Epoch 293/300
7/7 [=====] - ETA: 0s - loss: 0.0505 - accuracy: 0.9654
Epoch 293: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 813ms/step - loss: 0.0505 - accuracy: 0.9654 - val_loss: 0
.2874 - val_accuracy: 0.8808
Epoch 294/300
7/7 [=====] - ETA: 0s - loss: 0.0414 - accuracy: 0.9788
Epoch 294: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 818ms/step - loss: 0.0414 - accuracy: 0.9788 - val_loss: 0
.2763 - val_accuracy: 0.9119
Epoch 295/300
7/7 [=====] - ETA: 0s - loss: 0.0721 - accuracy: 0.9654
Epoch 295: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 812ms/step - loss: 0.0721 - accuracy: 0.9654 - val_loss: 0
.3452 - val_accuracy: 0.8497
Epoch 296/300
7/7 [=====] - ETA: 0s - loss: 0.0683 - accuracy: 0.9587
Epoch 296: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 825ms/step - loss: 0.0683 - accuracy: 0.9587 - val_loss: 0
.3538 - val_accuracy: 0.8653
Epoch 297/300
7/7 [=====] - ETA: 0s - loss: 0.0834 - accuracy: 0.9508
Epoch 297: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 805ms/step - loss: 0.0834 - accuracy: 0.9508 - val_loss: 0
.3265 - val_accuracy: 0.8912
Epoch 298/300
7/7 [=====] - ETA: 0s - loss: 0.0901 - accuracy: 0.9430
Epoch 298: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 818ms/step - loss: 0.0901 - accuracy: 0.9430 - val_loss: 0
.2989 - val_accuracy: 0.9067
Epoch 299/300
7/7 [=====] - ETA: 0s - loss: 0.0916 - accuracy: 0.9520
Epoch 299: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 812ms/step - loss: 0.0916 - accuracy: 0.9520 - val_loss: 0
.3506 - val_accuracy: 0.8601
Epoch 300/300
7/7 [=====] - ETA: 0s - loss: 0.0923 - accuracy: 0.9553
Epoch 300: val_accuracy did not improve from 0.91710
7/7 [=====] - 6s 809ms/step - loss: 0.0923 - accuracy: 0.9553 - val_loss: 0
.4284 - val_accuracy: 0.8394
Created model and loaded weights from file
```

In [268]:

```
results.loc[index,['Architecture','Dropout','Loss Fn','LR']] = ['CNN 2D',0.2, 'Cross-Entropy',0.001]
```

#### Evaluation: Training and Validation

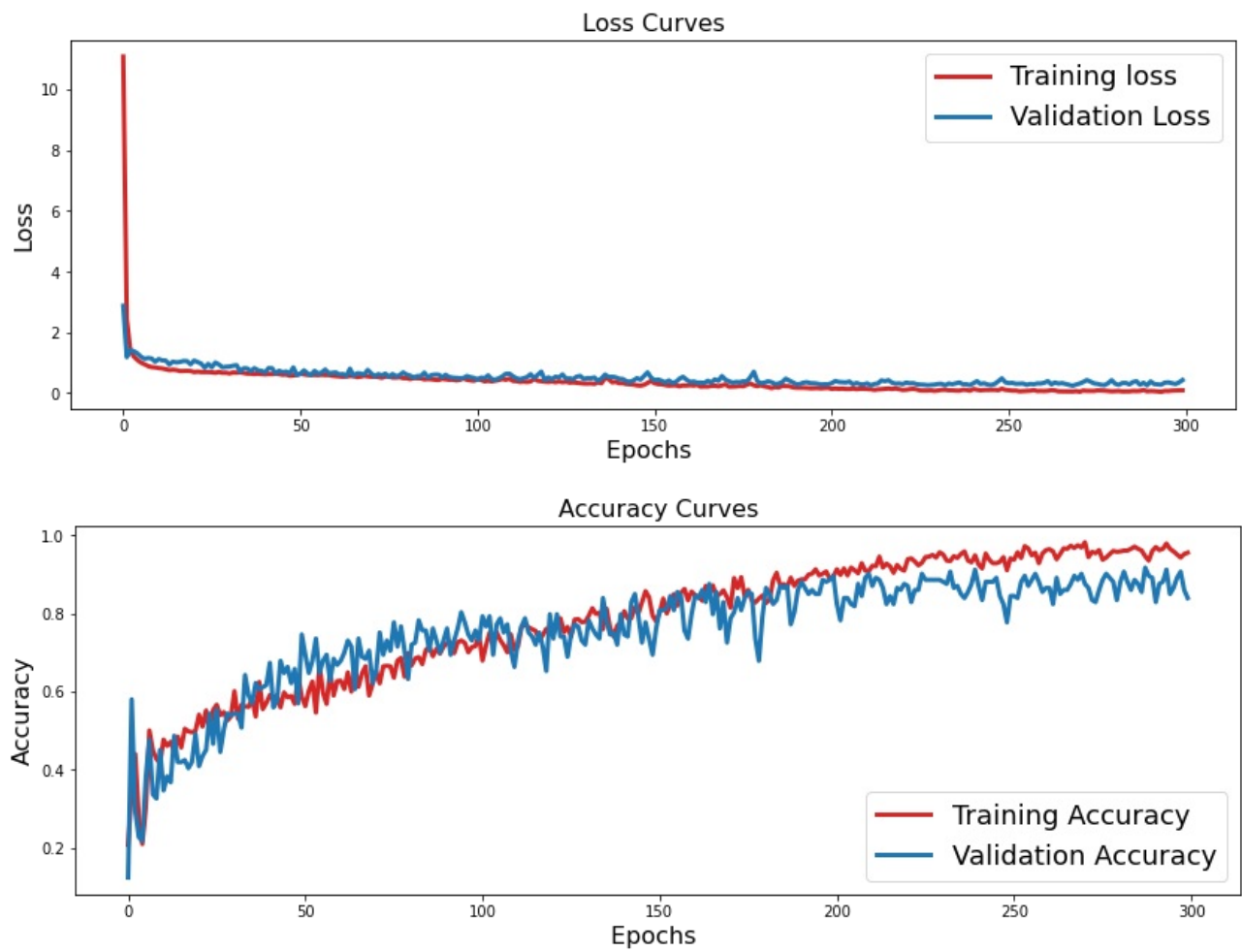
In [269]:

```
evaluation_train_val(model,x_train,y_train,x_val,y_val,results,index)
```

```
Training Accuracy: 0.994413435459137
Training Loss: 0.0216680895537138
Validation Accuracy: 0.9170984625816345
Validation Loss: 0.2732197940349579
```

In [270]:

```
plotfn(history)
```



Evaluation: Testing

In [271]:

```
evaluation_test(model,x_test,y_test,results,index)
```

7/7 [=====] - 0s 52ms/step - loss: 0.5668 - accuracy: 0.8342  
Test accuracy: 0.8341968655586243  
Test loss: 0.5668305158615112

Evaluation Metrics

F1 Score

In [272]:

```
_ , _ , _ , val_f1 = predictfn(model, x_val, y_val)
```

7/7 [=====] - 0s 50ms/step

	precision	recall	f1-score	support
extrahls	0.93	1.00	0.97	14
extrastole	0.73	0.80	0.76	10
murmur	0.85	0.96	0.90	49
normal	0.96	0.90	0.93	120
accuracy			0.92	193
macro avg	0.87	0.91	0.89	193
weighted avg	0.92	0.92	0.92	193

In [273]:

```
predictions, y_pred , y_true, test_f1 = predictfn(model,x_test,y_test)
```

7/7 [=====] - 0s 43ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.50	0.67	12
extrastole	0.38	0.83	0.53	6
murmur	0.85	0.85	0.85	59
normal	0.87	0.86	0.87	116
accuracy			0.83	193
macro avg	0.78	0.76	0.73	193
weighted avg	0.86	0.83	0.84	193

Confusion Matrix

In [274]:

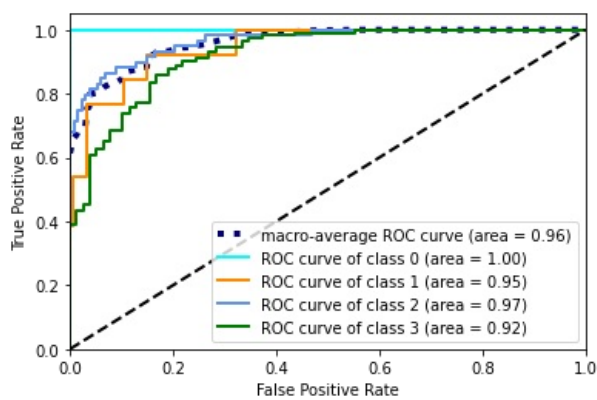
```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

In [275]:

```
roc = plot_ROC(y_test,predictions)
```



In [276]:

```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

Out[276]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547
3	CNN 2D	0.0001	0.2	KL divergence	0.984358	0.079908	0.911917	0.285003	0.797927	0.508575	0.911012	0.799109	0.958595
4	CNN 2D	0.001	0.2	Cross-Entropy	0.994413	0.021668	0.917098	0.27322	0.834197	0.566831	0.91787	0.837258	0.960526

Predicting a sample's label

In [277]:

```
model_name = "heartbeat_classifierLR1.h5"
model.save(model_name)
```

Predicting a Murmur sample

In [286]:

```
test.iloc[5]
```

Out[286]:

```
filename    /content/set_b/murmur__281_1311165683454_D.wav
label                               murmur
offset                                             3
Name: 997, dtype: object
```

In [278]:

```
sample_predict(model_name,5)
```

```
1/1 [=====] - 0s 110ms/step
Label Prediction Probabilities: [[3.7826599e-17 7.1827141e-11 9.9999940e-01 5.7285536e-07]]
-----
Label:
Murmur heartbeat
confidence: 0.9999994
```

Predicting a Normal sample

In [287]:

```
test.iloc[50]
```

Out[287]:

```
filename    /content/set_a/normal__201101151127.wav
label                               normal
offset                                             3
Name: 165, dtype: object
```

In [279]:

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 0s 128ms/step
Label Prediction Probabilities: [[7.3693432e-14 2.4881882e-07 4.0197882e-04 9.9959785e-01]]
-----
Label:
Normal heartbeat
confidence: 0.99959785
```

Predicting an Extrahls sample



In [285]:

```
test.iloc[77]
```

Out[285]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [280]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 114ms/step
Label Prediction Probabilities: [[9.9999988e-01 1.6705131e-21 4.6154835e-08 1.4859177e-07]]
-----
Label:
Extrahls heartbeat
confidence: 0.9999999
```

### ***Predicting a Extrasystole sample***

In [284]:

```
test.iloc[24]
```

Out[284]:

```
filename    /content/set_b/extrastole__191_1308077299430_A...
label                               extrastole
offset                                           7
Name: 626, dtype: object
```

In [283]:

```
sample_predict(model_name,24)
```

```
1/1 [=====] - 0s 220ms/step
Label Prediction Probabilities: [[8.3386587e-10 9.1592801e-01 6.2330805e-06 8.4065810e-02]]
-----
Label:
Extrasystole heartbeat
confidence: 0.915928
```

## **CNN Experiment 3: CONV1D**

In [288]:

```
model = Sequential()
model.add(Conv1D(filters=16, kernel_size=3, padding = 'same' ,input_shape=(x_train.shape[1],x_train.shape[2]), ac
tivation='relu'))
model.add(MaxPooling1D())
model.add(Dropout(0.2))

model.add(Conv1D(filters=32, kernel_size=3,padding = 'same' , activation='relu'))
model.add(MaxPooling1D())
model.add(Dropout(0.2))

model.add(Conv1D(filters=64, kernel_size=3,padding = 'same' , activation='relu'))
model.add(MaxPooling1D())
model.add(Dropout(0.2))

model.add(Conv1D(filters=128, kernel_size=3,padding = 'same' , activation='relu'))
model.add(MaxPooling1D())
model.add(GlobalAveragePooling1D())

model.add(Flatten())
model.add(Dense(256, activation='relu'))
model.add(Dropout(0.2))

model.add(Dense(len(encoder.classes_), activation='softmax'))
model.summary()
```

Model: "sequential\_10"

Layer (type)	Output Shape	Param #
=====		
conv1d (Conv1D)	(None, 40, 16)	6256
max_pooling1d (MaxPooling1D)	(None, 20, 16)	0
dropout_31 (Dropout)	(None, 20, 16)	0
conv1d_1 (Conv1D)	(None, 20, 32)	1568
max_pooling1d_1 (MaxPooling1D)	(None, 10, 32)	0
dropout_32 (Dropout)	(None, 10, 32)	0
conv1d_2 (Conv1D)	(None, 10, 64)	6208
max_pooling1d_2 (MaxPooling1D)	(None, 5, 64)	0
dropout_33 (Dropout)	(None, 5, 64)	0
conv1d_3 (Conv1D)	(None, 5, 128)	24704
max_pooling1d_3 (MaxPooling1D)	(None, 2, 128)	0
global_average_pooling1d (GlobalAveragePooling1D)	(None, 128)	0
flatten (Flatten)	(None, 128)	0
dense_10 (Dense)	(None, 256)	33024
dropout_34 (Dropout)	(None, 256)	0
dense_11 (Dense)	(None, 4)	1028
=====		
Total params: 72,788		
Trainable params: 72,788		
Non-trainable params: 0		

In [289]:

```
history, model = compile_fit(model)
```

Epoch 1/300  
7/7 [=====] - ETA: 0s - loss: 8.8861 - accuracy: 0.2402  
Epoch 1: val\_accuracy improved from -inf to 0.36788, saving model to /content/weights.best.hdf5  
7/7 [=====] - 2s 105ms/step - loss: 8.8861 - accuracy: 0.2402 - val\_loss: 1.5049 - val\_accuracy: 0.3679

Epoch 2/300  
7/7 [=====] - ETA: 0s - loss: 3.1817 - accuracy: 0.4156  
Epoch 2: val\_accuracy did not improve from 0.36788  
7/7 [=====] - 0s 54ms/step - loss: 3.1817 - accuracy: 0.4156 - val\_loss: 1.6522 - val\_accuracy: 0.3109  
Epoch 3/300  
6/7 [=====>.....] - ETA: 0s - loss: 2.2242 - accuracy: 0.2083  
Epoch 3: val\_accuracy did not improve from 0.36788  
7/7 [=====] - 0s 53ms/step - loss: 2.2253 - accuracy: 0.1933 - val\_loss: 1.9723 - val\_accuracy: 0.1244  
Epoch 4/300  
7/7 [=====] - ETA: 0s - loss: 1.7137 - accuracy: 0.2615  
Epoch 4: val\_accuracy improved from 0.36788 to 0.47150, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 48ms/step - loss: 1.7137 - accuracy: 0.2615 - val\_loss: 1.1729 - val\_accuracy: 0.4715  
Epoch 5/300  
7/7 [=====] - ETA: 0s - loss: 1.5329 - accuracy: 0.4313  
Epoch 5: val\_accuracy improved from 0.47150 to 0.52332, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 53ms/step - loss: 1.5329 - accuracy: 0.4313 - val\_loss: 1.1295 - val\_accuracy: 0.5233  
Epoch 6/300  
7/7 [=====] - ETA: 0s - loss: 1.2239 - accuracy: 0.3687  
Epoch 6: val\_accuracy did not improve from 0.52332  
7/7 [=====] - 0s 43ms/step - loss: 1.2239 - accuracy: 0.3687 - val\_loss: 1.1985 - val\_accuracy: 0.3264  
Epoch 7/300  
7/7 [=====] - ETA: 0s - loss: 1.2532 - accuracy: 0.3229  
Epoch 7: val\_accuracy improved from 0.52332 to 0.55959, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 58ms/step - loss: 1.2532 - accuracy: 0.3229 - val\_loss: 1.0443 - val\_accuracy: 0.5596  
Epoch 8/300  
7/7 [=====] - ETA: 0s - loss: 1.0961 - accuracy: 0.4223  
Epoch 8: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 56ms/step - loss: 1.0961 - accuracy: 0.4223 - val\_loss: 1.1333 - val\_accuracy: 0.3938  
Epoch 9/300  
6/7 [=====>.....] - ETA: 0s - loss: 1.1207 - accuracy: 0.3151  
Epoch 9: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 56ms/step - loss: 1.1184 - accuracy: 0.3173 - val\_loss: 1.2261 - val\_accuracy: 0.3264  
Epoch 10/300  
7/7 [=====] - ETA: 0s - loss: 1.1997 - accuracy: 0.3397  
Epoch 10: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 1.1997 - accuracy: 0.3397 - val\_loss: 1.1028 - val\_accuracy: 0.4508  
Epoch 11/300  
7/7 [=====] - ETA: 0s - loss: 1.0657 - accuracy: 0.3832  
Epoch 11: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 55ms/step - loss: 1.0657 - accuracy: 0.3832 - val\_loss: 1.1405 - val\_accuracy: 0.3938  
Epoch 12/300  
7/7 [=====] - ETA: 0s - loss: 1.0494 - accuracy: 0.3341  
Epoch 12: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 56ms/step - loss: 1.0494 - accuracy: 0.3341 - val\_loss: 1.1355 - val\_accuracy: 0.3886  
Epoch 13/300  
7/7 [=====] - ETA: 0s - loss: 1.0111 - accuracy: 0.3777  
Epoch 13: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 54ms/step - loss: 1.0111 - accuracy: 0.3777 - val\_loss: 1.0803 - val\_accuracy: 0.4301  
Epoch 14/300  
7/7 [=====] - ETA: 0s - loss: 1.0269 - accuracy: 0.3911  
Epoch 14: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 1.0269 - accuracy: 0.3911 - val\_loss: 1.0940 - val\_accuracy: 0.3938  
Epoch 15/300  
7/7 [=====] - ETA: 0s - loss: 0.9749 - accuracy: 0.3777  
Epoch 15: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.9749 - accuracy: 0.3777 - val\_loss: 1.1090 - val\_accuracy: 0.3679  
Epoch 16/300  
7/7 [=====] - ETA: 0s - loss: 1.0153 - accuracy: 0.3709  
Epoch 16: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 45ms/step - loss: 1.0153 - accuracy: 0.3709 - val\_loss: 1.1083 - val\_accuracy: 0.4041  
Epoch 17/300  
7/7 [=====] - ETA: 0s - loss: 0.9754 - accuracy: 0.4000  
Epoch 17: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 45ms/step - loss: 0.9754 - accuracy: 0.4000 - val\_loss: 1.0800 - val\_accuracy: 0.4093  
Epoch 18/300  
7/7 [=====] - ETA: 0s - loss: 1.0282 - accuracy: 0.3765  
Epoch 18: val\_accuracy did not improve from 0.55959

7/7 [=====] - 0s 43ms/step - loss: 1.0282 - accuracy: 0.3765 - val\_loss: 1.1088 - val\_accuracy: 0.3990  
Epoch 19/300  
7/7 [=====] - ETA: 0s - loss: 0.9755 - accuracy: 0.3587  
Epoch 19: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.9755 - accuracy: 0.3587 - val\_loss: 1.1739 - val\_accuracy: 0.3627  
Epoch 20/300  
7/7 [=====] - ETA: 0s - loss: 0.9178 - accuracy: 0.3642  
Epoch 20: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.9178 - accuracy: 0.3642 - val\_loss: 1.1071 - val\_accuracy: 0.3782  
Epoch 21/300  
7/7 [=====] - ETA: 0s - loss: 0.9879 - accuracy: 0.3810  
Epoch 21: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 46ms/step - loss: 0.9879 - accuracy: 0.3810 - val\_loss: 1.1809 - val\_accuracy: 0.3264  
Epoch 22/300  
7/7 [=====] - ETA: 0s - loss: 0.9709 - accuracy: 0.3743  
Epoch 22: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 76ms/step - loss: 0.9709 - accuracy: 0.3743 - val\_loss: 1.1030 - val\_accuracy: 0.4301  
Epoch 23/300  
7/7 [=====] - ETA: 0s - loss: 0.9495 - accuracy: 0.4000  
Epoch 23: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 62ms/step - loss: 0.9495 - accuracy: 0.4000 - val\_loss: 1.0856 - val\_accuracy: 0.4093  
Epoch 24/300  
7/7 [=====] - ETA: 0s - loss: 0.9954 - accuracy: 0.3799  
Epoch 24: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 84ms/step - loss: 0.9954 - accuracy: 0.3799 - val\_loss: 1.1392 - val\_accuracy: 0.4093  
Epoch 25/300  
7/7 [=====] - ETA: 0s - loss: 0.9513 - accuracy: 0.4179  
Epoch 25: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 84ms/step - loss: 0.9513 - accuracy: 0.4179 - val\_loss: 1.0862 - val\_accuracy: 0.4145  
Epoch 26/300  
7/7 [=====] - ETA: 0s - loss: 0.9324 - accuracy: 0.4302  
Epoch 26: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 92ms/step - loss: 0.9324 - accuracy: 0.4302 - val\_loss: 1.1247 - val\_accuracy: 0.3886  
Epoch 27/300  
7/7 [=====] - ETA: 0s - loss: 0.9199 - accuracy: 0.4045  
Epoch 27: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 91ms/step - loss: 0.9199 - accuracy: 0.4045 - val\_loss: 1.0967 - val\_accuracy: 0.4249  
Epoch 28/300  
7/7 [=====] - ETA: 0s - loss: 0.9306 - accuracy: 0.3966  
Epoch 28: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 96ms/step - loss: 0.9306 - accuracy: 0.3966 - val\_loss: 1.0404 - val\_accuracy: 0.4560  
Epoch 29/300  
7/7 [=====] - ETA: 0s - loss: 0.9270 - accuracy: 0.3944  
Epoch 29: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 79ms/step - loss: 0.9270 - accuracy: 0.3944 - val\_loss: 1.0964 - val\_accuracy: 0.4249  
Epoch 30/300  
7/7 [=====] - ETA: 0s - loss: 0.9138 - accuracy: 0.4022  
Epoch 30: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 80ms/step - loss: 0.9138 - accuracy: 0.4022 - val\_loss: 1.1817 - val\_accuracy: 0.3782  
Epoch 31/300  
7/7 [=====] - ETA: 0s - loss: 0.8991 - accuracy: 0.3922  
Epoch 31: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 83ms/step - loss: 0.8991 - accuracy: 0.3922 - val\_loss: 1.0146 - val\_accuracy: 0.4767  
Epoch 32/300  
7/7 [=====] - ETA: 0s - loss: 0.8766 - accuracy: 0.4380  
Epoch 32: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8766 - accuracy: 0.4380 - val\_loss: 1.0534 - val\_accuracy: 0.4352  
Epoch 33/300  
7/7 [=====] - ETA: 0s - loss: 0.9213 - accuracy: 0.3564  
Epoch 33: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 56ms/step - loss: 0.9213 - accuracy: 0.3564 - val\_loss: 1.1471 - val\_accuracy: 0.3523  
Epoch 34/300  
7/7 [=====] - ETA: 0s - loss: 0.9441 - accuracy: 0.4022  
Epoch 34: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.9441 - accuracy: 0.4022 - val\_loss: 1.0854 - val\_accuracy: 0.4560  
Epoch 35/300

7/7 [=====] - ETA: 0s - loss: 0.8853 - accuracy: 0.4469  
Epoch 35: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8853 - accuracy: 0.4469 - val\_loss: 1.0403 - val\_accuracy: 0.4611  
Epoch 36/300  
7/7 [=====] - ETA: 0s - loss: 0.8613 - accuracy: 0.4156  
Epoch 36: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 56ms/step - loss: 0.8613 - accuracy: 0.4156 - val\_loss: 1.1407 - val\_accuracy: 0.3834  
Epoch 37/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8521 - accuracy: 0.4180  
Epoch 37: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 54ms/step - loss: 0.8589 - accuracy: 0.4212 - val\_loss: 1.0598 - val\_accuracy: 0.4560  
Epoch 38/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.9160 - accuracy: 0.4492  
Epoch 38: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8958 - accuracy: 0.4413 - val\_loss: 1.1193 - val\_accuracy: 0.3990  
Epoch 39/300  
7/7 [=====] - ETA: 0s - loss: 0.8569 - accuracy: 0.4022  
Epoch 39: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 49ms/step - loss: 0.8569 - accuracy: 0.4022 - val\_loss: 1.0662 - val\_accuracy: 0.4404  
Epoch 40/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8416 - accuracy: 0.4284  
Epoch 40: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.8363 - accuracy: 0.4346 - val\_loss: 1.0467 - val\_accuracy: 0.4352  
Epoch 41/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8583 - accuracy: 0.4401  
Epoch 41: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.8573 - accuracy: 0.4402 - val\_loss: 1.0649 - val\_accuracy: 0.4404  
Epoch 42/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8450 - accuracy: 0.4466  
Epoch 42: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8642 - accuracy: 0.4335 - val\_loss: 1.0829 - val\_accuracy: 0.3990  
Epoch 43/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8400 - accuracy: 0.4010  
Epoch 43: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.8367 - accuracy: 0.4101 - val\_loss: 1.0417 - val\_accuracy: 0.4456  
Epoch 44/300  
7/7 [=====] - ETA: 0s - loss: 0.8569 - accuracy: 0.4201  
Epoch 44: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8569 - accuracy: 0.4201 - val\_loss: 1.0862 - val\_accuracy: 0.4041  
Epoch 45/300  
7/7 [=====] - ETA: 0s - loss: 0.8277 - accuracy: 0.4056  
Epoch 45: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 50ms/step - loss: 0.8277 - accuracy: 0.4056 - val\_loss: 1.0754 - val\_accuracy: 0.4041  
Epoch 46/300  
7/7 [=====] - ETA: 0s - loss: 0.8537 - accuracy: 0.4492  
Epoch 46: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8537 - accuracy: 0.4492 - val\_loss: 1.0708 - val\_accuracy: 0.4352  
Epoch 47/300  
7/7 [=====] - ETA: 0s - loss: 0.8285 - accuracy: 0.4436  
Epoch 47: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.8285 - accuracy: 0.4436 - val\_loss: 1.0164 - val\_accuracy: 0.4767  
Epoch 48/300  
7/7 [=====] - ETA: 0s - loss: 0.9092 - accuracy: 0.4536  
Epoch 48: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.9092 - accuracy: 0.4536 - val\_loss: 1.0719 - val\_accuracy: 0.4456  
Epoch 49/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8173 - accuracy: 0.3841  
Epoch 49: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8148 - accuracy: 0.3832 - val\_loss: 1.1809 - val\_accuracy: 0.3420  
Epoch 50/300  
7/7 [=====] - ETA: 0s - loss: 0.8614 - accuracy: 0.4257  
Epoch 50: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.8614 - accuracy: 0.4257 - val\_loss: 1.0335 - val\_accuracy: 0.4456  
Epoch 51/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8290 - accuracy: 0.4362  
Epoch 51: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 55ms/step - loss: 0.8422 - accuracy: 0.4346 - val\_loss: 1.

0289 - val\_accuracy: 0.4456  
Epoch 52/300  
7/7 [=====] - ETA: 0s - loss: 0.8318 - accuracy: 0.4380  
Epoch 52: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 46ms/step - loss: 0.8318 - accuracy: 0.4380 - val\_loss: 1.  
0317 - val\_accuracy: 0.4404  
Epoch 53/300  
7/7 [=====] - ETA: 0s - loss: 0.8234 - accuracy: 0.4469  
Epoch 53: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.8234 - accuracy: 0.4469 - val\_loss: 1.  
0008 - val\_accuracy: 0.4870  
Epoch 54/300  
7/7 [=====] - ETA: 0s - loss: 0.8304 - accuracy: 0.4112  
Epoch 54: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.8304 - accuracy: 0.4112 - val\_loss: 1.  
0640 - val\_accuracy: 0.4301  
Epoch 55/300  
7/7 [=====] - ETA: 0s - loss: 0.8172 - accuracy: 0.4436  
Epoch 55: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.8172 - accuracy: 0.4436 - val\_loss: 0.  
9863 - val\_accuracy: 0.4819  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.7797 - accuracy: 0.4536  
Epoch 56: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.7797 - accuracy: 0.4536 - val\_loss: 1.  
0780 - val\_accuracy: 0.4145  
Epoch 57/300  
7/7 [=====] - ETA: 0s - loss: 0.7980 - accuracy: 0.4279  
Epoch 57: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.7980 - accuracy: 0.4279 - val\_loss: 1.  
0017 - val\_accuracy: 0.4819  
Epoch 58/300  
7/7 [=====] - ETA: 0s - loss: 0.7846 - accuracy: 0.4469  
Epoch 58: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 47ms/step - loss: 0.7846 - accuracy: 0.4469 - val\_loss: 1.  
0243 - val\_accuracy: 0.4819  
Epoch 59/300  
7/7 [=====] - ETA: 0s - loss: 0.7953 - accuracy: 0.4592  
Epoch 59: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 58ms/step - loss: 0.7953 - accuracy: 0.4592 - val\_loss: 1.  
0068 - val\_accuracy: 0.4819  
Epoch 60/300  
7/7 [=====] - ETA: 0s - loss: 0.8048 - accuracy: 0.4447  
Epoch 60: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 58ms/step - loss: 0.8048 - accuracy: 0.4447 - val\_loss: 1.  
0827 - val\_accuracy: 0.4301  
Epoch 61/300  
7/7 [=====] - ETA: 0s - loss: 0.7466 - accuracy: 0.4503  
Epoch 61: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 47ms/step - loss: 0.7466 - accuracy: 0.4503 - val\_loss: 1.  
0576 - val\_accuracy: 0.4301  
Epoch 62/300  
7/7 [=====] - ETA: 0s - loss: 0.7667 - accuracy: 0.4682  
Epoch 62: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7667 - accuracy: 0.4682 - val\_loss: 1.  
0153 - val\_accuracy: 0.4819  
Epoch 63/300  
7/7 [=====] - ETA: 0s - loss: 0.7458 - accuracy: 0.4983  
Epoch 63: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.7458 - accuracy: 0.4983 - val\_loss: 1.  
0324 - val\_accuracy: 0.4611  
Epoch 64/300  
7/7 [=====] - ETA: 0s - loss: 0.7839 - accuracy: 0.4358  
Epoch 64: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7839 - accuracy: 0.4358 - val\_loss: 1.  
1859 - val\_accuracy: 0.3834  
Epoch 65/300  
7/7 [=====] - ETA: 0s - loss: 0.8116 - accuracy: 0.4246  
Epoch 65: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 45ms/step - loss: 0.8116 - accuracy: 0.4246 - val\_loss: 1.  
0640 - val\_accuracy: 0.4301  
Epoch 66/300  
7/7 [=====] - ETA: 0s - loss: 0.7501 - accuracy: 0.4682  
Epoch 66: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 46ms/step - loss: 0.7501 - accuracy: 0.4682 - val\_loss: 1.  
0658 - val\_accuracy: 0.4301  
Epoch 67/300  
7/7 [=====] - ETA: 0s - loss: 0.7694 - accuracy: 0.4380  
Epoch 67: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7694 - accuracy: 0.4380 - val\_loss: 1.  
0835 - val\_accuracy: 0.4249  
Epoch 68/300  
7/7 [=====] - ETA: 0s - loss: 0.7517 - accuracy: 0.4670

Epoch 68: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7517 - accuracy: 0.4670 - val\_loss: 1.0874 - val\_accuracy: 0.4352  
Epoch 69/300  
7/7 [=====] - ETA: 0s - loss: 0.7862 - accuracy: 0.4894  
Epoch 69: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.7862 - accuracy: 0.4894 - val\_loss: 1.1072 - val\_accuracy: 0.4197  
Epoch 70/300  
7/7 [=====] - ETA: 0s - loss: 0.8051 - accuracy: 0.4816  
Epoch 70: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.8051 - accuracy: 0.4816 - val\_loss: 1.0454 - val\_accuracy: 0.4456  
Epoch 71/300  
7/7 [=====] - ETA: 0s - loss: 0.7986 - accuracy: 0.4402  
Epoch 71: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.7986 - accuracy: 0.4402 - val\_loss: 1.0054 - val\_accuracy: 0.4715  
Epoch 72/300  
7/7 [=====] - ETA: 0s - loss: 0.7893 - accuracy: 0.4682  
Epoch 72: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.7893 - accuracy: 0.4682 - val\_loss: 1.0304 - val\_accuracy: 0.4715  
Epoch 73/300  
7/7 [=====] - ETA: 0s - loss: 0.8236 - accuracy: 0.4413  
Epoch 73: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 42ms/step - loss: 0.8236 - accuracy: 0.4413 - val\_loss: 0.9811 - val\_accuracy: 0.5078  
Epoch 74/300  
7/7 [=====] - ETA: 0s - loss: 0.7834 - accuracy: 0.4592  
Epoch 74: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7834 - accuracy: 0.4592 - val\_loss: 1.0671 - val\_accuracy: 0.4352  
Epoch 75/300  
7/7 [=====] - ETA: 0s - loss: 0.7299 - accuracy: 0.4547  
Epoch 75: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.7299 - accuracy: 0.4547 - val\_loss: 1.0084 - val\_accuracy: 0.4922  
Epoch 76/300  
7/7 [=====] - ETA: 0s - loss: 0.7631 - accuracy: 0.5073  
Epoch 76: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.7631 - accuracy: 0.5073 - val\_loss: 1.0191 - val\_accuracy: 0.4611  
Epoch 77/300  
7/7 [=====] - ETA: 0s - loss: 0.7289 - accuracy: 0.4592  
Epoch 77: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 45ms/step - loss: 0.7289 - accuracy: 0.4592 - val\_loss: 1.0710 - val\_accuracy: 0.4352  
Epoch 78/300  
7/7 [=====] - ETA: 0s - loss: 0.7237 - accuracy: 0.4615  
Epoch 78: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7237 - accuracy: 0.4615 - val\_loss: 1.0097 - val\_accuracy: 0.4715  
Epoch 79/300  
7/7 [=====] - ETA: 0s - loss: 0.7398 - accuracy: 0.4704  
Epoch 79: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 46ms/step - loss: 0.7398 - accuracy: 0.4704 - val\_loss: 0.9938 - val\_accuracy: 0.4404  
Epoch 80/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7865 - accuracy: 0.4583  
Epoch 80: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 47ms/step - loss: 0.7745 - accuracy: 0.4648 - val\_loss: 1.1073 - val\_accuracy: 0.4249  
Epoch 81/300  
7/7 [=====] - ETA: 0s - loss: 0.7548 - accuracy: 0.4581  
Epoch 81: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7548 - accuracy: 0.4581 - val\_loss: 1.0171 - val\_accuracy: 0.4663  
Epoch 82/300  
7/7 [=====] - ETA: 0s - loss: 0.7428 - accuracy: 0.4816  
Epoch 82: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.7428 - accuracy: 0.4816 - val\_loss: 1.0354 - val\_accuracy: 0.4715  
Epoch 83/300  
7/7 [=====] - ETA: 0s - loss: 0.7429 - accuracy: 0.4581  
Epoch 83: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.7429 - accuracy: 0.4581 - val\_loss: 0.9989 - val\_accuracy: 0.4560  
Epoch 84/300  
7/7 [=====] - ETA: 0s - loss: 0.7100 - accuracy: 0.4894  
Epoch 84: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 47ms/step - loss: 0.7100 - accuracy: 0.4894 - val\_loss: 1.0678 - val\_accuracy: 0.4352

Epoch 85/300  
7/7 [=====] - ETA: 0s - loss: 0.7408 - accuracy: 0.5251  
Epoch 85: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.7408 - accuracy: 0.5251 - val\_loss: 0.9980 - val\_accuracy: 0.4767  
Epoch 86/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.6953 - accuracy: 0.5052  
Epoch 86: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 59ms/step - loss: 0.6879 - accuracy: 0.5039 - val\_loss: 1.1351 - val\_accuracy: 0.3990  
Epoch 87/300  
7/7 [=====] - ETA: 0s - loss: 0.7520 - accuracy: 0.4637  
Epoch 87: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 46ms/step - loss: 0.7520 - accuracy: 0.4637 - val\_loss: 0.9572 - val\_accuracy: 0.5026  
Epoch 88/300  
7/7 [=====] - ETA: 0s - loss: 0.7435 - accuracy: 0.4983  
Epoch 88: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 41ms/step - loss: 0.7435 - accuracy: 0.4983 - val\_loss: 1.0639 - val\_accuracy: 0.4508  
Epoch 89/300  
7/7 [=====] - ETA: 0s - loss: 0.7041 - accuracy: 0.4603  
Epoch 89: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.7041 - accuracy: 0.4603 - val\_loss: 1.0769 - val\_accuracy: 0.3990  
Epoch 90/300  
7/7 [=====] - ETA: 0s - loss: 0.7262 - accuracy: 0.4514  
Epoch 90: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 48ms/step - loss: 0.7262 - accuracy: 0.4514 - val\_loss: 0.9607 - val\_accuracy: 0.4663  
Epoch 91/300  
7/7 [=====] - ETA: 0s - loss: 0.6739 - accuracy: 0.5151  
Epoch 91: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.6739 - accuracy: 0.5151 - val\_loss: 0.9795 - val\_accuracy: 0.4922  
Epoch 92/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7242 - accuracy: 0.4987  
Epoch 92: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 54ms/step - loss: 0.7283 - accuracy: 0.5050 - val\_loss: 1.0497 - val\_accuracy: 0.4301  
Epoch 93/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7145 - accuracy: 0.4844  
Epoch 93: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 49ms/step - loss: 0.7086 - accuracy: 0.4849 - val\_loss: 1.0341 - val\_accuracy: 0.4508  
Epoch 94/300  
7/7 [=====] - ETA: 0s - loss: 0.6751 - accuracy: 0.4771  
Epoch 94: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.6751 - accuracy: 0.4771 - val\_loss: 1.0450 - val\_accuracy: 0.4922  
Epoch 95/300  
7/7 [=====] - ETA: 0s - loss: 0.6670 - accuracy: 0.5106  
Epoch 95: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.6670 - accuracy: 0.5106 - val\_loss: 0.9559 - val\_accuracy: 0.4922  
Epoch 96/300  
7/7 [=====] - ETA: 0s - loss: 0.6630 - accuracy: 0.5263  
Epoch 96: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 49ms/step - loss: 0.6630 - accuracy: 0.5263 - val\_loss: 1.0127 - val\_accuracy: 0.5026  
Epoch 97/300  
7/7 [=====] - ETA: 0s - loss: 0.6703 - accuracy: 0.5285  
Epoch 97: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.6703 - accuracy: 0.5285 - val\_loss: 1.0180 - val\_accuracy: 0.4767  
Epoch 98/300  
7/7 [=====] - ETA: 0s - loss: 0.6972 - accuracy: 0.5341  
Epoch 98: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 58ms/step - loss: 0.6972 - accuracy: 0.5341 - val\_loss: 1.0086 - val\_accuracy: 0.4819  
Epoch 99/300  
7/7 [=====] - ETA: 0s - loss: 0.6818 - accuracy: 0.5151  
Epoch 99: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 54ms/step - loss: 0.6818 - accuracy: 0.5151 - val\_loss: 1.0506 - val\_accuracy: 0.4560  
Epoch 100/300  
7/7 [=====] - ETA: 0s - loss: 0.6772 - accuracy: 0.5073  
Epoch 100: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.6772 - accuracy: 0.5073 - val\_loss: 0.9979 - val\_accuracy: 0.5078  
Epoch 101/300  
7/7 [=====] - ETA: 0s - loss: 0.7034 - accuracy: 0.5184  
Epoch 101: val\_accuracy did not improve from 0.55959



7/7 [=====] - 0s 51ms/step - loss: 0.7034 - accuracy: 0.5184 - val\_loss: 0.  
9420 - val\_accuracy: 0.5337  
Epoch 102/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7005 - accuracy: 0.4896  
Epoch 102: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 50ms/step - loss: 0.7054 - accuracy: 0.4927 - val\_loss: 0.  
9875 - val\_accuracy: 0.4767  
Epoch 103/300  
7/7 [=====] - ETA: 0s - loss: 0.6607 - accuracy: 0.5520  
Epoch 103: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.6607 - accuracy: 0.5520 - val\_loss: 0.  
8984 - val\_accuracy: 0.5389  
Epoch 104/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.6815 - accuracy: 0.5378  
Epoch 104: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 54ms/step - loss: 0.6748 - accuracy: 0.5341 - val\_loss: 1.  
0356 - val\_accuracy: 0.4197  
Epoch 105/300  
7/7 [=====] - ETA: 0s - loss: 0.6983 - accuracy: 0.5084  
Epoch 105: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.6983 - accuracy: 0.5084 - val\_loss: 0.  
9744 - val\_accuracy: 0.4819  
Epoch 106/300  
7/7 [=====] - ETA: 0s - loss: 0.6482 - accuracy: 0.5397  
Epoch 106: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 43ms/step - loss: 0.6482 - accuracy: 0.5397 - val\_loss: 0.  
9986 - val\_accuracy: 0.4508  
Epoch 107/300  
7/7 [=====] - ETA: 0s - loss: 0.6261 - accuracy: 0.5196  
Epoch 107: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 44ms/step - loss: 0.6261 - accuracy: 0.5196 - val\_loss: 0.  
9453 - val\_accuracy: 0.5389  
Epoch 108/300  
7/7 [=====] - ETA: 0s - loss: 0.6585 - accuracy: 0.5486  
Epoch 108: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.6585 - accuracy: 0.5486 - val\_loss: 1.  
0306 - val\_accuracy: 0.4715  
Epoch 109/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.6801 - accuracy: 0.4974  
Epoch 109: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.6591 - accuracy: 0.5117 - val\_loss: 0.  
9079 - val\_accuracy: 0.5440  
Epoch 110/300  
7/7 [=====] - ETA: 0s - loss: 0.6980 - accuracy: 0.5531  
Epoch 110: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 57ms/step - loss: 0.6980 - accuracy: 0.5531 - val\_loss: 1.  
0388 - val\_accuracy: 0.4819  
Epoch 111/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.6294 - accuracy: 0.5065  
Epoch 111: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.6478 - accuracy: 0.5050 - val\_loss: 0.  
9597 - val\_accuracy: 0.4663  
Epoch 112/300  
7/7 [=====] - ETA: 0s - loss: 0.6581 - accuracy: 0.5006  
Epoch 112: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.6581 - accuracy: 0.5006 - val\_loss: 1.  
0365 - val\_accuracy: 0.4974  
Epoch 113/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.6609 - accuracy: 0.5169  
Epoch 113: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 55ms/step - loss: 0.6769 - accuracy: 0.5251 - val\_loss: 1.  
0097 - val\_accuracy: 0.4767  
Epoch 114/300  
7/7 [=====] - ETA: 0s - loss: 0.6996 - accuracy: 0.5196  
Epoch 114: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 58ms/step - loss: 0.6996 - accuracy: 0.5196 - val\_loss: 1.  
0103 - val\_accuracy: 0.4767  
Epoch 115/300  
7/7 [=====] - ETA: 0s - loss: 0.6139 - accuracy: 0.5743  
Epoch 115: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 95ms/step - loss: 0.6139 - accuracy: 0.5743 - val\_loss: 1.  
0148 - val\_accuracy: 0.4819  
Epoch 116/300  
7/7 [=====] - ETA: 0s - loss: 0.6212 - accuracy: 0.5263  
Epoch 116: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 82ms/step - loss: 0.6212 - accuracy: 0.5263 - val\_loss: 0.  
9470 - val\_accuracy: 0.4767  
Epoch 117/300  
7/7 [=====] - ETA: 0s - loss: 0.6289 - accuracy: 0.5352  
Epoch 117: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 85ms/step - loss: 0.6289 - accuracy: 0.5352 - val\_loss: 1.  
0395 - val\_accuracy: 0.4715  
Epoch 118/300

7/7 [=====] - ETA: 0s - loss: 0.6607 - accuracy: 0.5709  
Epoch 118: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 84ms/step - loss: 0.6607 - accuracy: 0.5709 - val\_loss: 0.  
9330 - val\_accuracy: 0.5440  
Epoch 119/300  
7/7 [=====] - ETA: 0s - loss: 0.5998 - accuracy: 0.5531  
Epoch 119: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 92ms/step - loss: 0.5998 - accuracy: 0.5531 - val\_loss: 0.  
9705 - val\_accuracy: 0.5181  
Epoch 120/300  
7/7 [=====] - ETA: 0s - loss: 0.6416 - accuracy: 0.5385  
Epoch 120: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 90ms/step - loss: 0.6416 - accuracy: 0.5385 - val\_loss: 1.  
0159 - val\_accuracy: 0.5026  
Epoch 121/300  
7/7 [=====] - ETA: 0s - loss: 0.6167 - accuracy: 0.5061  
Epoch 121: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 1s 87ms/step - loss: 0.6167 - accuracy: 0.5061 - val\_loss: 0.  
9088 - val\_accuracy: 0.5130  
Epoch 122/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.6202 - accuracy: 0.5781  
Epoch 122: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 62ms/step - loss: 0.6113 - accuracy: 0.5743 - val\_loss: 0.  
9987 - val\_accuracy: 0.4715  
Epoch 123/300  
7/7 [=====] - ETA: 0s - loss: 0.6342 - accuracy: 0.5732  
Epoch 123: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 52ms/step - loss: 0.6342 - accuracy: 0.5732 - val\_loss: 1.  
0535 - val\_accuracy: 0.4870  
Epoch 124/300  
7/7 [=====] - ETA: 0s - loss: 0.6479 - accuracy: 0.5385  
Epoch 124: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 50ms/step - loss: 0.6479 - accuracy: 0.5385 - val\_loss: 1.  
0070 - val\_accuracy: 0.4974  
Epoch 125/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5897 - accuracy: 0.5794  
Epoch 125: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 53ms/step - loss: 0.5843 - accuracy: 0.5654 - val\_loss: 0.  
9461 - val\_accuracy: 0.5233  
Epoch 126/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5936 - accuracy: 0.5612  
Epoch 126: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.5863 - accuracy: 0.5732 - val\_loss: 1.  
0031 - val\_accuracy: 0.5544  
Epoch 127/300  
7/7 [=====] - ETA: 0s - loss: 0.5788 - accuracy: 0.5933  
Epoch 127: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 51ms/step - loss: 0.5788 - accuracy: 0.5933 - val\_loss: 1.  
0037 - val\_accuracy: 0.5285  
Epoch 128/300  
7/7 [=====] - ETA: 0s - loss: 0.5893 - accuracy: 0.5341  
Epoch 128: val\_accuracy did not improve from 0.55959  
7/7 [=====] - 0s 46ms/step - loss: 0.5893 - accuracy: 0.5341 - val\_loss: 0.  
9917 - val\_accuracy: 0.5233  
Epoch 129/300  
7/7 [=====] - ETA: 0s - loss: 0.5562 - accuracy: 0.5966  
Epoch 129: val\_accuracy improved from 0.55959 to 0.57513, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 50ms/step - loss: 0.5562 - accuracy: 0.5966 - val\_loss: 0.  
9383 - val\_accuracy: 0.5751  
Epoch 130/300  
7/7 [=====] - ETA: 0s - loss: 0.5369 - accuracy: 0.6078  
Epoch 130: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 44ms/step - loss: 0.5369 - accuracy: 0.6078 - val\_loss: 0.  
9633 - val\_accuracy: 0.5285  
Epoch 131/300  
7/7 [=====] - ETA: 0s - loss: 0.5214 - accuracy: 0.6223  
Epoch 131: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 55ms/step - loss: 0.5214 - accuracy: 0.6223 - val\_loss: 1.  
0910 - val\_accuracy: 0.5078  
Epoch 132/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5506 - accuracy: 0.6107  
Epoch 132: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 52ms/step - loss: 0.5514 - accuracy: 0.6212 - val\_loss: 0.  
9325 - val\_accuracy: 0.5596  
Epoch 133/300  
7/7 [=====] - ETA: 0s - loss: 0.5886 - accuracy: 0.5620  
Epoch 133: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 50ms/step - loss: 0.5886 - accuracy: 0.5620 - val\_loss: 1.  
0475 - val\_accuracy: 0.5130  
Epoch 134/300  
7/7 [=====] - ETA: 0s - loss: 0.5763 - accuracy: 0.5955  
Epoch 134: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 59ms/step - loss: 0.5763 - accuracy: 0.5955 - val\_loss: 0.

9384 - val\_accuracy: 0.5285  
Epoch 135/300  
7/7 [=====] - ETA: 0s - loss: 0.5918 - accuracy: 0.6000  
Epoch 135: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 51ms/step - loss: 0.5918 - accuracy: 0.6000 - val\_loss: 1.  
0462 - val\_accuracy: 0.5181  
Epoch 136/300  
7/7 [=====] - ETA: 0s - loss: 0.5965 - accuracy: 0.5821  
Epoch 136: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 49ms/step - loss: 0.5965 - accuracy: 0.5821 - val\_loss: 0.  
9598 - val\_accuracy: 0.5596  
Epoch 137/300  
7/7 [=====] - ETA: 0s - loss: 0.5576 - accuracy: 0.5888  
Epoch 137: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 45ms/step - loss: 0.5576 - accuracy: 0.5888 - val\_loss: 1.  
0720 - val\_accuracy: 0.4974  
Epoch 138/300  
7/7 [=====] - ETA: 0s - loss: 0.5659 - accuracy: 0.5788  
Epoch 138: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 45ms/step - loss: 0.5659 - accuracy: 0.5788 - val\_loss: 0.  
9369 - val\_accuracy: 0.5751  
Epoch 139/300  
7/7 [=====] - ETA: 0s - loss: 0.5690 - accuracy: 0.6369  
Epoch 139: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 44ms/step - loss: 0.5690 - accuracy: 0.6369 - val\_loss: 1.  
0186 - val\_accuracy: 0.4974  
Epoch 140/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5736 - accuracy: 0.5664  
Epoch 140: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 54ms/step - loss: 0.5535 - accuracy: 0.5698 - val\_loss: 1.  
0083 - val\_accuracy: 0.5648  
Epoch 141/300  
7/7 [=====] - ETA: 0s - loss: 0.5635 - accuracy: 0.6101  
Epoch 141: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 52ms/step - loss: 0.5635 - accuracy: 0.6101 - val\_loss: 0.  
8895 - val\_accuracy: 0.5751  
Epoch 142/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5859 - accuracy: 0.5938  
Epoch 142: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 53ms/step - loss: 0.5816 - accuracy: 0.5955 - val\_loss: 0.  
9665 - val\_accuracy: 0.5337  
Epoch 143/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5642 - accuracy: 0.5625  
Epoch 143: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 55ms/step - loss: 0.5582 - accuracy: 0.5620 - val\_loss: 0.  
9618 - val\_accuracy: 0.5337  
Epoch 144/300  
7/7 [=====] - ETA: 0s - loss: 0.5287 - accuracy: 0.6291  
Epoch 144: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 51ms/step - loss: 0.5287 - accuracy: 0.6291 - val\_loss: 0.  
9405 - val\_accuracy: 0.5389  
Epoch 145/300  
7/7 [=====] - ETA: 0s - loss: 0.4690 - accuracy: 0.6436  
Epoch 145: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 53ms/step - loss: 0.4690 - accuracy: 0.6436 - val\_loss: 0.  
9635 - val\_accuracy: 0.5492  
Epoch 146/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5302 - accuracy: 0.6094  
Epoch 146: val\_accuracy did not improve from 0.57513  
7/7 [=====] - 0s 53ms/step - loss: 0.5515 - accuracy: 0.5955 - val\_loss: 1.  
0354 - val\_accuracy: 0.5078  
Epoch 147/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5948 - accuracy: 0.5872  
Epoch 147: val\_accuracy improved from 0.57513 to 0.59067, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 60ms/step - loss: 0.5799 - accuracy: 0.5966 - val\_loss: 0.  
9369 - val\_accuracy: 0.5907  
Epoch 148/300  
7/7 [=====] - ETA: 0s - loss: 0.5631 - accuracy: 0.6201  
Epoch 148: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 53ms/step - loss: 0.5631 - accuracy: 0.6201 - val\_loss: 1.  
1442 - val\_accuracy: 0.4404  
Epoch 149/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5430 - accuracy: 0.5768  
Epoch 149: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 53ms/step - loss: 0.5400 - accuracy: 0.5754 - val\_loss: 0.  
9329 - val\_accuracy: 0.5544  
Epoch 150/300  
7/7 [=====] - ETA: 0s - loss: 0.5028 - accuracy: 0.6313  
Epoch 150: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 53ms/step - loss: 0.5028 - accuracy: 0.6313 - val\_loss: 1.  
1662 - val\_accuracy: 0.5389  
Epoch 151/300  
7/7 [=====] - ETA: 0s - loss: 0.5135 - accuracy: 0.6570

Epoch 151: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 54ms/step - loss: 0.5135 - accuracy: 0.6570 - val\_loss: 0.9645 - val\_accuracy: 0.5855  
Epoch 152/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5235 - accuracy: 0.6146  
Epoch 152: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 51ms/step - loss: 0.5373 - accuracy: 0.6022 - val\_loss: 1.0150 - val\_accuracy: 0.5026  
Epoch 153/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5400 - accuracy: 0.5833  
Epoch 153: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 53ms/step - loss: 0.5279 - accuracy: 0.6011 - val\_loss: 0.8993 - val\_accuracy: 0.5648  
Epoch 154/300  
7/7 [=====] - ETA: 0s - loss: 0.5286 - accuracy: 0.6168  
Epoch 154: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 51ms/step - loss: 0.5286 - accuracy: 0.6168 - val\_loss: 0.9170 - val\_accuracy: 0.4922  
Epoch 155/300  
7/7 [=====] - ETA: 0s - loss: 0.4938 - accuracy: 0.6078  
Epoch 155: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 53ms/step - loss: 0.4938 - accuracy: 0.6078 - val\_loss: 0.9855 - val\_accuracy: 0.5492  
Epoch 156/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4940 - accuracy: 0.5951  
Epoch 156: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 49ms/step - loss: 0.5002 - accuracy: 0.6123 - val\_loss: 0.9176 - val\_accuracy: 0.5440  
Epoch 157/300  
7/7 [=====] - ETA: 0s - loss: 0.5043 - accuracy: 0.6592  
Epoch 157: val\_accuracy improved from 0.59067 to 0.59585, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 50ms/step - loss: 0.5043 - accuracy: 0.6592 - val\_loss: 0.9205 - val\_accuracy: 0.5959  
Epoch 158/300  
7/7 [=====] - ETA: 0s - loss: 0.5359 - accuracy: 0.5955  
Epoch 158: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 46ms/step - loss: 0.5359 - accuracy: 0.5955 - val\_loss: 1.0411 - val\_accuracy: 0.5078  
Epoch 159/300  
7/7 [=====] - ETA: 0s - loss: 0.5216 - accuracy: 0.5888  
Epoch 159: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 45ms/step - loss: 0.5216 - accuracy: 0.5888 - val\_loss: 0.9342 - val\_accuracy: 0.5492  
Epoch 160/300  
7/7 [=====] - ETA: 0s - loss: 0.4932 - accuracy: 0.6324  
Epoch 160: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 46ms/step - loss: 0.4932 - accuracy: 0.6324 - val\_loss: 0.9594 - val\_accuracy: 0.5803  
Epoch 161/300  
7/7 [=====] - ETA: 0s - loss: 0.5809 - accuracy: 0.6425  
Epoch 161: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 46ms/step - loss: 0.5809 - accuracy: 0.6425 - val\_loss: 1.1164 - val\_accuracy: 0.4819  
Epoch 162/300  
7/7 [=====] - ETA: 0s - loss: 0.5338 - accuracy: 0.5609  
Epoch 162: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 49ms/step - loss: 0.5338 - accuracy: 0.5609 - val\_loss: 0.9160 - val\_accuracy: 0.5648  
Epoch 163/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4782 - accuracy: 0.6680  
Epoch 163: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 59ms/step - loss: 0.4844 - accuracy: 0.6749 - val\_loss: 0.8999 - val\_accuracy: 0.5751  
Epoch 164/300  
7/7 [=====] - ETA: 0s - loss: 0.4917 - accuracy: 0.6358  
Epoch 164: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 62ms/step - loss: 0.4917 - accuracy: 0.6358 - val\_loss: 0.8991 - val\_accuracy: 0.5544  
Epoch 165/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5159 - accuracy: 0.6198  
Epoch 165: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 63ms/step - loss: 0.5142 - accuracy: 0.6268 - val\_loss: 1.0083 - val\_accuracy: 0.5389  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.5033 - accuracy: 0.6056  
Epoch 166: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 63ms/step - loss: 0.5033 - accuracy: 0.6056 - val\_loss: 0.9714 - val\_accuracy: 0.5285  
Epoch 167/300  
7/7 [=====] - ETA: 0s - loss: 0.5230 - accuracy: 0.6670  
Epoch 167: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 62ms/step - loss: 0.5230 - accuracy: 0.6670 - val\_loss: 1.0132 - val\_accuracy: 0.5751

Epoch 168/300  
7/7 [=====] - ETA: 0s - loss: 0.4831 - accuracy: 0.6492  
Epoch 168: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 58ms/step - loss: 0.4831 - accuracy: 0.6492 - val\_loss: 1.0539 - val\_accuracy: 0.5389  
Epoch 169/300  
7/7 [=====] - ETA: 0s - loss: 0.4598 - accuracy: 0.5978  
Epoch 169: val\_accuracy did not improve from 0.59585  
7/7 [=====] - 0s 60ms/step - loss: 0.4598 - accuracy: 0.5978 - val\_loss: 0.9730 - val\_accuracy: 0.5803  
Epoch 170/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4890 - accuracy: 0.6549  
Epoch 170: val\_accuracy improved from 0.59585 to 0.61658, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 70ms/step - loss: 0.4940 - accuracy: 0.6525 - val\_loss: 0.9280 - val\_accuracy: 0.6166  
Epoch 171/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4743 - accuracy: 0.6732  
Epoch 171: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 0s 58ms/step - loss: 0.4734 - accuracy: 0.6637 - val\_loss: 1.0500 - val\_accuracy: 0.5596  
Epoch 172/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4760 - accuracy: 0.5977  
Epoch 172: val\_accuracy did not improve from 0.61658  
7/7 [=====] - 0s 47ms/step - loss: 0.4727 - accuracy: 0.6067 - val\_loss: 0.9726 - val\_accuracy: 0.5440  
Epoch 173/300  
7/7 [=====] - ETA: 0s - loss: 0.4358 - accuracy: 0.6737  
Epoch 173: val\_accuracy improved from 0.61658 to 0.65285, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 53ms/step - loss: 0.4358 - accuracy: 0.6737 - val\_loss: 0.9036 - val\_accuracy: 0.6528  
Epoch 174/300  
7/7 [=====] - ETA: 0s - loss: 0.4650 - accuracy: 0.6916  
Epoch 174: val\_accuracy did not improve from 0.65285  
7/7 [=====] - 0s 47ms/step - loss: 0.4650 - accuracy: 0.6916 - val\_loss: 0.9451 - val\_accuracy: 0.6218  
Epoch 175/300  
7/7 [=====] - ETA: 0s - loss: 0.4493 - accuracy: 0.6682  
Epoch 175: val\_accuracy improved from 0.65285 to 0.66321, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 62ms/step - loss: 0.4493 - accuracy: 0.6682 - val\_loss: 0.9395 - val\_accuracy: 0.6632  
Epoch 176/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4452 - accuracy: 0.6745  
Epoch 176: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 62ms/step - loss: 0.4482 - accuracy: 0.6749 - val\_loss: 0.8971 - val\_accuracy: 0.5803  
Epoch 177/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4351 - accuracy: 0.6901  
Epoch 177: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 49ms/step - loss: 0.4405 - accuracy: 0.6782 - val\_loss: 0.9748 - val\_accuracy: 0.6269  
Epoch 178/300  
7/7 [=====] - ETA: 0s - loss: 0.4368 - accuracy: 0.6693  
Epoch 178: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 43ms/step - loss: 0.4368 - accuracy: 0.6693 - val\_loss: 0.9604 - val\_accuracy: 0.5492  
Epoch 179/300  
7/7 [=====] - ETA: 0s - loss: 0.4458 - accuracy: 0.6559  
Epoch 179: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 43ms/step - loss: 0.4458 - accuracy: 0.6559 - val\_loss: 0.9600 - val\_accuracy: 0.6477  
Epoch 180/300  
7/7 [=====] - ETA: 0s - loss: 0.4283 - accuracy: 0.6637  
Epoch 180: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 46ms/step - loss: 0.4283 - accuracy: 0.6637 - val\_loss: 0.9262 - val\_accuracy: 0.6218  
Epoch 181/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4433 - accuracy: 0.6523  
Epoch 181: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 60ms/step - loss: 0.4513 - accuracy: 0.6547 - val\_loss: 0.9859 - val\_accuracy: 0.6269  
Epoch 182/300  
7/7 [=====] - ETA: 0s - loss: 0.4226 - accuracy: 0.6771  
Epoch 182: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 56ms/step - loss: 0.4226 - accuracy: 0.6771 - val\_loss: 0.9514 - val\_accuracy: 0.6166  
Epoch 183/300  
7/7 [=====] - ETA: 0s - loss: 0.4452 - accuracy: 0.6726  
Epoch 183: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 56ms/step - loss: 0.4452 - accuracy: 0.6726 - val\_loss: 0.9602 - val\_accuracy: 0.5855  
Epoch 184/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.5106 - accuracy: 0.6029  
Epoch 184: val\_accuracy did not improve from 0.66321

7/7 [=====] - 0s 53ms/step - loss: 0.4942 - accuracy: 0.6235 - val\_loss: 1.  
0832 - val\_accuracy: 0.5803  
Epoch 185/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4958 - accuracy: 0.6576  
Epoch 185: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 55ms/step - loss: 0.4972 - accuracy: 0.6670 - val\_loss: 0.  
9530 - val\_accuracy: 0.6114  
Epoch 186/300  
7/7 [=====] - ETA: 0s - loss: 0.4801 - accuracy: 0.6737  
Epoch 186: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 60ms/step - loss: 0.4801 - accuracy: 0.6737 - val\_loss: 0.  
9174 - val\_accuracy: 0.6425  
Epoch 187/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4618 - accuracy: 0.6706  
Epoch 187: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 53ms/step - loss: 0.4552 - accuracy: 0.6715 - val\_loss: 0.  
9424 - val\_accuracy: 0.5803  
Epoch 188/300  
7/7 [=====] - ETA: 0s - loss: 0.5020 - accuracy: 0.6670  
Epoch 188: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 65ms/step - loss: 0.5020 - accuracy: 0.6670 - val\_loss: 1.  
0104 - val\_accuracy: 0.5699  
Epoch 189/300  
7/7 [=====] - ETA: 0s - loss: 0.4787 - accuracy: 0.6156  
Epoch 189: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 55ms/step - loss: 0.4787 - accuracy: 0.6156 - val\_loss: 1.  
0084 - val\_accuracy: 0.5026  
Epoch 190/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4468 - accuracy: 0.6302  
Epoch 190: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 57ms/step - loss: 0.4454 - accuracy: 0.6391 - val\_loss: 0.  
9447 - val\_accuracy: 0.5648  
Epoch 191/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4004 - accuracy: 0.7174  
Epoch 191: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 48ms/step - loss: 0.4170 - accuracy: 0.7140 - val\_loss: 0.  
9385 - val\_accuracy: 0.5699  
Epoch 192/300  
7/7 [=====] - ETA: 0s - loss: 0.4292 - accuracy: 0.6749  
Epoch 192: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 45ms/step - loss: 0.4292 - accuracy: 0.6749 - val\_loss: 0.  
9390 - val\_accuracy: 0.5596  
Epoch 193/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4330 - accuracy: 0.6745  
Epoch 193: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 48ms/step - loss: 0.4281 - accuracy: 0.6715 - val\_loss: 1.  
0168 - val\_accuracy: 0.5803  
Epoch 194/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4460 - accuracy: 0.6992  
Epoch 194: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 57ms/step - loss: 0.4404 - accuracy: 0.6994 - val\_loss: 1.  
0079 - val\_accuracy: 0.5440  
Epoch 195/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4323 - accuracy: 0.6237  
Epoch 195: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 53ms/step - loss: 0.4287 - accuracy: 0.6235 - val\_loss: 1.  
0103 - val\_accuracy: 0.5233  
Epoch 196/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4238 - accuracy: 0.7253  
Epoch 196: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 55ms/step - loss: 0.4373 - accuracy: 0.7218 - val\_loss: 0.  
9334 - val\_accuracy: 0.5959  
Epoch 197/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3986 - accuracy: 0.7096  
Epoch 197: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 53ms/step - loss: 0.3984 - accuracy: 0.7073 - val\_loss: 0.  
9415 - val\_accuracy: 0.5751  
Epoch 198/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4029 - accuracy: 0.6719  
Epoch 198: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 54ms/step - loss: 0.3922 - accuracy: 0.6816 - val\_loss: 0.  
8523 - val\_accuracy: 0.6373  
Epoch 199/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3975 - accuracy: 0.7435  
Epoch 199: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 56ms/step - loss: 0.3902 - accuracy: 0.7419 - val\_loss: 0.  
8913 - val\_accuracy: 0.6114  
Epoch 200/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3855 - accuracy: 0.6732  
Epoch 200: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 52ms/step - loss: 0.3846 - accuracy: 0.6760 - val\_loss: 0.  
9496 - val\_accuracy: 0.5648  
Epoch 201/300

6/7 [=====>.....] - ETA: 0s - loss: 0.3984 - accuracy: 0.7044  
Epoch 201: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 54ms/step - loss: 0.4063 - accuracy: 0.7039 - val\_loss: 0.8935 - val\_accuracy: 0.5803  
Epoch 202/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3804 - accuracy: 0.7148  
Epoch 202: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 56ms/step - loss: 0.3818 - accuracy: 0.7117 - val\_loss: 0.9452 - val\_accuracy: 0.6010  
Epoch 203/300  
7/7 [=====] - ETA: 0s - loss: 0.4086 - accuracy: 0.6704  
Epoch 203: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 55ms/step - loss: 0.4086 - accuracy: 0.6704 - val\_loss: 0.8821 - val\_accuracy: 0.6010  
Epoch 204/300  
7/7 [=====] - ETA: 0s - loss: 0.4158 - accuracy: 0.7028  
Epoch 204: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 54ms/step - loss: 0.4158 - accuracy: 0.7028 - val\_loss: 1.0280 - val\_accuracy: 0.5699  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.4165 - accuracy: 0.6615  
Epoch 205: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 47ms/step - loss: 0.4165 - accuracy: 0.6615 - val\_loss: 0.9221 - val\_accuracy: 0.5855  
Epoch 206/300  
7/7 [=====] - ETA: 0s - loss: 0.4241 - accuracy: 0.7229  
Epoch 206: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 47ms/step - loss: 0.4241 - accuracy: 0.7229 - val\_loss: 0.9830 - val\_accuracy: 0.5648  
Epoch 207/300  
7/7 [=====] - ETA: 0s - loss: 0.4030 - accuracy: 0.6615  
Epoch 207: val\_accuracy did not improve from 0.66321  
7/7 [=====] - 0s 50ms/step - loss: 0.4030 - accuracy: 0.6615 - val\_loss: 0.9365 - val\_accuracy: 0.6114  
Epoch 208/300  
7/7 [=====] - ETA: 0s - loss: 0.4070 - accuracy: 0.7397  
Epoch 208: val\_accuracy improved from 0.66321 to 0.67358, saving model to /content/weights.best.hdf5  
7/7 [=====] - 0s 64ms/step - loss: 0.4070 - accuracy: 0.7397 - val\_loss: 0.8936 - val\_accuracy: 0.6736  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.4043 - accuracy: 0.6927  
Epoch 209: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 54ms/step - loss: 0.4043 - accuracy: 0.6927 - val\_loss: 0.9114 - val\_accuracy: 0.5751  
Epoch 210/300  
7/7 [=====] - ETA: 0s - loss: 0.3878 - accuracy: 0.6827  
Epoch 210: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 53ms/step - loss: 0.3878 - accuracy: 0.6827 - val\_loss: 0.8935 - val\_accuracy: 0.6166  
Epoch 211/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3948 - accuracy: 0.6849  
Epoch 211: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 53ms/step - loss: 0.3798 - accuracy: 0.6983 - val\_loss: 0.8603 - val\_accuracy: 0.5959  
Epoch 212/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3653 - accuracy: 0.7370  
Epoch 212: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 52ms/step - loss: 0.3735 - accuracy: 0.7307 - val\_loss: 0.8452 - val\_accuracy: 0.6218  
Epoch 213/300  
7/7 [=====] - ETA: 0s - loss: 0.3857 - accuracy: 0.7173  
Epoch 213: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 54ms/step - loss: 0.3857 - accuracy: 0.7173 - val\_loss: 0.9214 - val\_accuracy: 0.6166  
Epoch 214/300  
7/7 [=====] - ETA: 0s - loss: 0.3678 - accuracy: 0.7006  
Epoch 214: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 58ms/step - loss: 0.3678 - accuracy: 0.7006 - val\_loss: 0.9238 - val\_accuracy: 0.6062  
Epoch 215/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3746 - accuracy: 0.7331  
Epoch 215: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 70ms/step - loss: 0.3804 - accuracy: 0.7285 - val\_loss: 0.9381 - val\_accuracy: 0.6218  
Epoch 216/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3701 - accuracy: 0.7122  
Epoch 216: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 68ms/step - loss: 0.3700 - accuracy: 0.7117 - val\_loss: 0.9184 - val\_accuracy: 0.6010  
Epoch 217/300  
7/7 [=====] - ETA: 0s - loss: 0.3893 - accuracy: 0.7486  
Epoch 217: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 71ms/step - loss: 0.3893 - accuracy: 0.7486 - val\_loss: 0.

9181 - val\_accuracy: 0.6166  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.3639 - accuracy: 0.7061  
Epoch 218: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 68ms/step - loss: 0.3639 - accuracy: 0.7061 - val\_loss: 0.  
9512 - val\_accuracy: 0.5959  
Epoch 219/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3895 - accuracy: 0.7227  
Epoch 219: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 53ms/step - loss: 0.3886 - accuracy: 0.7218 - val\_loss: 0.  
9121 - val\_accuracy: 0.6269  
Epoch 220/300  
7/7 [=====] - ETA: 0s - loss: 0.3591 - accuracy: 0.7475  
Epoch 220: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 53ms/step - loss: 0.3591 - accuracy: 0.7475 - val\_loss: 0.  
9490 - val\_accuracy: 0.6218  
Epoch 221/300  
7/7 [=====] - ETA: 0s - loss: 0.3573 - accuracy: 0.7207  
Epoch 221: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 50ms/step - loss: 0.3573 - accuracy: 0.7207 - val\_loss: 0.  
9254 - val\_accuracy: 0.6218  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.3334 - accuracy: 0.7508  
Epoch 222: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 56ms/step - loss: 0.3334 - accuracy: 0.7508 - val\_loss: 0.  
9181 - val\_accuracy: 0.6632  
Epoch 223/300  
7/7 [=====] - ETA: 0s - loss: 0.3488 - accuracy: 0.7430  
Epoch 223: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 65ms/step - loss: 0.3488 - accuracy: 0.7430 - val\_loss: 0.  
9234 - val\_accuracy: 0.6373  
Epoch 224/300  
7/7 [=====] - ETA: 0s - loss: 0.3587 - accuracy: 0.7341  
Epoch 224: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 64ms/step - loss: 0.3587 - accuracy: 0.7341 - val\_loss: 1.  
0209 - val\_accuracy: 0.6062  
Epoch 225/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3750 - accuracy: 0.7318  
Epoch 225: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 64ms/step - loss: 0.3709 - accuracy: 0.7296 - val\_loss: 0.  
9849 - val\_accuracy: 0.5959  
Epoch 226/300  
7/7 [=====] - ETA: 0s - loss: 0.3573 - accuracy: 0.7039  
Epoch 226: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 68ms/step - loss: 0.3573 - accuracy: 0.7039 - val\_loss: 0.  
9831 - val\_accuracy: 0.6218  
Epoch 227/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3773 - accuracy: 0.7305  
Epoch 227: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 64ms/step - loss: 0.3741 - accuracy: 0.7307 - val\_loss: 0.  
9363 - val\_accuracy: 0.5959  
Epoch 228/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3638 - accuracy: 0.7005  
Epoch 228: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 64ms/step - loss: 0.3755 - accuracy: 0.6983 - val\_loss: 1.  
0026 - val\_accuracy: 0.6477  
Epoch 229/300  
7/7 [=====] - ETA: 0s - loss: 0.3777 - accuracy: 0.7553  
Epoch 229: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 66ms/step - loss: 0.3777 - accuracy: 0.7553 - val\_loss: 0.  
9299 - val\_accuracy: 0.6010  
Epoch 230/300  
7/7 [=====] - ETA: 0s - loss: 0.3892 - accuracy: 0.7017  
Epoch 230: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 66ms/step - loss: 0.3892 - accuracy: 0.7017 - val\_loss: 0.  
9382 - val\_accuracy: 0.6166  
Epoch 231/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3932 - accuracy: 0.7096  
Epoch 231: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 66ms/step - loss: 0.3891 - accuracy: 0.7028 - val\_loss: 1.  
0294 - val\_accuracy: 0.6062  
Epoch 232/300  
7/7 [=====] - ETA: 0s - loss: 0.4272 - accuracy: 0.7173  
Epoch 232: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 65ms/step - loss: 0.4272 - accuracy: 0.7173 - val\_loss: 0.  
9478 - val\_accuracy: 0.5440  
Epoch 233/300  
7/7 [=====] - ETA: 0s - loss: 0.3387 - accuracy: 0.7039  
Epoch 233: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 65ms/step - loss: 0.3387 - accuracy: 0.7039 - val\_loss: 0.  
8631 - val\_accuracy: 0.6528  
Epoch 234/300  
7/7 [=====] - ETA: 0s - loss: 0.4261 - accuracy: 0.7464



Epoch 234: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 62ms/step - loss: 0.4261 - accuracy: 0.7464 - val\_loss: 0.8850 - val\_accuracy: 0.6736  
Epoch 235/300  
7/7 [=====] - ETA: 0s - loss: 0.4064 - accuracy: 0.7151  
Epoch 235: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 62ms/step - loss: 0.4064 - accuracy: 0.7151 - val\_loss: 1.0408 - val\_accuracy: 0.6166  
Epoch 236/300  
7/7 [=====] - ETA: 0s - loss: 0.4018 - accuracy: 0.7028  
Epoch 236: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 48ms/step - loss: 0.4018 - accuracy: 0.7028 - val\_loss: 1.1982 - val\_accuracy: 0.5907  
Epoch 237/300  
7/7 [=====] - ETA: 0s - loss: 0.4475 - accuracy: 0.7006  
Epoch 237: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 48ms/step - loss: 0.4475 - accuracy: 0.7006 - val\_loss: 0.9990 - val\_accuracy: 0.5959  
Epoch 238/300  
7/7 [=====] - ETA: 0s - loss: 0.3873 - accuracy: 0.6883  
Epoch 238: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 47ms/step - loss: 0.3873 - accuracy: 0.6883 - val\_loss: 0.9769 - val\_accuracy: 0.5907  
Epoch 239/300  
7/7 [=====] - ETA: 0s - loss: 0.3503 - accuracy: 0.7028  
Epoch 239: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 67ms/step - loss: 0.3503 - accuracy: 0.7028 - val\_loss: 0.9255 - val\_accuracy: 0.6166  
Epoch 240/300  
7/7 [=====] - ETA: 0s - loss: 0.3484 - accuracy: 0.7497  
Epoch 240: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 69ms/step - loss: 0.3484 - accuracy: 0.7497 - val\_loss: 0.9077 - val\_accuracy: 0.6425  
Epoch 241/300  
7/7 [=====] - ETA: 0s - loss: 0.3618 - accuracy: 0.7296  
Epoch 241: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 64ms/step - loss: 0.3618 - accuracy: 0.7296 - val\_loss: 0.9043 - val\_accuracy: 0.6218  
Epoch 242/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.2945 - accuracy: 0.7812  
Epoch 242: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 65ms/step - loss: 0.2995 - accuracy: 0.7832 - val\_loss: 0.9394 - val\_accuracy: 0.6373  
Epoch 243/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3108 - accuracy: 0.7526  
Epoch 243: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 56ms/step - loss: 0.3402 - accuracy: 0.7441 - val\_loss: 0.9388 - val\_accuracy: 0.6218  
Epoch 244/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3288 - accuracy: 0.7474  
Epoch 244: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 0s 51ms/step - loss: 0.3345 - accuracy: 0.7453 - val\_loss: 0.9111 - val\_accuracy: 0.6010  
Epoch 245/300  
7/7 [=====] - ETA: 0s - loss: 0.3399 - accuracy: 0.7453  
Epoch 245: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 84ms/step - loss: 0.3399 - accuracy: 0.7453 - val\_loss: 0.9457 - val\_accuracy: 0.5907  
Epoch 246/300  
7/7 [=====] - ETA: 0s - loss: 0.3499 - accuracy: 0.7542  
Epoch 246: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 82ms/step - loss: 0.3499 - accuracy: 0.7542 - val\_loss: 0.9701 - val\_accuracy: 0.6166  
Epoch 247/300  
7/7 [=====] - ETA: 0s - loss: 0.3454 - accuracy: 0.7408  
Epoch 247: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 79ms/step - loss: 0.3454 - accuracy: 0.7408 - val\_loss: 1.0182 - val\_accuracy: 0.6062  
Epoch 248/300  
7/7 [=====] - ETA: 0s - loss: 0.3971 - accuracy: 0.7218  
Epoch 248: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 88ms/step - loss: 0.3971 - accuracy: 0.7218 - val\_loss: 1.0472 - val\_accuracy: 0.6062  
Epoch 249/300  
7/7 [=====] - ETA: 0s - loss: 0.3262 - accuracy: 0.7117  
Epoch 249: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 99ms/step - loss: 0.3262 - accuracy: 0.7117 - val\_loss: 0.9839 - val\_accuracy: 0.6632  
Epoch 250/300  
7/7 [=====] - ETA: 0s - loss: 0.3607 - accuracy: 0.7553  
Epoch 250: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 83ms/step - loss: 0.3607 - accuracy: 0.7553 - val\_loss: 0.9791 - val\_accuracy: 0.5907

Epoch 251/300  
7/7 [=====] - ETA: 0s - loss: 0.3046 - accuracy: 0.7520  
Epoch 251: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 91ms/step - loss: 0.3046 - accuracy: 0.7520 - val\_loss: 0.9563 - val\_accuracy: 0.6632  
Epoch 252/300  
7/7 [=====] - ETA: 0s - loss: 0.3396 - accuracy: 0.7642  
Epoch 252: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 99ms/step - loss: 0.3396 - accuracy: 0.7642 - val\_loss: 0.9172 - val\_accuracy: 0.6166  
Epoch 253/300  
7/7 [=====] - ETA: 0s - loss: 0.3111 - accuracy: 0.7732  
Epoch 253: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 92ms/step - loss: 0.3111 - accuracy: 0.7732 - val\_loss: 0.8884 - val\_accuracy: 0.6373  
Epoch 254/300  
7/7 [=====] - ETA: 0s - loss: 0.3274 - accuracy: 0.7654  
Epoch 254: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 91ms/step - loss: 0.3274 - accuracy: 0.7654 - val\_loss: 0.9563 - val\_accuracy: 0.6373  
Epoch 255/300  
7/7 [=====] - ETA: 0s - loss: 0.3115 - accuracy: 0.7587  
Epoch 255: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 111ms/step - loss: 0.3115 - accuracy: 0.7587 - val\_loss: 1.0021 - val\_accuracy: 0.6269  
Epoch 256/300  
7/7 [=====] - ETA: 0s - loss: 0.3106 - accuracy: 0.7665  
Epoch 256: val\_accuracy did not improve from 0.67358  
7/7 [=====] - 1s 93ms/step - loss: 0.3106 - accuracy: 0.7665 - val\_loss: 1.0077 - val\_accuracy: 0.6477  
Epoch 257/300  
7/7 [=====] - ETA: 0s - loss: 0.3357 - accuracy: 0.7564  
Epoch 257: val\_accuracy improved from 0.67358 to 0.69948, saving model to /content/weights.best.hdf5  
7/7 [=====] - 1s 114ms/step - loss: 0.3357 - accuracy: 0.7564 - val\_loss: 1.0621 - val\_accuracy: 0.6995  
Epoch 258/300  
7/7 [=====] - ETA: 0s - loss: 0.3761 - accuracy: 0.6849  
Epoch 258: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 1s 69ms/step - loss: 0.3761 - accuracy: 0.6849 - val\_loss: 1.0020 - val\_accuracy: 0.5699  
Epoch 259/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4077 - accuracy: 0.7604  
Epoch 259: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 57ms/step - loss: 0.4131 - accuracy: 0.7587 - val\_loss: 1.0590 - val\_accuracy: 0.6684  
Epoch 260/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4879 - accuracy: 0.6914  
Epoch 260: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.4854 - accuracy: 0.6849 - val\_loss: 1.2120 - val\_accuracy: 0.5026  
Epoch 261/300  
7/7 [=====] - ETA: 0s - loss: 0.5150 - accuracy: 0.6291  
Epoch 261: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 46ms/step - loss: 0.5150 - accuracy: 0.6291 - val\_loss: 0.9800 - val\_accuracy: 0.6166  
Epoch 262/300  
7/7 [=====] - ETA: 0s - loss: 0.4317 - accuracy: 0.6983  
Epoch 262: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 46ms/step - loss: 0.4317 - accuracy: 0.6983 - val\_loss: 0.9119 - val\_accuracy: 0.6010  
Epoch 263/300  
7/7 [=====] - ETA: 0s - loss: 0.3962 - accuracy: 0.6860  
Epoch 263: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 48ms/step - loss: 0.3962 - accuracy: 0.6860 - val\_loss: 0.8817 - val\_accuracy: 0.5907  
Epoch 264/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3699 - accuracy: 0.7096  
Epoch 264: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 57ms/step - loss: 0.3578 - accuracy: 0.7162 - val\_loss: 0.8977 - val\_accuracy: 0.6062  
Epoch 265/300  
7/7 [=====] - ETA: 0s - loss: 0.3361 - accuracy: 0.7631  
Epoch 265: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.3361 - accuracy: 0.7631 - val\_loss: 0.8791 - val\_accuracy: 0.6269  
Epoch 266/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3016 - accuracy: 0.7799  
Epoch 266: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 58ms/step - loss: 0.3027 - accuracy: 0.7888 - val\_loss: 0.8899 - val\_accuracy: 0.6425  
Epoch 267/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3372 - accuracy: 0.7513  
Epoch 267: val\_accuracy did not improve from 0.69948

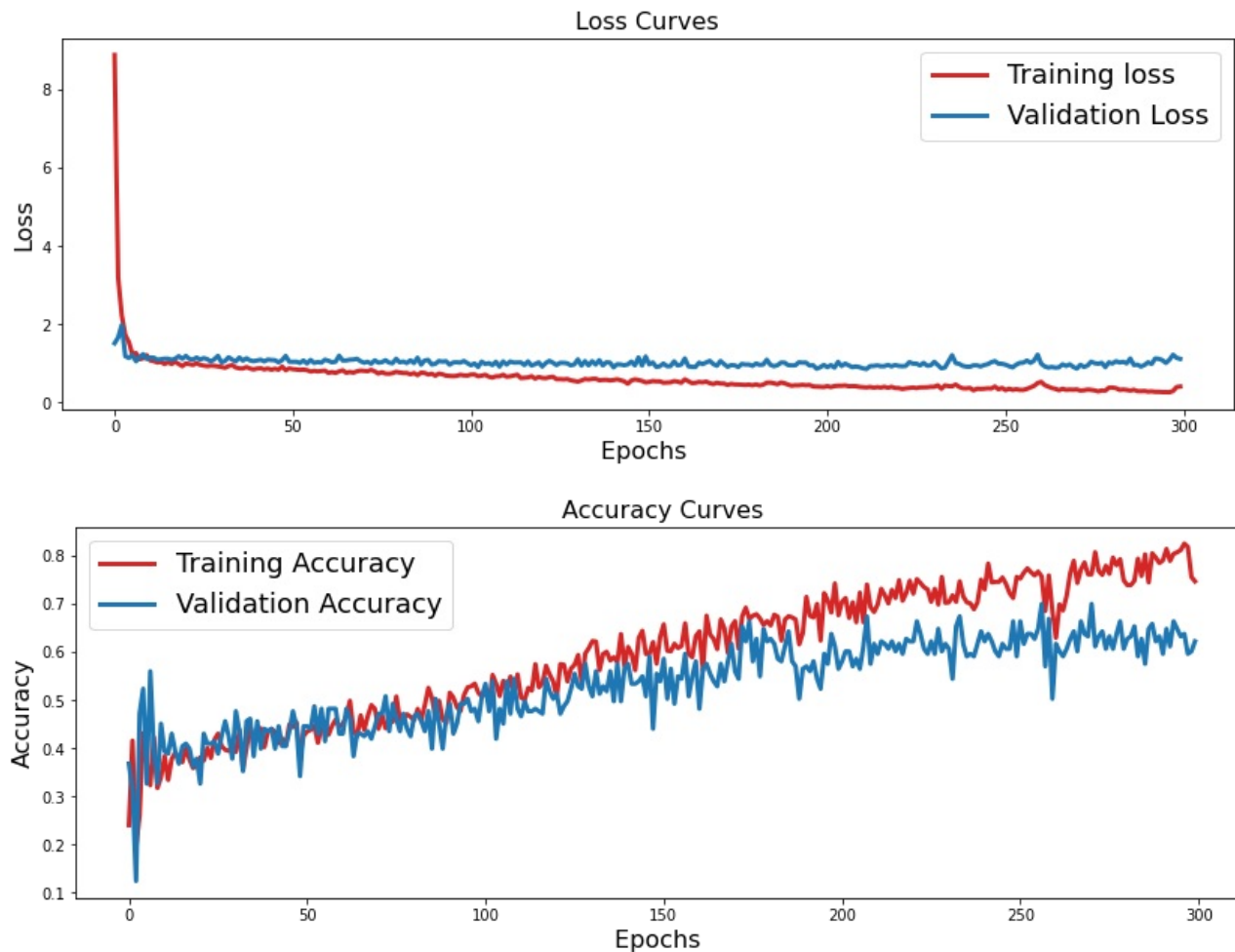
7/7 [=====] - 0s 56ms/step - loss: 0.3380 - accuracy: 0.7430 - val\_loss: 0.  
9645 - val\_accuracy: 0.6010  
Epoch 268/300  
7/7 [=====] - ETA: 0s - loss: 0.3119 - accuracy: 0.7709  
Epoch 268: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 59ms/step - loss: 0.3119 - accuracy: 0.7709 - val\_loss: 0.  
9240 - val\_accuracy: 0.6632  
Epoch 269/300  
7/7 [=====] - ETA: 0s - loss: 0.3192 - accuracy: 0.7855  
Epoch 269: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 55ms/step - loss: 0.3192 - accuracy: 0.7855 - val\_loss: 0.  
9653 - val\_accuracy: 0.6373  
Epoch 270/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3036 - accuracy: 0.7552  
Epoch 270: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 58ms/step - loss: 0.3146 - accuracy: 0.7609 - val\_loss: 0.  
9003 - val\_accuracy: 0.6321  
Epoch 271/300  
7/7 [=====] - ETA: 0s - loss: 0.3216 - accuracy: 0.7609  
Epoch 271: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.3216 - accuracy: 0.7609 - val\_loss: 0.  
8558 - val\_accuracy: 0.6995  
Epoch 272/300  
7/7 [=====] - ETA: 0s - loss: 0.2929 - accuracy: 0.8067  
Epoch 272: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 57ms/step - loss: 0.2929 - accuracy: 0.8067 - val\_loss: 0.  
9541 - val\_accuracy: 0.6114  
Epoch 273/300  
7/7 [=====] - ETA: 0s - loss: 0.3016 - accuracy: 0.7676  
Epoch 273: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.3016 - accuracy: 0.7676 - val\_loss: 0.  
8997 - val\_accuracy: 0.6321  
Epoch 274/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3280 - accuracy: 0.7513  
Epoch 274: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 65ms/step - loss: 0.3177 - accuracy: 0.7598 - val\_loss: 0.  
9333 - val\_accuracy: 0.6425  
Epoch 275/300  
7/7 [=====] - ETA: 0s - loss: 0.3108 - accuracy: 0.7788  
Epoch 275: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 55ms/step - loss: 0.3108 - accuracy: 0.7788 - val\_loss: 1.  
0329 - val\_accuracy: 0.6062  
Epoch 276/300  
7/7 [=====] - ETA: 0s - loss: 0.2975 - accuracy: 0.7620  
Epoch 276: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 59ms/step - loss: 0.2975 - accuracy: 0.7620 - val\_loss: 0.  
9952 - val\_accuracy: 0.6321  
Epoch 277/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.2804 - accuracy: 0.7865  
Epoch 277: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 59ms/step - loss: 0.2731 - accuracy: 0.7955 - val\_loss: 0.  
9819 - val\_accuracy: 0.6062  
Epoch 278/300  
7/7 [=====] - ETA: 0s - loss: 0.2959 - accuracy: 0.7799  
Epoch 278: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 65ms/step - loss: 0.2959 - accuracy: 0.7799 - val\_loss: 1.  
0036 - val\_accuracy: 0.6373  
Epoch 279/300  
7/7 [=====] - ETA: 0s - loss: 0.2907 - accuracy: 0.7922  
Epoch 279: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.2907 - accuracy: 0.7922 - val\_loss: 0.  
8947 - val\_accuracy: 0.6632  
Epoch 280/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3223 - accuracy: 0.7682  
Epoch 280: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.3664 - accuracy: 0.7486 - val\_loss: 1.  
0153 - val\_accuracy: 0.6062  
Epoch 281/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3695 - accuracy: 0.7344  
Epoch 281: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 57ms/step - loss: 0.3711 - accuracy: 0.7385 - val\_loss: 0.  
9873 - val\_accuracy: 0.6269  
Epoch 282/300  
7/7 [=====] - ETA: 0s - loss: 0.3542 - accuracy: 0.7385  
Epoch 282: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.3542 - accuracy: 0.7385 - val\_loss: 1.  
0437 - val\_accuracy: 0.6321  
Epoch 283/300  
7/7 [=====] - ETA: 0s - loss: 0.3097 - accuracy: 0.7475  
Epoch 283: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 62ms/step - loss: 0.3097 - accuracy: 0.7475 - val\_loss: 1.  
0113 - val\_accuracy: 0.6528  
Epoch 284/300

7/7 [=====] - ETA: 0s - loss: 0.3194 - accuracy: 0.7933  
Epoch 284: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 60ms/step - loss: 0.3194 - accuracy: 0.7933 - val\_loss: 1.0289 - val\_accuracy: 0.5907  
Epoch 285/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.3019 - accuracy: 0.7591  
Epoch 285: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 56ms/step - loss: 0.3093 - accuracy: 0.7575 - val\_loss: 0.9914 - val\_accuracy: 0.6269  
Epoch 286/300  
7/7 [=====] - ETA: 0s - loss: 0.2925 - accuracy: 0.8022  
Epoch 286: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 54ms/step - loss: 0.2925 - accuracy: 0.8022 - val\_loss: 1.1142 - val\_accuracy: 0.5751  
Epoch 287/300  
7/7 [=====] - ETA: 0s - loss: 0.3134 - accuracy: 0.7441  
Epoch 287: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 54ms/step - loss: 0.3134 - accuracy: 0.7441 - val\_loss: 0.9478 - val\_accuracy: 0.6477  
Epoch 288/300  
7/7 [=====] - ETA: 0s - loss: 0.2792 - accuracy: 0.8045  
Epoch 288: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 55ms/step - loss: 0.2792 - accuracy: 0.8045 - val\_loss: 0.9561 - val\_accuracy: 0.6580  
Epoch 289/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.2841 - accuracy: 0.7917  
Epoch 289: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 54ms/step - loss: 0.2775 - accuracy: 0.7955 - val\_loss: 0.9083 - val\_accuracy: 0.6218  
Epoch 290/300  
7/7 [=====] - ETA: 0s - loss: 0.2827 - accuracy: 0.7844  
Epoch 290: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 58ms/step - loss: 0.2827 - accuracy: 0.7844 - val\_loss: 0.9486 - val\_accuracy: 0.6321  
Epoch 291/300  
7/7 [=====] - ETA: 0s - loss: 0.2657 - accuracy: 0.7899  
Epoch 291: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 55ms/step - loss: 0.2657 - accuracy: 0.7899 - val\_loss: 1.0180 - val\_accuracy: 0.5959  
Epoch 292/300  
7/7 [=====] - ETA: 0s - loss: 0.2719 - accuracy: 0.8134  
Epoch 292: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 56ms/step - loss: 0.2719 - accuracy: 0.8134 - val\_loss: 0.9746 - val\_accuracy: 0.6477  
Epoch 293/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.2547 - accuracy: 0.7930  
Epoch 293: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 61ms/step - loss: 0.2596 - accuracy: 0.7888 - val\_loss: 1.1141 - val\_accuracy: 0.6114  
Epoch 294/300  
7/7 [=====] - ETA: 0s - loss: 0.2592 - accuracy: 0.8034  
Epoch 294: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 44ms/step - loss: 0.2592 - accuracy: 0.8034 - val\_loss: 1.1056 - val\_accuracy: 0.6632  
Epoch 295/300  
7/7 [=====] - ETA: 0s - loss: 0.2529 - accuracy: 0.8067  
Epoch 295: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 45ms/step - loss: 0.2529 - accuracy: 0.8067 - val\_loss: 1.0721 - val\_accuracy: 0.6477  
Epoch 296/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.2513 - accuracy: 0.8099  
Epoch 296: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 48ms/step - loss: 0.2535 - accuracy: 0.8112 - val\_loss: 0.9994 - val\_accuracy: 0.6321  
Epoch 297/300  
7/7 [=====] - ETA: 0s - loss: 0.2491 - accuracy: 0.8246  
Epoch 297: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 55ms/step - loss: 0.2491 - accuracy: 0.8246 - val\_loss: 1.0838 - val\_accuracy: 0.6373  
Epoch 298/300  
7/7 [=====] - ETA: 0s - loss: 0.2815 - accuracy: 0.8179  
Epoch 298: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 56ms/step - loss: 0.2815 - accuracy: 0.8179 - val\_loss: 1.2100 - val\_accuracy: 0.5959  
Epoch 299/300  
7/7 [=====] - ETA: 0s - loss: 0.3843 - accuracy: 0.7553  
Epoch 299: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 55ms/step - loss: 0.3843 - accuracy: 0.7553 - val\_loss: 1.1315 - val\_accuracy: 0.6010  
Epoch 300/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.4069 - accuracy: 0.7487  
Epoch 300: val\_accuracy did not improve from 0.69948  
7/7 [=====] - 0s 61ms/step - loss: 0.3965 - accuracy: 0.7464 - val\_loss: 1.

1038 - val accuracy: 0.6218  
Created model and loaded weights from file

In [290]:

```
plotfn(history)
```



In [291]:

```
results.loc[index,['Architecture','Dropout','Loss Fn', 'LR']] = ['CNN 1D',0.2, 'Cross-Entropy',0.0001]
```

**Evaluation:** Training and Validation

In [292]:

```
evaluation_train_val(model,x_train,y_train,x_val,y_val, results, index)
```

Training Accuracy: 0.832402229309082  
Training Loss: 0.4133915901184082  
Validation Accuracy: 0.6994818449020386  
Validation Loss: 1.0621323585510254

**Evaluation:** Testing

In [293]:

```
evaluation_test(model,x_test,y_test, results, index)
```

7/7 [=====] - 0s 5ms/step - loss: 1.1640 - accuracy: 0.6166  
Test accuracy: 0.6165803074836731  
Test loss: 1.1640427112579346

**Evaluation Metrics**

## F1 score

In [294]:

```
_ , _ , _ , val_f1 = predictfn(model, x_val,y_val)
```

```
7/7 [=====] - 30s 6ms/step
      precision    recall  f1-score   support

extrahls      0.93      0.82      0.87        17
extrastole     0.09      0.08      0.09         12
murmur         0.51      0.74      0.60         38
normal         0.82      0.73      0.77       126

accuracy              0.70       193
macro avg      0.59      0.59      0.58       193
weighted avg   0.72      0.70      0.71       193
```

In [295]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model,x_test,y_test)
```

```
7/7 [=====] - 0s 4ms/step
      precision    recall  f1-score   support

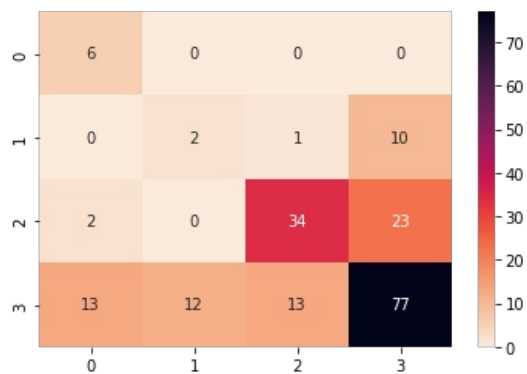
extrahls      1.00      0.29      0.44        21
extrastole     0.15      0.14      0.15         14
murmur         0.58      0.71      0.64         48
normal         0.67      0.70      0.68       110

accuracy              0.62       193
macro avg      0.60      0.46      0.48       193
weighted avg   0.64      0.62      0.61       193
```

## Confusion Matrix

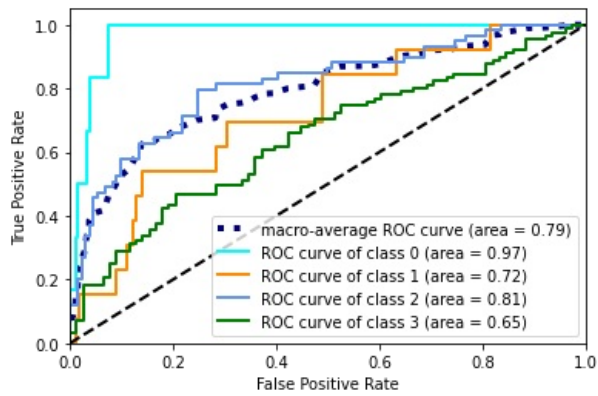
In [296]:

```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



## ROC and AUC

```
roc = plot_ROC(y_test, predictions)
```



```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

Out[298]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547
3	CNN 2D	0.0001	0.2	KL divergence	0.984358	0.079908	0.911917	0.285003	0.797927	0.508575	0.911012	0.799109	0.958595
4	CNN 2D	0.001	0.2	Cross-Entropy	0.994413	0.021668	0.917098	0.27322	0.834197	0.566831	0.91787	0.837258	0.960526
5	CNN 1D	0.0001	0.2	Cross-Entropy	0.832402	0.413392	0.699482	1.062132	0.61658	1.164043	0.705761	0.607259	0.791756

**COMMENTS:**

We observed that CONV 1D performance was mediocre as presented by the confusion matrix that most of the samples of class 1 and 2 were misclassified. The previous models had better results.

### Predicting a sample's label

```
model_name = "heartbeat_classifier1D_1.h5"
model.save(model_name)
```

### Predicting a Murmur sample

```
test.iloc[5]
```

Out[309]:

[illegible]

In [300]:

```
sample_predict(model_name,5)
```

```
1/1 [=====] - 0s 154ms/step
Label Prediction Probabilities: [[1.2026994e-09 3.7738516e-06 7.1122938e-01 2.8876674e-01]]
-----
Label:
Murmur heartbeat
confidence: 0.7112294
```

### Predicting a Normal sample

In [308]:

```
test.iloc[50]
```

Out[308]:

[illegible]

In [301]:

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 0s 199ms/step
Label Prediction Probabilities: [[3.3338239e-08 2.8064102e-03 3.5869348e-01 6.3850003e-01]]
-----
Label:
Normal heartbeat
confidence: 0.63850003
```

### ***Predicting an Extrahls sample***

In [307]:

```
test.iloc[77]
```

Out[307]:

[illegible]

In [302]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 157ms/step
Label Prediction Probabilities: [[9.7751039e-01 1.4232057e-07 6.6392007e-04 2.1825645e-02]]
-----
Label:
Extrahls heartbeat
confidence: 0.9775104
```

### Predicting a Extrasystole sample

In [305]:

```
test.iloc[16]
```

Out[305]:

[illegible]



In [306]:

```
sample_predict(model_name,16)
```

1/1 [=====] - 0s 229ms/step

Label Prediction Probabilities: [[1.8655954e-11 9.8336029e-01 2.4054985e-04 1.6399171e-02]]

-----

Label:

Extrasystole heartbeat

confidence: 0.9833603

## ANN Experiment (Feed-forward Network): Multi-layer Perceptron (MLP)

In [310]:

```
# for training data
X_train = extract_features_helper(train_1)
X_train = np.array(X_train)
print("X train:", X_train.shape)
# for validation data
X_val = extract_features_helper(val)
X_val = np.array(X_val)
print("X validation:", X_val.shape)
# for testing data
X_test = extract_features_helper(test)
X_test = np.array(X_test)
print("X testing:", X_test.shape)
```

100%|██████████| 1088/1088 [01:10<00:00, 15.50it/s]

X train: (1088, 40)

100%|██████████| 193/193 [00:19<00:00, 9.83it/s]

X validation: (193, 40)

100%|██████████| 193/193 [00:19<00:00, 10.15it/s]

X testing: (193, 40)

In [ ]:

In [311]:

```
# encode the labels
encoder = LabelEncoder()
encoder.fit(test.label)
Y_train = encoder.transform(train_1.label)
Y_train = to_categorical(Y_train)
Y_test = encoder.transform(test.label)
Y_test = to_categorical(Y_test)
Y_val = encoder.transform(val.label)
Y_val = to_categorical(Y_val)
X_train = np.array(X_train)
Y_train = np.array(Y_train)
```

## ANN Experiment 1:

In [312]:

```
model = Sequential()  
model.add(Dense(32, input_shape = (X_train[1].shape), activation = "relu" ))  
model.add(Dense(16, activation = "relu"))  
model.add(Dense(8, activation = "relu"))  
model.add(Dense(4, activation = "relu"))  
model.add(Dropout(0.1))  
model.add(Dense(len(encoder.classes_), activation = "softmax"))  
model.summary()
```

Model: "sequential\_11"

Layer (type)	Output Shape	Param #
dense_12 (Dense)	(None, 32)	1312
dense_13 (Dense)	(None, 16)	528
dense_14 (Dense)	(None, 8)	136
dense_15 (Dense)	(None, 4)	36
dropout_35 (Dropout)	(None, 4)	0
dense_16 (Dense)	(None, 4)	20

=====  
Total params: 2,032  
Trainable params: 2,032  
Non-trainable params: 0  
=====

In [313]:

```
adam = keras.optimizers.Adam(learning_rate=0.0001)  
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])  
filepath="/content/weightsMLP1.best.hdf5"  
checkpoint = ModelCheckpoint(filepath, monitor='val_accuracy', verbose=1, save_best_only=True, mode='max')  
history = model.fit(X_train, Y_train, epochs=300, batch_size=128, verbose=1, validation_split=0.17647059, shuffle  
=True, callbacks = [checkpoint], class_weight=classWeights)
```

Epoch 1/300  
1/7 [==>.....] - ETA: 4s - loss: 76.9249 - accuracy: 0.5547  
Epoch 1: val\_accuracy improved from -inf to 0.58549, saving model to /content/weightsMLP1.best.hdf5  
7/7 [=====] - 1s 57ms/step - loss: 77.6899 - accuracy: 0.5497 - val\_loss: 3  
4.1105 - val\_accuracy: 0.5855  
Epoch 2/300  
1/7 [==>.....] - ETA: 0s - loss: 60.2220 - accuracy: 0.5625  
Epoch 2: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 55.0785 - accuracy: 0.5464 - val\_loss: 22  
.8973 - val\_accuracy: 0.5855  
Epoch 3/300  
1/7 [==>.....] - ETA: 0s - loss: 38.6671 - accuracy: 0.5391  
Epoch 3: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 34.4784 - accuracy: 0.5486 - val\_loss: 12  
.9843 - val\_accuracy: 0.5855  
Epoch 4/300  
1/7 [==>.....] - ETA: 0s - loss: 24.1464 - accuracy: 0.5312  
Epoch 4: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 17.9554 - accuracy: 0.5587 - val\_loss: 4.  
2870 - val\_accuracy: 0.5855  
Epoch 5/300  
1/7 [==>.....] - ETA: 0s - loss: 7.9530 - accuracy: 0.5000  
Epoch 5: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 5.6191 - accuracy: 0.2559 - val\_loss: 6.5  
144 - val\_accuracy: 0.0311  
Epoch 6/300  
1/7 [==>.....] - ETA: 0s - loss: 4.4377 - accuracy: 0.0781  
Epoch 6: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 4.9984 - accuracy: 0.0603 - val\_loss: 5.5  
189 - val\_accuracy: 0.0311  
Epoch 7/300  
1/7 [==>.....] - ETA: 0s - loss: 4.0041 - accuracy: 0.0547  
Epoch 7: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 3.8106 - accuracy: 0.0603 - val\_loss: 3.1  
316 - val\_accuracy: 0.0259  
Epoch 8/300  
1/7 [==>.....] - ETA: 0s - loss: 2.9975 - accuracy: 0.0469  
Epoch 8: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 2.2002 - accuracy: 0.1676 - val\_loss: 1.9  
679 - val\_accuracy: 0.3161  
Epoch 9/300

1/7 [===>.....] - ETA: 0s - loss: 2.1671 - accuracy: 0.2891  
Epoch 9: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 1.8587 - accuracy: 0.2559 - val\_loss: 1.9011 - val\_accuracy: 0.1503  
Epoch 10/300  
1/7 [===>.....] - ETA: 0s - loss: 1.6191 - accuracy: 0.1719  
Epoch 10: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 1.4182 - accuracy: 0.1184 - val\_loss: 1.8777 - val\_accuracy: 0.0881  
Epoch 11/300  
1/7 [===>.....] - ETA: 0s - loss: 1.4014 - accuracy: 0.1094  
Epoch 11: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 7ms/step - loss: 1.3462 - accuracy: 0.1307 - val\_loss: 1.6653 - val\_accuracy: 0.1762  
Epoch 12/300  
1/7 [===>.....] - ETA: 0s - loss: 1.3326 - accuracy: 0.1719  
Epoch 12: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 1.2053 - accuracy: 0.2190 - val\_loss: 1.5857 - val\_accuracy: 0.2124  
Epoch 13/300  
1/7 [===>.....] - ETA: 0s - loss: 1.2099 - accuracy: 0.3047  
Epoch 13: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 1.1635 - accuracy: 0.2927 - val\_loss: 1.5453 - val\_accuracy: 0.3005  
Epoch 14/300  
1/7 [===>.....] - ETA: 0s - loss: 1.3405 - accuracy: 0.2734  
Epoch 14: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 1.1775 - accuracy: 0.3419 - val\_loss: 1.5170 - val\_accuracy: 0.3109  
Epoch 15/300  
1/7 [===>.....] - ETA: 0s - loss: 1.1695 - accuracy: 0.3516  
Epoch 15: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 7ms/step - loss: 1.1203 - accuracy: 0.3419 - val\_loss: 1.4917 - val\_accuracy: 0.2953  
Epoch 16/300  
1/7 [===>.....] - ETA: 0s - loss: 1.1708 - accuracy: 0.4219  
Epoch 16: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 1.1537 - accuracy: 0.3251 - val\_loss: 1.4781 - val\_accuracy: 0.2746  
Epoch 17/300  
1/7 [===>.....] - ETA: 0s - loss: 1.1553 - accuracy: 0.3125  
Epoch 17: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 1.1401 - accuracy: 0.3039 - val\_loss: 1.4700 - val\_accuracy: 0.2798  
Epoch 18/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9851 - accuracy: 0.3203  
Epoch 18: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 1.1285 - accuracy: 0.3162 - val\_loss: 1.4658 - val\_accuracy: 0.2953  
Epoch 19/300  
1/7 [===>.....] - ETA: 0s - loss: 1.1104 - accuracy: 0.3359  
Epoch 19: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 1.1110 - accuracy: 0.3251 - val\_loss: 1.4618 - val\_accuracy: 0.2953  
Epoch 20/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9984 - accuracy: 0.3516  
Epoch 20: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 14ms/step - loss: 1.1394 - accuracy: 0.3475 - val\_loss: 1.4560 - val\_accuracy: 0.3161  
Epoch 21/300  
1/7 [===>.....] - ETA: 0s - loss: 1.1485 - accuracy: 0.3438  
Epoch 21: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 13ms/step - loss: 1.1759 - accuracy: 0.3363 - val\_loss: 1.4549 - val\_accuracy: 0.2953  
Epoch 22/300  
1/7 [===>.....] - ETA: 0s - loss: 1.0575 - accuracy: 0.4141  
Epoch 22: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 1.1378 - accuracy: 0.3352 - val\_loss: 1.4433 - val\_accuracy: 0.3005  
Epoch 23/300  
1/7 [===>.....] - ETA: 0s - loss: 1.2196 - accuracy: 0.3672  
Epoch 23: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 1.1092 - accuracy: 0.3285 - val\_loss: 1.4401 - val\_accuracy: 0.3057  
Epoch 24/300  
1/7 [===>.....] - ETA: 0s - loss: 1.2962 - accuracy: 0.3828  
Epoch 24: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 19ms/step - loss: 1.0981 - accuracy: 0.3363 - val\_loss: 1.4428 - val\_accuracy: 0.3057  
Epoch 25/300  
7/7 [=====] - ETA: 0s - loss: 1.0826 - accuracy: 0.3363  
Epoch 25: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 17ms/step - loss: 1.0826 - accuracy: 0.3363 - val\_loss: 1.

4328 - val\_accuracy: 0.3057  
Epoch 26/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1805 - accuracy: 0.3125  
Epoch 26: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 23ms/step - loss: 1.1042 - accuracy: 0.3251 - val\_loss: 1.  
4264 - val\_accuracy: 0.3161  
Epoch 27/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9469 - accuracy: 0.3047  
Epoch 27: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 17ms/step - loss: 1.1097 - accuracy: 0.3486 - val\_loss: 1.  
4202 - val\_accuracy: 0.3316  
Epoch 28/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1962 - accuracy: 0.3359  
Epoch 28: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 14ms/step - loss: 1.1154 - accuracy: 0.3430 - val\_loss: 1.  
4244 - val\_accuracy: 0.3264  
Epoch 29/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9453 - accuracy: 0.4219  
Epoch 29: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 1.0439 - accuracy: 0.3508 - val\_loss: 1.  
4283 - val\_accuracy: 0.3109  
Epoch 30/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1640 - accuracy: 0.3672  
Epoch 30: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 20ms/step - loss: 1.1060 - accuracy: 0.3330 - val\_loss: 1.  
4218 - val\_accuracy: 0.3212  
Epoch 31/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0765 - accuracy: 0.3359  
Epoch 31: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 14ms/step - loss: 1.1141 - accuracy: 0.3531 - val\_loss: 1.  
4088 - val\_accuracy: 0.3472  
Epoch 32/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1085 - accuracy: 0.3125  
Epoch 32: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 16ms/step - loss: 1.0706 - accuracy: 0.3531 - val\_loss: 1.  
4075 - val\_accuracy: 0.3523  
Epoch 33/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9761 - accuracy: 0.4375  
Epoch 33: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 16ms/step - loss: 1.0416 - accuracy: 0.3788 - val\_loss: 1.  
3981 - val\_accuracy: 0.3472  
Epoch 34/300  
7/7 [=====] - ETA: 0s - loss: 1.0399 - accuracy: 0.3665  
Epoch 34: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 24ms/step - loss: 1.0399 - accuracy: 0.3665 - val\_loss: 1.  
4007 - val\_accuracy: 0.3472  
Epoch 35/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9548 - accuracy: 0.3281  
Epoch 35: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 1.0384 - accuracy: 0.3743 - val\_loss: 1.  
3946 - val\_accuracy: 0.3575  
Epoch 36/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0012 - accuracy: 0.3281  
Epoch 36: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 1.0614 - accuracy: 0.3911 - val\_loss: 1.  
3932 - val\_accuracy: 0.3523  
Epoch 37/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0380 - accuracy: 0.3672  
Epoch 37: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 1.0320 - accuracy: 0.3765 - val\_loss: 1.  
3755 - val\_accuracy: 0.3834  
Epoch 38/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0207 - accuracy: 0.4141  
Epoch 38: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 14ms/step - loss: 1.0526 - accuracy: 0.3922 - val\_loss: 1.  
3915 - val\_accuracy: 0.3472  
Epoch 39/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1308 - accuracy: 0.3906  
Epoch 39: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 18ms/step - loss: 1.0757 - accuracy: 0.3151 - val\_loss: 1.  
4150 - val\_accuracy: 0.2694  
Epoch 40/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9670 - accuracy: 0.3359  
Epoch 40: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 18ms/step - loss: 1.0531 - accuracy: 0.3006 - val\_loss: 1.  
4132 - val\_accuracy: 0.2694  
Epoch 41/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0411 - accuracy: 0.2734  
Epoch 41: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 16ms/step - loss: 1.0540 - accuracy: 0.3196 - val\_loss: 1.  
3883 - val\_accuracy: 0.3368  
Epoch 42/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9784 - accuracy: 0.4297

Epoch 42: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 18ms/step - loss: 1.0456 - accuracy: 0.3844 - val\_loss: 1.3657 - val\_accuracy: 0.3731  
Epoch 43/300  
5/7 [=====>.....] - ETA: 0s - loss: 1.0322 - accuracy: 0.3953  
Epoch 43: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 26ms/step - loss: 1.0206 - accuracy: 0.3721 - val\_loss: 1.3825 - val\_accuracy: 0.3368  
Epoch 44/300  
1/7 [==>.....] - ETA: 0s - loss: 1.2985 - accuracy: 0.3203  
Epoch 44: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 17ms/step - loss: 1.0479 - accuracy: 0.3117 - val\_loss: 1.4011 - val\_accuracy: 0.2850  
Epoch 45/300  
1/7 [==>.....] - ETA: 0s - loss: 1.2150 - accuracy: 0.3438  
Epoch 45: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 19ms/step - loss: 1.0673 - accuracy: 0.3173 - val\_loss: 1.3955 - val\_accuracy: 0.2902  
Epoch 46/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1907 - accuracy: 0.3438  
Epoch 46: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 1.0455 - accuracy: 0.3441 - val\_loss: 1.3713 - val\_accuracy: 0.3627  
Epoch 47/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9649 - accuracy: 0.4297  
Epoch 47: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 1.0637 - accuracy: 0.3832 - val\_loss: 1.3515 - val\_accuracy: 0.3990  
Epoch 48/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0240 - accuracy: 0.4531  
Epoch 48: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 0.9996 - accuracy: 0.4089 - val\_loss: 1.3773 - val\_accuracy: 0.3472  
Epoch 49/300  
7/7 [=====] - ETA: 0s - loss: 1.0043 - accuracy: 0.3754  
Epoch 49: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 25ms/step - loss: 1.0043 - accuracy: 0.3754 - val\_loss: 1.3845 - val\_accuracy: 0.3109  
Epoch 50/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7847 - accuracy: 0.4141  
Epoch 50: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 22ms/step - loss: 0.9986 - accuracy: 0.3765 - val\_loss: 1.3683 - val\_accuracy: 0.3575  
Epoch 51/300  
7/7 [=====] - ETA: 0s - loss: 1.0229 - accuracy: 0.3899  
Epoch 51: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 29ms/step - loss: 1.0229 - accuracy: 0.3899 - val\_loss: 1.3591 - val\_accuracy: 0.3834  
Epoch 52/300  
5/7 [=====>.....] - ETA: 0s - loss: 1.0104 - accuracy: 0.3750  
Epoch 52: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 46ms/step - loss: 1.0201 - accuracy: 0.3687 - val\_loss: 1.3635 - val\_accuracy: 0.3523  
Epoch 53/300  
6/7 [=====>.....] - ETA: 0s - loss: 1.0123 - accuracy: 0.3854  
Epoch 53: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 30ms/step - loss: 0.9963 - accuracy: 0.3922 - val\_loss: 1.3425 - val\_accuracy: 0.4041  
Epoch 54/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.9999 - accuracy: 0.4206  
Epoch 54: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 27ms/step - loss: 1.0248 - accuracy: 0.4179 - val\_loss: 1.3355 - val\_accuracy: 0.4145  
Epoch 55/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8531 - accuracy: 0.4453  
Epoch 55: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 19ms/step - loss: 0.9838 - accuracy: 0.3721 - val\_loss: 1.3746 - val\_accuracy: 0.3316  
Epoch 56/300  
7/7 [=====] - ETA: 0s - loss: 0.9585 - accuracy: 0.3497  
Epoch 56: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 22ms/step - loss: 0.9585 - accuracy: 0.3497 - val\_loss: 1.3692 - val\_accuracy: 0.3264  
Epoch 57/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9345 - accuracy: 0.3203  
Epoch 57: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 16ms/step - loss: 0.9832 - accuracy: 0.3899 - val\_loss: 1.3447 - val\_accuracy: 0.3782  
Epoch 58/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9571 - accuracy: 0.4297  
Epoch 58: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 15ms/step - loss: 1.0122 - accuracy: 0.4201 - val\_loss: 1.3234 - val\_accuracy: 0.4301

Epoch 59/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9589 - accuracy: 0.4531  
Epoch 59: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 17ms/step - loss: 0.9740 - accuracy: 0.4123 - val\_loss: 1.3542 - val\_accuracy: 0.3368  
Epoch 60/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1378 - accuracy: 0.3750  
Epoch 60: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 14ms/step - loss: 1.0419 - accuracy: 0.3732 - val\_loss: 1.3532 - val\_accuracy: 0.3523  
Epoch 61/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0175 - accuracy: 0.3672  
Epoch 61: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 17ms/step - loss: 1.0146 - accuracy: 0.4246 - val\_loss: 1.2979 - val\_accuracy: 0.4663  
Epoch 62/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0849 - accuracy: 0.4609  
Epoch 62: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 18ms/step - loss: 1.0126 - accuracy: 0.4324 - val\_loss: 1.3330 - val\_accuracy: 0.4041  
Epoch 63/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0454 - accuracy: 0.3594  
Epoch 63: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 13ms/step - loss: 1.0121 - accuracy: 0.3721 - val\_loss: 1.3538 - val\_accuracy: 0.3523  
Epoch 64/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9173 - accuracy: 0.3203  
Epoch 64: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 16ms/step - loss: 1.0056 - accuracy: 0.3709 - val\_loss: 1.3391 - val\_accuracy: 0.3731  
Epoch 65/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0377 - accuracy: 0.4219  
Epoch 65: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9921 - accuracy: 0.3955 - val\_loss: 1.3459 - val\_accuracy: 0.3472  
Epoch 66/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8613 - accuracy: 0.3594  
Epoch 66: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9828 - accuracy: 0.3899 - val\_loss: 1.3235 - val\_accuracy: 0.3990  
Epoch 67/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9912 - accuracy: 0.4531  
Epoch 67: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9854 - accuracy: 0.4000 - val\_loss: 1.3405 - val\_accuracy: 0.3679  
Epoch 68/300  
1/7 [==>.....] - ETA: 0s - loss: 1.1497 - accuracy: 0.4062  
Epoch 68: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 1.0132 - accuracy: 0.3855 - val\_loss: 1.3056 - val\_accuracy: 0.4456  
Epoch 69/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9113 - accuracy: 0.4375  
Epoch 69: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9468 - accuracy: 0.4156 - val\_loss: 1.3214 - val\_accuracy: 0.3990  
Epoch 70/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9790 - accuracy: 0.3984  
Epoch 70: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9909 - accuracy: 0.3966 - val\_loss: 1.3229 - val\_accuracy: 0.3886  
Epoch 71/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8762 - accuracy: 0.4766  
Epoch 71: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 0.9793 - accuracy: 0.3922 - val\_loss: 1.3094 - val\_accuracy: 0.4041  
Epoch 72/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9425 - accuracy: 0.4219  
Epoch 72: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9468 - accuracy: 0.4000 - val\_loss: 1.3009 - val\_accuracy: 0.4197  
Epoch 73/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8482 - accuracy: 0.4531  
Epoch 73: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9991 - accuracy: 0.4335 - val\_loss: 1.2941 - val\_accuracy: 0.4197  
Epoch 74/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0776 - accuracy: 0.4219  
Epoch 74: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 0.9312 - accuracy: 0.4145 - val\_loss: 1.3267 - val\_accuracy: 0.3523  
Epoch 75/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0842 - accuracy: 0.3672  
Epoch 75: val\_accuracy did not improve from 0.58549

7/7 [=====] - 0s 9ms/step - loss: 0.9579 - accuracy: 0.3989 - val\_loss: 1.2  
747 - val\_accuracy: 0.4870  
Epoch 76/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8536 - accuracy: 0.3828  
Epoch 76: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9808 - accuracy: 0.4715 - val\_loss: 1.2  
884 - val\_accuracy: 0.4456  
Epoch 77/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0164 - accuracy: 0.4141  
Epoch 77: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 1.0008 - accuracy: 0.4000 - val\_loss: 1.2  
936 - val\_accuracy: 0.4145  
Epoch 78/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9006 - accuracy: 0.5000  
Epoch 78: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 0.9497 - accuracy: 0.4592 - val\_loss: 1.  
2558 - val\_accuracy: 0.4870  
Epoch 79/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0977 - accuracy: 0.4453  
Epoch 79: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9448 - accuracy: 0.4547 - val\_loss: 1.2  
730 - val\_accuracy: 0.4611  
Epoch 80/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9705 - accuracy: 0.4688  
Epoch 80: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9599 - accuracy: 0.4346 - val\_loss: 1.2  
759 - val\_accuracy: 0.4611  
Epoch 81/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8787 - accuracy: 0.5000  
Epoch 81: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9195 - accuracy: 0.4291 - val\_loss: 1.3  
242 - val\_accuracy: 0.3731  
Epoch 82/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8894 - accuracy: 0.4531  
Epoch 82: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9433 - accuracy: 0.4190 - val\_loss: 1.  
2543 - val\_accuracy: 0.4819  
Epoch 83/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9641 - accuracy: 0.4844  
Epoch 83: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9809 - accuracy: 0.4726 - val\_loss: 1.2  
754 - val\_accuracy: 0.4456  
Epoch 84/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9588 - accuracy: 0.3906  
Epoch 84: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9335 - accuracy: 0.3821 - val\_loss: 1.3  
347 - val\_accuracy: 0.3575  
Epoch 85/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9631 - accuracy: 0.3594  
Epoch 85: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9121 - accuracy: 0.4212 - val\_loss: 1.2  
319 - val\_accuracy: 0.5026  
Epoch 86/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9501 - accuracy: 0.4844  
Epoch 86: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9175 - accuracy: 0.4547 - val\_loss: 1.3  
198 - val\_accuracy: 0.3679  
Epoch 87/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8489 - accuracy: 0.3828  
Epoch 87: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9412 - accuracy: 0.3989 - val\_loss: 1.2  
765 - val\_accuracy: 0.4456  
Epoch 88/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0352 - accuracy: 0.4219  
Epoch 88: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9437 - accuracy: 0.4022 - val\_loss: 1.2  
815 - val\_accuracy: 0.4301  
Epoch 89/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8932 - accuracy: 0.3516  
Epoch 89: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9765 - accuracy: 0.4447 - val\_loss: 1.2  
555 - val\_accuracy: 0.4715  
Epoch 90/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9461 - accuracy: 0.4922  
Epoch 90: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9691 - accuracy: 0.4246 - val\_loss: 1.2  
358 - val\_accuracy: 0.4974  
Epoch 91/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9539 - accuracy: 0.4688  
Epoch 91: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9308 - accuracy: 0.4469 - val\_loss: 1.2  
820 - val\_accuracy: 0.4145  
Epoch 92/300

1/7 [===>.....] - ETA: 0s - loss: 0.8953 - accuracy: 0.3828  
Epoch 92: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9445 - accuracy: 0.4123 - val\_loss: 1.2308 - val\_accuracy: 0.4974  
Epoch 93/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8116 - accuracy: 0.4609  
Epoch 93: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 0.9252 - accuracy: 0.4916 - val\_loss: 1.2411 - val\_accuracy: 0.4663  
Epoch 94/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8973 - accuracy: 0.4531  
Epoch 94: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 0.9716 - accuracy: 0.4045 - val\_loss: 1.2687 - val\_accuracy: 0.4249  
Epoch 95/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8970 - accuracy: 0.5000  
Epoch 95: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9075 - accuracy: 0.4726 - val\_loss: 1.2087 - val\_accuracy: 0.4922  
Epoch 96/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8767 - accuracy: 0.5156  
Epoch 96: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9027 - accuracy: 0.4637 - val\_loss: 1.2644 - val\_accuracy: 0.4301  
Epoch 97/300  
1/7 [===>.....] - ETA: 0s - loss: 1.0194 - accuracy: 0.3672  
Epoch 97: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9292 - accuracy: 0.4380 - val\_loss: 1.2029 - val\_accuracy: 0.4767  
Epoch 98/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9105 - accuracy: 0.4609  
Epoch 98: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9559 - accuracy: 0.4615 - val\_loss: 1.2434 - val\_accuracy: 0.4560  
Epoch 99/300  
1/7 [===>.....] - ETA: 0s - loss: 1.0534 - accuracy: 0.4688  
Epoch 99: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9352 - accuracy: 0.4358 - val\_loss: 1.2029 - val\_accuracy: 0.4870  
Epoch 100/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8000 - accuracy: 0.5234  
Epoch 100: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9139 - accuracy: 0.4872 - val\_loss: 1.2063 - val\_accuracy: 0.4922  
Epoch 101/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9137 - accuracy: 0.4062  
Epoch 101: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8952 - accuracy: 0.4503 - val\_loss: 1.2318 - val\_accuracy: 0.4767  
Epoch 102/300  
1/7 [===>.....] - ETA: 0s - loss: 1.0652 - accuracy: 0.5000  
Epoch 102: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9020 - accuracy: 0.4860 - val\_loss: 1.1889 - val\_accuracy: 0.4974  
Epoch 103/300  
1/7 [===>.....] - ETA: 0s - loss: 1.0092 - accuracy: 0.4922  
Epoch 103: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 7ms/step - loss: 0.9294 - accuracy: 0.4536 - val\_loss: 1.2409 - val\_accuracy: 0.4560  
Epoch 104/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9848 - accuracy: 0.4062  
Epoch 104: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 7ms/step - loss: 0.9000 - accuracy: 0.5017 - val\_loss: 1.1831 - val\_accuracy: 0.5026  
Epoch 105/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8557 - accuracy: 0.5312  
Epoch 105: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 7ms/step - loss: 0.9747 - accuracy: 0.4469 - val\_loss: 1.2117 - val\_accuracy: 0.4715  
Epoch 106/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9834 - accuracy: 0.4531  
Epoch 106: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9233 - accuracy: 0.5061 - val\_loss: 1.2434 - val\_accuracy: 0.4352  
Epoch 107/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8516 - accuracy: 0.5078  
Epoch 107: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 0.9226 - accuracy: 0.4514 - val\_loss: 1.1699 - val\_accuracy: 0.5026  
Epoch 108/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9324 - accuracy: 0.5312  
Epoch 108: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8910 - accuracy: 0.4704 - val\_loss: 1.2



269 - val\_accuracy: 0.4508  
Epoch 109/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9245 - accuracy: 0.4062  
Epoch 109: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8825 - accuracy: 0.4872 - val\_loss: 1.1  
704 - val\_accuracy: 0.4922  
Epoch 110/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9342 - accuracy: 0.4688  
Epoch 110: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9107 - accuracy: 0.4726 - val\_loss: 1.2  
059 - val\_accuracy: 0.4870  
Epoch 111/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8878 - accuracy: 0.4453  
Epoch 111: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9200 - accuracy: 0.4682 - val\_loss: 1.2  
471 - val\_accuracy: 0.4197  
Epoch 112/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8136 - accuracy: 0.4609  
Epoch 112: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 7ms/step - loss: 0.9024 - accuracy: 0.4503 - val\_loss: 1.1  
326 - val\_accuracy: 0.5233  
Epoch 113/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8661 - accuracy: 0.5234  
Epoch 113: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8981 - accuracy: 0.4648 - val\_loss: 1.2  
582 - val\_accuracy: 0.4041  
Epoch 114/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8469 - accuracy: 0.3906  
Epoch 114: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8721 - accuracy: 0.4793 - val\_loss: 1.1  
640 - val\_accuracy: 0.5078  
Epoch 115/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8779 - accuracy: 0.5312  
Epoch 115: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9068 - accuracy: 0.4324 - val\_loss: 1.2  
112 - val\_accuracy: 0.4508  
Epoch 116/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7670 - accuracy: 0.4297  
Epoch 116: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8843 - accuracy: 0.4804 - val\_loss: 1.2  
630 - val\_accuracy: 0.3938  
Epoch 117/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9006 - accuracy: 0.4375  
Epoch 117: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9029 - accuracy: 0.3933 - val\_loss: 1.  
2445 - val\_accuracy: 0.4093  
Epoch 118/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8102 - accuracy: 0.4609  
Epoch 118: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 0.8993 - accuracy: 0.4849 - val\_loss: 1.  
1552 - val\_accuracy: 0.4767  
Epoch 119/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9209 - accuracy: 0.5703  
Epoch 119: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9156 - accuracy: 0.4816 - val\_loss: 1.1  
579 - val\_accuracy: 0.5026  
Epoch 120/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9229 - accuracy: 0.5078  
Epoch 120: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9003 - accuracy: 0.4972 - val\_loss: 1.  
2366 - val\_accuracy: 0.4197  
Epoch 121/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0169 - accuracy: 0.3906  
Epoch 121: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8843 - accuracy: 0.4335 - val\_loss: 1.1  
243 - val\_accuracy: 0.5285  
Epoch 122/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8286 - accuracy: 0.5234  
Epoch 122: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 12ms/step - loss: 0.8330 - accuracy: 0.5017 - val\_loss: 1.  
1920 - val\_accuracy: 0.4560  
Epoch 123/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8228 - accuracy: 0.4062  
Epoch 123: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 0.8938 - accuracy: 0.4559 - val\_loss: 1.  
1058 - val\_accuracy: 0.5337  
Epoch 124/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9544 - accuracy: 0.5547  
Epoch 124: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8449 - accuracy: 0.5263 - val\_loss: 1.2  
036 - val\_accuracy: 0.4404  
Epoch 125/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8064 - accuracy: 0.4844

Epoch 125: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8767 - accuracy: 0.4961 - val\_loss: 1.1764 - val\_accuracy: 0.4819  
Epoch 126/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8733 - accuracy: 0.4844  
Epoch 126: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9054 - accuracy: 0.4335 - val\_loss: 1.1611 - val\_accuracy: 0.5078  
Epoch 127/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8540 - accuracy: 0.5078  
Epoch 127: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8266 - accuracy: 0.5263 - val\_loss: 1.2066 - val\_accuracy: 0.4352  
Epoch 128/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0368 - accuracy: 0.4766  
Epoch 128: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.9299 - accuracy: 0.4447 - val\_loss: 1.1120 - val\_accuracy: 0.5337  
Epoch 129/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9967 - accuracy: 0.5078  
Epoch 129: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8619 - accuracy: 0.4603 - val\_loss: 1.2355 - val\_accuracy: 0.3938  
Epoch 130/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9069 - accuracy: 0.4062  
Epoch 130: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.9203 - accuracy: 0.4782 - val\_loss: 1.1171 - val\_accuracy: 0.5078  
Epoch 131/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8364 - accuracy: 0.5078  
Epoch 131: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8495 - accuracy: 0.4659 - val\_loss: 1.1457 - val\_accuracy: 0.4922  
Epoch 132/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8348 - accuracy: 0.4219  
Epoch 132: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8451 - accuracy: 0.4983 - val\_loss: 1.1654 - val\_accuracy: 0.4663  
Epoch 133/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8641 - accuracy: 0.4922  
Epoch 133: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8590 - accuracy: 0.5061 - val\_loss: 1.1534 - val\_accuracy: 0.4922  
Epoch 134/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8310 - accuracy: 0.5469  
Epoch 134: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9050 - accuracy: 0.4413 - val\_loss: 1.1158 - val\_accuracy: 0.5389  
Epoch 135/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7683 - accuracy: 0.5156  
Epoch 135: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8578 - accuracy: 0.5017 - val\_loss: 1.1274 - val\_accuracy: 0.5285  
Epoch 136/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7752 - accuracy: 0.5000  
Epoch 136: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8433 - accuracy: 0.4950 - val\_loss: 1.1329 - val\_accuracy: 0.4974  
Epoch 137/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8891 - accuracy: 0.4766  
Epoch 137: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8495 - accuracy: 0.4983 - val\_loss: 1.1249 - val\_accuracy: 0.5337  
Epoch 138/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8697 - accuracy: 0.5234  
Epoch 138: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8596 - accuracy: 0.5196 - val\_loss: 1.1260 - val\_accuracy: 0.5337  
Epoch 139/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8499 - accuracy: 0.5234  
Epoch 139: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8647 - accuracy: 0.4860 - val\_loss: 1.1015 - val\_accuracy: 0.5337  
Epoch 140/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8264 - accuracy: 0.4922  
Epoch 140: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8164 - accuracy: 0.5061 - val\_loss: 1.1216 - val\_accuracy: 0.5337  
Epoch 141/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7361 - accuracy: 0.5703  
Epoch 141: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8827 - accuracy: 0.5330 - val\_loss: 1.1766 - val\_accuracy: 0.4301

Epoch 142/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8432 - accuracy: 0.4531  
Epoch 142: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.9044 - accuracy: 0.4156 - val\_loss: 1.1  
940 - val\_accuracy: 0.4352  
Epoch 143/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8823 - accuracy: 0.5156  
Epoch 143: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8685 - accuracy: 0.5061 - val\_loss: 1.0  
929 - val\_accuracy: 0.5648  
Epoch 144/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8447 - accuracy: 0.4609  
Epoch 144: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8506 - accuracy: 0.4346 - val\_loss: 1.  
1767 - val\_accuracy: 0.4352  
Epoch 145/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8086 - accuracy: 0.5000  
Epoch 145: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8888 - accuracy: 0.5263 - val\_loss: 1.0  
911 - val\_accuracy: 0.5337  
Epoch 146/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9674 - accuracy: 0.5000  
Epoch 146: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8360 - accuracy: 0.4559 - val\_loss: 1.1  
377 - val\_accuracy: 0.4715  
Epoch 147/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7811 - accuracy: 0.5078  
Epoch 147: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8426 - accuracy: 0.5117 - val\_loss: 1.  
1686 - val\_accuracy: 0.4560  
Epoch 148/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7641 - accuracy: 0.5000  
Epoch 148: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 11ms/step - loss: 0.8670 - accuracy: 0.4179 - val\_loss: 1.  
1668 - val\_accuracy: 0.4611  
Epoch 149/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9323 - accuracy: 0.4375  
Epoch 149: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8448 - accuracy: 0.5173 - val\_loss: 1.  
1073 - val\_accuracy: 0.5181  
Epoch 150/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7965 - accuracy: 0.4844  
Epoch 150: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8167 - accuracy: 0.4961 - val\_loss: 1.0  
677 - val\_accuracy: 0.5440  
Epoch 151/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9380 - accuracy: 0.4688  
Epoch 151: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8375 - accuracy: 0.5050 - val\_loss: 1.  
0685 - val\_accuracy: 0.5648  
Epoch 152/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8947 - accuracy: 0.5000  
Epoch 152: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 13ms/step - loss: 0.8447 - accuracy: 0.5240 - val\_loss: 1.  
1129 - val\_accuracy: 0.4767  
Epoch 153/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0099 - accuracy: 0.5000  
Epoch 153: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8188 - accuracy: 0.4894 - val\_loss: 1.0  
408 - val\_accuracy: 0.5544  
Epoch 154/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7436 - accuracy: 0.4844  
Epoch 154: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8386 - accuracy: 0.5251 - val\_loss: 1.  
1152 - val\_accuracy: 0.4663  
Epoch 155/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8083 - accuracy: 0.4531  
Epoch 155: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8666 - accuracy: 0.4637 - val\_loss: 1.0  
254 - val\_accuracy: 0.5648  
Epoch 156/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9065 - accuracy: 0.5078  
Epoch 156: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8626 - accuracy: 0.5084 - val\_loss: 1.  
1107 - val\_accuracy: 0.4922  
Epoch 157/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8838 - accuracy: 0.4375  
Epoch 157: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8683 - accuracy: 0.5117 - val\_loss: 1.0  
686 - val\_accuracy: 0.5389  
Epoch 158/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8463 - accuracy: 0.5469  
Epoch 158: val\_accuracy did not improve from 0.58549

7/7 [=====] - 0s 9ms/step - loss: 0.7747 - accuracy: 0.5218 - val\_loss: 1.1  
026 - val\_accuracy: 0.5181  
Epoch 159/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7073 - accuracy: 0.5156  
Epoch 159: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8115 - accuracy: 0.5050 - val\_loss: 1.0  
936 - val\_accuracy: 0.5078  
Epoch 160/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8737 - accuracy: 0.4609  
Epoch 160: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 9ms/step - loss: 0.8021 - accuracy: 0.5140 - val\_loss: 1.0  
881 - val\_accuracy: 0.5233  
Epoch 161/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8880 - accuracy: 0.5078  
Epoch 161: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 10ms/step - loss: 0.8120 - accuracy: 0.4883 - val\_loss: 1.  
0231 - val\_accuracy: 0.5648  
Epoch 162/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7985 - accuracy: 0.4766  
Epoch 162: val\_accuracy did not improve from 0.58549  
7/7 [=====] - 0s 8ms/step - loss: 0.8277 - accuracy: 0.5251 - val\_loss: 1.1  
452 - val\_accuracy: 0.4456  
Epoch 163/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8467 - accuracy: 0.4219  
Epoch 163: val\_accuracy improved from 0.58549 to 0.59067, saving model to /content/weightsMLP1.best.  
hdf5  
7/7 [=====] - 0s 12ms/step - loss: 0.8799 - accuracy: 0.4927 - val\_loss: 1.  
0136 - val\_accuracy: 0.5907  
Epoch 164/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8158 - accuracy: 0.5859  
Epoch 164: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 8ms/step - loss: 0.8601 - accuracy: 0.4916 - val\_loss: 1.1  
553 - val\_accuracy: 0.4352  
Epoch 165/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8083 - accuracy: 0.4375  
Epoch 165: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 14ms/step - loss: 0.8056 - accuracy: 0.5039 - val\_loss: 1.  
0764 - val\_accuracy: 0.4974  
Epoch 166/300  
7/7 [=====] - ETA: 0s - loss: 0.7854 - accuracy: 0.4849  
Epoch 166: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 21ms/step - loss: 0.7854 - accuracy: 0.4849 - val\_loss: 1.  
0418 - val\_accuracy: 0.5492  
Epoch 167/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7297 - accuracy: 0.5391  
Epoch 167: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 15ms/step - loss: 0.7881 - accuracy: 0.4883 - val\_loss: 1.  
0335 - val\_accuracy: 0.5492  
Epoch 168/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9793 - accuracy: 0.5234  
Epoch 168: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 15ms/step - loss: 0.8353 - accuracy: 0.5274 - val\_loss: 1.  
0219 - val\_accuracy: 0.5648  
Epoch 169/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7403 - accuracy: 0.5469  
Epoch 169: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 17ms/step - loss: 0.8577 - accuracy: 0.4994 - val\_loss: 1.  
0626 - val\_accuracy: 0.5285  
Epoch 170/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7915 - accuracy: 0.5469  
Epoch 170: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 9ms/step - loss: 0.8210 - accuracy: 0.5263 - val\_loss: 1.0  
529 - val\_accuracy: 0.5233  
Epoch 171/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8402 - accuracy: 0.5156  
Epoch 171: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 8ms/step - loss: 0.8176 - accuracy: 0.5128 - val\_loss: 1.0  
892 - val\_accuracy: 0.4922  
Epoch 172/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8193 - accuracy: 0.5156  
Epoch 172: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 11ms/step - loss: 0.8204 - accuracy: 0.5207 - val\_loss: 1.  
0417 - val\_accuracy: 0.5440  
Epoch 173/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7132 - accuracy: 0.5312  
Epoch 173: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 9ms/step - loss: 0.7393 - accuracy: 0.5117 - val\_loss: 0.9  
981 - val\_accuracy: 0.5699  
Epoch 174/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9538 - accuracy: 0.5547  
Epoch 174: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 11ms/step - loss: 0.8495 - accuracy: 0.5196 - val\_loss: 1.  
1080 - val\_accuracy: 0.4767

Epoch 175/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0491 - accuracy: 0.4453  
Epoch 175: val\_accuracy did not improve from 0.59067  
7/7 [=====] - 0s 14ms/step - loss: 0.8353 - accuracy: 0.5017 - val\_loss: 1.0350 - val\_accuracy: 0.5648  
Epoch 176/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8462 - accuracy: 0.4609  
Epoch 176: val\_accuracy improved from 0.59067 to 0.60104, saving model to /content/weightsMLP1.best.hdf5  
7/7 [=====] - 0s 26ms/step - loss: 0.8295 - accuracy: 0.4771 - val\_loss: 1.0056 - val\_accuracy: 0.6010  
Epoch 177/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0383 - accuracy: 0.5078  
Epoch 177: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.8928 - accuracy: 0.5028 - val\_loss: 1.1128 - val\_accuracy: 0.4715  
Epoch 178/300  
1/7 [==>.....] - ETA: 0s - loss: 1.0153 - accuracy: 0.4609  
Epoch 178: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 17ms/step - loss: 0.8373 - accuracy: 0.5128 - val\_loss: 0.9811 - val\_accuracy: 0.6010  
Epoch 179/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8347 - accuracy: 0.6250  
Epoch 179: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 16ms/step - loss: 0.8186 - accuracy: 0.5017 - val\_loss: 1.1379 - val\_accuracy: 0.4456  
Epoch 180/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9070 - accuracy: 0.4453  
Epoch 180: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 15ms/step - loss: 0.7842 - accuracy: 0.4704 - val\_loss: 0.9811 - val\_accuracy: 0.5803  
Epoch 181/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6226 - accuracy: 0.6094  
Epoch 181: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 16ms/step - loss: 0.8097 - accuracy: 0.5229 - val\_loss: 1.1155 - val\_accuracy: 0.4663  
Epoch 182/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7537 - accuracy: 0.4219  
Epoch 182: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 12ms/step - loss: 0.7824 - accuracy: 0.4950 - val\_loss: 0.9883 - val\_accuracy: 0.5855  
Epoch 183/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7489 - accuracy: 0.5312  
Epoch 183: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 14ms/step - loss: 0.7819 - accuracy: 0.5162 - val\_loss: 1.0303 - val\_accuracy: 0.5389  
Epoch 184/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8262 - accuracy: 0.5625  
Epoch 184: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 15ms/step - loss: 0.8210 - accuracy: 0.5263 - val\_loss: 1.0596 - val\_accuracy: 0.4922  
Epoch 185/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7345 - accuracy: 0.4375  
Epoch 185: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 11ms/step - loss: 0.7974 - accuracy: 0.5128 - val\_loss: 0.9664 - val\_accuracy: 0.5751  
Epoch 186/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6651 - accuracy: 0.5391  
Epoch 186: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.8438 - accuracy: 0.4749 - val\_loss: 1.0677 - val\_accuracy: 0.4974  
Epoch 187/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7952 - accuracy: 0.4531  
Epoch 187: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 14ms/step - loss: 0.8071 - accuracy: 0.5229 - val\_loss: 0.9894 - val\_accuracy: 0.5648  
Epoch 188/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9119 - accuracy: 0.5234  
Epoch 188: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 14ms/step - loss: 0.7853 - accuracy: 0.5196 - val\_loss: 1.0191 - val\_accuracy: 0.5337  
Epoch 189/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7789 - accuracy: 0.4844  
Epoch 189: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.7781 - accuracy: 0.5229 - val\_loss: 1.0110 - val\_accuracy: 0.5389  
Epoch 190/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7061 - accuracy: 0.5312  
Epoch 190: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 16ms/step - loss: 0.8205 - accuracy: 0.5251 - val\_loss: 1.0269 - val\_accuracy: 0.5285  
Epoch 191/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8017 - accuracy: 0.5208

Epoch 191: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 22ms/step - loss: 0.8155 - accuracy: 0.5173 - val\_loss: 1.0395 - val\_accuracy: 0.5026  
Epoch 192/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6671 - accuracy: 0.5156  
Epoch 192: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 17ms/step - loss: 0.7760 - accuracy: 0.5240 - val\_loss: 0.9750 - val\_accuracy: 0.5699  
Epoch 193/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.8112 - accuracy: 0.5375  
Epoch 193: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 20ms/step - loss: 0.7983 - accuracy: 0.5274 - val\_loss: 1.0277 - val\_accuracy: 0.5285  
Epoch 194/300  
7/7 [=====] - ETA: 0s - loss: 0.7955 - accuracy: 0.5307  
Epoch 194: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 20ms/step - loss: 0.7955 - accuracy: 0.5307 - val\_loss: 1.0140 - val\_accuracy: 0.5389  
Epoch 195/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6639 - accuracy: 0.4922  
Epoch 195: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 22ms/step - loss: 0.7963 - accuracy: 0.5263 - val\_loss: 0.9940 - val\_accuracy: 0.5440  
Epoch 196/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.8054 - accuracy: 0.5391  
Epoch 196: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 30ms/step - loss: 0.7606 - accuracy: 0.5408 - val\_loss: 0.9891 - val\_accuracy: 0.5544  
Epoch 197/300  
7/7 [=====] - ETA: 0s - loss: 0.7984 - accuracy: 0.5184  
Epoch 197: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 25ms/step - loss: 0.7984 - accuracy: 0.5184 - val\_loss: 1.0059 - val\_accuracy: 0.5389  
Epoch 198/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7526 - accuracy: 0.5104  
Epoch 198: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 41ms/step - loss: 0.7470 - accuracy: 0.5207 - val\_loss: 0.9650 - val\_accuracy: 0.5751  
Epoch 199/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.7932 - accuracy: 0.5328  
Epoch 199: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 46ms/step - loss: 0.8284 - accuracy: 0.5229 - val\_loss: 0.9830 - val\_accuracy: 0.5648  
Epoch 200/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.7988 - accuracy: 0.4922  
Epoch 200: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 49ms/step - loss: 0.8050 - accuracy: 0.4726 - val\_loss: 1.0676 - val\_accuracy: 0.4870  
Epoch 201/300  
4/7 [=====>.....] - ETA: 0s - loss: 0.8284 - accuracy: 0.5156  
Epoch 201: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 53ms/step - loss: 0.8297 - accuracy: 0.5307 - val\_loss: 1.0395 - val\_accuracy: 0.5130  
Epoch 202/300  
7/7 [=====] - ETA: 0s - loss: 0.7343 - accuracy: 0.5341  
Epoch 202: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 53ms/step - loss: 0.7343 - accuracy: 0.5341 - val\_loss: 1.0821 - val\_accuracy: 0.4715  
Epoch 203/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.8061 - accuracy: 0.4328  
Epoch 203: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 32ms/step - loss: 0.8403 - accuracy: 0.4302 - val\_loss: 1.0330 - val\_accuracy: 0.5026  
Epoch 204/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8134 - accuracy: 0.5430  
Epoch 204: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 28ms/step - loss: 0.8000 - accuracy: 0.5385 - val\_loss: 1.1008 - val\_accuracy: 0.4663  
Epoch 205/300  
7/7 [=====] - ETA: 0s - loss: 0.7989 - accuracy: 0.4257  
Epoch 205: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 27ms/step - loss: 0.7989 - accuracy: 0.4257 - val\_loss: 0.9855 - val\_accuracy: 0.5440  
Epoch 206/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8149 - accuracy: 0.5352  
Epoch 206: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 31ms/step - loss: 0.7938 - accuracy: 0.5296 - val\_loss: 1.0455 - val\_accuracy: 0.5078  
Epoch 207/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.7860 - accuracy: 0.5016  
Epoch 207: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 30ms/step - loss: 0.7900 - accuracy: 0.5095 - val\_loss: 0.9345 - val\_accuracy: 0.5959

Epoch 208/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8125 - accuracy: 0.5156  
Epoch 208: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 31ms/step - loss: 0.8162 - accuracy: 0.5084 - val\_loss: 1.0218 - val\_accuracy: 0.5078  
Epoch 209/300  
7/7 [=====] - ETA: 0s - loss: 0.8456 - accuracy: 0.4693  
Epoch 209: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 29ms/step - loss: 0.8456 - accuracy: 0.4693 - val\_loss: 0.9180 - val\_accuracy: 0.5803  
Epoch 210/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9629 - accuracy: 0.5703  
Epoch 210: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 19ms/step - loss: 0.8144 - accuracy: 0.5073 - val\_loss: 1.0572 - val\_accuracy: 0.4767  
Epoch 211/300  
7/7 [=====] - ETA: 0s - loss: 0.8698 - accuracy: 0.4950  
Epoch 211: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 31ms/step - loss: 0.8698 - accuracy: 0.4950 - val\_loss: 0.9692 - val\_accuracy: 0.5492  
Epoch 212/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7320 - accuracy: 0.5339  
Epoch 212: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 30ms/step - loss: 0.7550 - accuracy: 0.5408 - val\_loss: 0.9899 - val\_accuracy: 0.5337  
Epoch 213/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8358 - accuracy: 0.5781  
Epoch 213: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 23ms/step - loss: 0.8136 - accuracy: 0.5274 - val\_loss: 0.9779 - val\_accuracy: 0.5544  
Epoch 214/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.8460 - accuracy: 0.5109  
Epoch 214: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 27ms/step - loss: 0.8107 - accuracy: 0.4950 - val\_loss: 1.0631 - val\_accuracy: 0.4819  
Epoch 215/300  
7/7 [=====] - ETA: 0s - loss: 0.7559 - accuracy: 0.5274  
Epoch 215: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 30ms/step - loss: 0.7559 - accuracy: 0.5274 - val\_loss: 0.9217 - val\_accuracy: 0.5803  
Epoch 216/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.7406 - accuracy: 0.5052  
Epoch 216: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 28ms/step - loss: 0.7754 - accuracy: 0.5061 - val\_loss: 0.9722 - val\_accuracy: 0.5544  
Epoch 217/300  
5/7 [=====>.....] - ETA: 0s - loss: 0.8026 - accuracy: 0.5406  
Epoch 217: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 29ms/step - loss: 0.7899 - accuracy: 0.5140 - val\_loss: 1.0723 - val\_accuracy: 0.4819  
Epoch 218/300  
7/7 [=====] - ETA: 0s - loss: 0.8045 - accuracy: 0.5207  
Epoch 218: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 36ms/step - loss: 0.8045 - accuracy: 0.5207 - val\_loss: 1.0184 - val\_accuracy: 0.5181  
Epoch 219/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8217 - accuracy: 0.5326  
Epoch 219: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 21ms/step - loss: 0.8438 - accuracy: 0.5274 - val\_loss: 1.0018 - val\_accuracy: 0.5233  
Epoch 220/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7941 - accuracy: 0.5078  
Epoch 220: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 22ms/step - loss: 0.8092 - accuracy: 0.5207 - val\_loss: 0.9507 - val\_accuracy: 0.5751  
Epoch 221/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8547 - accuracy: 0.5547  
Epoch 221: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.8172 - accuracy: 0.5050 - val\_loss: 1.0378 - val\_accuracy: 0.5285  
Epoch 222/300  
7/7 [=====] - ETA: 0s - loss: 0.7430 - accuracy: 0.5274  
Epoch 222: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 21ms/step - loss: 0.7430 - accuracy: 0.5274 - val\_loss: 1.0916 - val\_accuracy: 0.4767  
Epoch 223/300  
1/7 [==>.....] - ETA: 0s - loss: 1.3126 - accuracy: 0.4531  
Epoch 223: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 14ms/step - loss: 0.8711 - accuracy: 0.4391 - val\_loss: 0.9840 - val\_accuracy: 0.5492  
Epoch 224/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8888 - accuracy: 0.4922  
Epoch 224: val\_accuracy did not improve from 0.60104

7/7 [=====] - 0s 15ms/step - loss: 0.7848 - accuracy: 0.5263 - val\_loss: 1.  
0392 - val\_accuracy: 0.5181  
Epoch 225/300  
6/7 [=====>.....] - ETA: 0s - loss: 0.8056 - accuracy: 0.5404  
Epoch 225: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 17ms/step - loss: 0.8082 - accuracy: 0.5374 - val\_loss: 0.  
9911 - val\_accuracy: 0.5337  
Epoch 226/300  
1/7 [====>.....] - ETA: 0s - loss: 1.0013 - accuracy: 0.4688  
Epoch 226: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 8ms/step - loss: 0.8043 - accuracy: 0.4592 - val\_loss: 0.9  
934 - val\_accuracy: 0.5337  
Epoch 227/300  
1/7 [====>.....] - ETA: 0s - loss: 0.7547 - accuracy: 0.4766  
Epoch 227: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7744 - accuracy: 0.5620 - val\_loss: 1.  
0887 - val\_accuracy: 0.4767  
Epoch 228/300  
1/7 [====>.....] - ETA: 0s - loss: 0.7079 - accuracy: 0.4531  
Epoch 228: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 9ms/step - loss: 0.8006 - accuracy: 0.4268 - val\_loss: 0.9  
865 - val\_accuracy: 0.5285  
Epoch 229/300  
1/7 [====>.....] - ETA: 0s - loss: 0.7608 - accuracy: 0.6172  
Epoch 229: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 9ms/step - loss: 0.7942 - accuracy: 0.5631 - val\_loss: 0.9  
956 - val\_accuracy: 0.5389  
Epoch 230/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6423 - accuracy: 0.5312  
Epoch 230: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 14ms/step - loss: 0.7275 - accuracy: 0.5061 - val\_loss: 0.  
9595 - val\_accuracy: 0.5337  
Epoch 231/300  
1/7 [====>.....] - ETA: 0s - loss: 0.8569 - accuracy: 0.5000  
Epoch 231: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.7461 - accuracy: 0.5385 - val\_loss: 0.  
9625 - val\_accuracy: 0.5285  
Epoch 232/300  
1/7 [====>.....] - ETA: 0s - loss: 0.7787 - accuracy: 0.5781  
Epoch 232: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7674 - accuracy: 0.5408 - val\_loss: 0.  
9377 - val\_accuracy: 0.5544  
Epoch 233/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6029 - accuracy: 0.5234  
Epoch 233: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7471 - accuracy: 0.5162 - val\_loss: 0.  
9466 - val\_accuracy: 0.5492  
Epoch 234/300  
1/7 [====>.....] - ETA: 0s - loss: 0.8410 - accuracy: 0.6484  
Epoch 234: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7573 - accuracy: 0.5453 - val\_loss: 1.  
0323 - val\_accuracy: 0.4819  
Epoch 235/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6095 - accuracy: 0.4844  
Epoch 235: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 12ms/step - loss: 0.8314 - accuracy: 0.5117 - val\_loss: 0.  
9701 - val\_accuracy: 0.5389  
Epoch 236/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6463 - accuracy: 0.5781  
Epoch 236: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7497 - accuracy: 0.4670 - val\_loss: 1.  
0285 - val\_accuracy: 0.5026  
Epoch 237/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6136 - accuracy: 0.5078  
Epoch 237: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 11ms/step - loss: 0.7791 - accuracy: 0.5464 - val\_loss: 0.  
9918 - val\_accuracy: 0.5337  
Epoch 238/300  
1/7 [====>.....] - ETA: 0s - loss: 0.8129 - accuracy: 0.4453  
Epoch 238: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 11ms/step - loss: 0.8050 - accuracy: 0.5162 - val\_loss: 0.  
9715 - val\_accuracy: 0.5389  
Epoch 239/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6369 - accuracy: 0.5625  
Epoch 239: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7650 - accuracy: 0.5341 - val\_loss: 0.  
9717 - val\_accuracy: 0.5544  
Epoch 240/300  
1/7 [====>.....] - ETA: 0s - loss: 0.6908 - accuracy: 0.6094  
Epoch 240: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.8199 - accuracy: 0.5128 - val\_loss: 0.  
9678 - val\_accuracy: 0.5440  
Epoch 241/300



1/7 [===>.....] - ETA: 0s - loss: 0.8611 - accuracy: 0.5781  
Epoch 241: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.7665 - accuracy: 0.5374 - val\_loss: 0.  
9847 - val\_accuracy: 0.5492  
Epoch 242/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6891 - accuracy: 0.6172  
Epoch 242: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7796 - accuracy: 0.5307 - val\_loss: 0.  
9792 - val\_accuracy: 0.5389  
Epoch 243/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7074 - accuracy: 0.4844  
Epoch 243: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 11ms/step - loss: 0.7586 - accuracy: 0.5162 - val\_loss: 1.  
0641 - val\_accuracy: 0.4922  
Epoch 244/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9796 - accuracy: 0.3906  
Epoch 244: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 13ms/step - loss: 0.7923 - accuracy: 0.5173 - val\_loss: 0.  
9326 - val\_accuracy: 0.5907  
Epoch 245/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7303 - accuracy: 0.5547  
Epoch 245: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7777 - accuracy: 0.4950 - val\_loss: 0.  
9685 - val\_accuracy: 0.5596  
Epoch 246/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9138 - accuracy: 0.4375  
Epoch 246: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 10ms/step - loss: 0.7319 - accuracy: 0.5475 - val\_loss: 1.  
0064 - val\_accuracy: 0.5130  
Epoch 247/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6977 - accuracy: 0.5703  
Epoch 247: val\_accuracy did not improve from 0.60104  
7/7 [=====] - 0s 9ms/step - loss: 0.7219 - accuracy: 0.5374 - val\_loss: 1.0  
143 - val\_accuracy: 0.4974  
Epoch 248/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6656 - accuracy: 0.4922  
Epoch 248: val\_accuracy improved from 0.60104 to 0.60622, saving model to /content/weightsMLP1.best.  
hdf5  
7/7 [=====] - 0s 16ms/step - loss: 0.7630 - accuracy: 0.4983 - val\_loss: 0.  
8973 - val\_accuracy: 0.6062  
Epoch 249/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7160 - accuracy: 0.6094  
Epoch 249: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7622 - accuracy: 0.5430 - val\_loss: 0.9  
870 - val\_accuracy: 0.5389  
Epoch 250/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7543 - accuracy: 0.5703  
Epoch 250: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7690 - accuracy: 0.5642 - val\_loss: 0.  
9486 - val\_accuracy: 0.5389  
Epoch 251/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7040 - accuracy: 0.5703  
Epoch 251: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 11ms/step - loss: 0.7417 - accuracy: 0.5453 - val\_loss: 0.  
9163 - val\_accuracy: 0.5751  
Epoch 252/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9006 - accuracy: 0.5312  
Epoch 252: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 12ms/step - loss: 0.7679 - accuracy: 0.4927 - val\_loss: 1.  
0226 - val\_accuracy: 0.4974  
Epoch 253/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9813 - accuracy: 0.4453  
Epoch 253: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 11ms/step - loss: 0.8709 - accuracy: 0.5251 - val\_loss: 0.  
9593 - val\_accuracy: 0.5699  
Epoch 254/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8549 - accuracy: 0.4844  
Epoch 254: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7588 - accuracy: 0.5296 - val\_loss: 0.  
9844 - val\_accuracy: 0.5389  
Epoch 255/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7115 - accuracy: 0.4922  
Epoch 255: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 11ms/step - loss: 0.7777 - accuracy: 0.5318 - val\_loss: 0.  
9550 - val\_accuracy: 0.5492  
Epoch 256/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8306 - accuracy: 0.5547  
Epoch 256: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7615 - accuracy: 0.5296 - val\_loss: 0.  
9357 - val\_accuracy: 0.5544  
Epoch 257/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6415 - accuracy: 0.5469  
Epoch 257: val\_accuracy did not improve from 0.60622

7/7 [=====] - 0s 10ms/step - loss: 0.6600 - accuracy: 0.5464 - val\_loss: 0.  
9362 - val\_accuracy: 0.5751  
Epoch 258/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6766 - accuracy: 0.5938  
Epoch 258: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7387 - accuracy: 0.5285 - val\_loss: 0.  
9537 - val\_accuracy: 0.5596  
Epoch 259/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6592 - accuracy: 0.5312  
Epoch 259: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 11ms/step - loss: 0.7005 - accuracy: 0.5497 - val\_loss: 0.  
9764 - val\_accuracy: 0.5285  
Epoch 260/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6528 - accuracy: 0.4922  
Epoch 260: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7236 - accuracy: 0.5531 - val\_loss: 0.  
9374 - val\_accuracy: 0.5440  
Epoch 261/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6000 - accuracy: 0.6016  
Epoch 261: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 12ms/step - loss: 0.7171 - accuracy: 0.5665 - val\_loss: 0.  
9130 - val\_accuracy: 0.5751  
Epoch 262/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8765 - accuracy: 0.5625  
Epoch 262: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7766 - accuracy: 0.5330 - val\_loss: 0.  
9432 - val\_accuracy: 0.5648  
Epoch 263/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8314 - accuracy: 0.5547  
Epoch 263: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 13ms/step - loss: 0.8037 - accuracy: 0.5453 - val\_loss: 0.  
9748 - val\_accuracy: 0.5337  
Epoch 264/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6410 - accuracy: 0.5391  
Epoch 264: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 12ms/step - loss: 0.7527 - accuracy: 0.5620 - val\_loss: 0.  
9438 - val\_accuracy: 0.5596  
Epoch 265/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6360 - accuracy: 0.6094  
Epoch 265: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7263 - accuracy: 0.5765 - val\_loss: 0.9  
559 - val\_accuracy: 0.5544  
Epoch 266/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7896 - accuracy: 0.5781  
Epoch 266: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.6964 - accuracy: 0.5721 - val\_loss: 0.8  
990 - val\_accuracy: 0.6062  
Epoch 267/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9715 - accuracy: 0.6172  
Epoch 267: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 14ms/step - loss: 0.7512 - accuracy: 0.5676 - val\_loss: 0.  
9281 - val\_accuracy: 0.5855  
Epoch 268/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6904 - accuracy: 0.5938  
Epoch 268: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7868 - accuracy: 0.5419 - val\_loss: 0.9  
865 - val\_accuracy: 0.5181  
Epoch 269/300  
1/7 [==>.....] - ETA: 0s - loss: 0.7259 - accuracy: 0.5000  
Epoch 269: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7376 - accuracy: 0.5642 - val\_loss: 0.9  
986 - val\_accuracy: 0.5337  
Epoch 270/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8911 - accuracy: 0.5547  
Epoch 270: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7406 - accuracy: 0.5609 - val\_loss: 0.9  
117 - val\_accuracy: 0.6062  
Epoch 271/300  
1/7 [==>.....] - ETA: 0s - loss: 0.6984 - accuracy: 0.6719  
Epoch 271: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7684 - accuracy: 0.5486 - val\_loss: 0.9  
397 - val\_accuracy: 0.5596  
Epoch 272/300  
1/7 [==>.....] - ETA: 0s - loss: 0.9083 - accuracy: 0.5703  
Epoch 272: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7698 - accuracy: 0.5609 - val\_loss: 0.9  
325 - val\_accuracy: 0.5751  
Epoch 273/300  
1/7 [==>.....] - ETA: 0s - loss: 0.8957 - accuracy: 0.5078  
Epoch 273: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 8ms/step - loss: 0.7932 - accuracy: 0.5654 - val\_loss: 0.9  
386 - val\_accuracy: 0.5751  
Epoch 274/300

1/7 [===>.....] - ETA: 0s - loss: 0.8096 - accuracy: 0.5469  
Epoch 274: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 9ms/step - loss: 0.7348 - accuracy: 0.5754 - val\_loss: 1.0  
061 - val\_accuracy: 0.5440  
Epoch 275/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7312 - accuracy: 0.5703  
Epoch 275: val\_accuracy did not improve from 0.60622  
7/7 [=====] - 0s 10ms/step - loss: 0.7743 - accuracy: 0.5609 - val\_loss: 0.  
9291 - val\_accuracy: 0.5751  
Epoch 276/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6586 - accuracy: 0.5156  
Epoch 276: val\_accuracy improved from 0.60622 to 0.61140, saving model to /content/weightsMLP1.best.  
hdf5  
7/7 [=====] - 0s 14ms/step - loss: 0.7096 - accuracy: 0.5642 - val\_loss: 0.  
8809 - val\_accuracy: 0.6114  
Epoch 277/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9082 - accuracy: 0.6641  
Epoch 277: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 8ms/step - loss: 0.7587 - accuracy: 0.5877 - val\_loss: 0.9  
494 - val\_accuracy: 0.5544  
Epoch 278/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7987 - accuracy: 0.5391  
Epoch 278: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 9ms/step - loss: 0.7534 - accuracy: 0.5888 - val\_loss: 1.0  
233 - val\_accuracy: 0.5078  
Epoch 279/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7600 - accuracy: 0.5078  
Epoch 279: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.6948 - accuracy: 0.5609 - val\_loss: 0.  
9350 - val\_accuracy: 0.5544  
Epoch 280/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7729 - accuracy: 0.5000  
Epoch 280: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.7023 - accuracy: 0.5821 - val\_loss: 0.  
9035 - val\_accuracy: 0.5855  
Epoch 281/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7020 - accuracy: 0.5703  
Epoch 281: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 9ms/step - loss: 0.8028 - accuracy: 0.5508 - val\_loss: 0.9  
761 - val\_accuracy: 0.5337  
Epoch 282/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7127 - accuracy: 0.5547  
Epoch 282: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.7520 - accuracy: 0.5598 - val\_loss: 1.  
0287 - val\_accuracy: 0.4922  
Epoch 283/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9404 - accuracy: 0.4922  
Epoch 283: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 11ms/step - loss: 0.7828 - accuracy: 0.5531 - val\_loss: 0.  
9502 - val\_accuracy: 0.5596  
Epoch 284/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8817 - accuracy: 0.5000  
Epoch 284: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.7301 - accuracy: 0.5542 - val\_loss: 0.  
8926 - val\_accuracy: 0.5907  
Epoch 285/300  
1/7 [===>.....] - ETA: 0s - loss: 0.9364 - accuracy: 0.6719  
Epoch 285: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 13ms/step - loss: 0.7868 - accuracy: 0.6078 - val\_loss: 0.  
9728 - val\_accuracy: 0.5544  
Epoch 286/300  
1/7 [===>.....] - ETA: 0s - loss: 0.8180 - accuracy: 0.6016  
Epoch 286: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.7232 - accuracy: 0.5743 - val\_loss: 0.  
9080 - val\_accuracy: 0.5907  
Epoch 287/300  
1/7 [===>.....] - ETA: 0s - loss: 0.5527 - accuracy: 0.6875  
Epoch 287: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 11ms/step - loss: 0.7479 - accuracy: 0.6112 - val\_loss: 0.  
9515 - val\_accuracy: 0.5699  
Epoch 288/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6295 - accuracy: 0.5781  
Epoch 288: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.6465 - accuracy: 0.5888 - val\_loss: 0.  
9307 - val\_accuracy: 0.5596  
Epoch 289/300  
1/7 [===>.....] - ETA: 0s - loss: 0.6014 - accuracy: 0.6328  
Epoch 289: val\_accuracy did not improve from 0.61140  
7/7 [=====] - 0s 10ms/step - loss: 0.7144 - accuracy: 0.5911 - val\_loss: 0.  
9678 - val\_accuracy: 0.5596  
Epoch 290/300  
1/7 [===>.....] - ETA: 0s - loss: 0.7438 - accuracy: 0.4922  
Epoch 290: val\_accuracy did not improve from 0.61140

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7/7 [=====] - 0s 11ms/step - loss: 0.6795 - accuracy: 0.5911 - val_loss: 0.
9312 - val_accuracy: 0.5440
Epoch 291/300
1/7 [==>.....] - ETA: 0s - loss: 0.5579 - accuracy: 0.6328
Epoch 291: val_accuracy did not improve from 0.61140
7/7 [=====] - 0s 10ms/step - loss: 0.7435 - accuracy: 0.5866 - val_loss: 0.
9432 - val_accuracy: 0.5648
Epoch 292/300
1/7 [==>.....] - ETA: 0s - loss: 0.6817 - accuracy: 0.6328
Epoch 292: val_accuracy did not improve from 0.61140
7/7 [=====] - 0s 13ms/step - loss: 0.7145 - accuracy: 0.6056 - val_loss: 0.
9505 - val_accuracy: 0.5492
Epoch 293/300
1/7 [==>.....] - ETA: 0s - loss: 0.7723 - accuracy: 0.5781
Epoch 293: val_accuracy did not improve from 0.61140
7/7 [=====] - 0s 10ms/step - loss: 0.7374 - accuracy: 0.6212 - val_loss: 0.
9628 - val_accuracy: 0.5337
Epoch 294/300
1/7 [==>.....] - ETA: 0s - loss: 0.8028 - accuracy: 0.6172
Epoch 294: val_accuracy did not improve from 0.61140
7/7 [=====] - 0s 11ms/step - loss: 0.7267 - accuracy: 0.6078 - val_loss: 0.
9137 - val_accuracy: 0.5648
Epoch 295/300
1/7 [==>.....] - ETA: 0s - loss: 0.5358 - accuracy: 0.6172
Epoch 295: val_accuracy did not improve from 0.61140
7/7 [=====] - 0s 9ms/step - loss: 0.6921 - accuracy: 0.6324 - val_loss: 1.0
667 - val_accuracy: 0.5026
Epoch 296/300
1/7 [==>.....] - ETA: 0s - loss: 0.6512 - accuracy: 0.5156
Epoch 296: val_accuracy improved from 0.61140 to 0.61658, saving model to /content/weightsMLP1.best.
hdf5
7/7 [=====] - 0s 15ms/step - loss: 0.7476 - accuracy: 0.5464 - val_loss: 0.
8900 - val_accuracy: 0.6166
Epoch 297/300
1/7 [==>.....] - ETA: 0s - loss: 0.6114 - accuracy: 0.6250
Epoch 297: val_accuracy did not improve from 0.61658
7/7 [=====] - 0s 10ms/step - loss: 0.7302 - accuracy: 0.5698 - val_loss: 1.
0062 - val_accuracy: 0.4767
Epoch 298/300
1/7 [==>.....] - ETA: 0s - loss: 0.8942 - accuracy: 0.4688
Epoch 298: val_accuracy did not improve from 0.61658
7/7 [=====] - 0s 9ms/step - loss: 0.7480 - accuracy: 0.5989 - val_loss: 0.9
602 - val_accuracy: 0.5181
Epoch 299/300
1/7 [==>.....] - ETA: 0s - loss: 0.9159 - accuracy: 0.5469
Epoch 299: val_accuracy did not improve from 0.61658
7/7 [=====] - 0s 10ms/step - loss: 0.7883 - accuracy: 0.5709 - val_loss: 0.
9384 - val_accuracy: 0.5648
Epoch 300/300
1/7 [==>.....] - ETA: 0s - loss: 0.8430 - accuracy: 0.6484
Epoch 300: val_accuracy did not improve from 0.61658
7/7 [=====] - 0s 9ms/step - loss: 0.7818 - accuracy: 0.5911 - val_loss: 0.9
931 - val_accuracy: 0.5181

```

In [314]:

```

model.load_weights("/content/weightsMLP1.best.hdf5")
adam = keras.optimizers.Adam(learning_rate=0.0001)
model.compile(loss='categorical_crossentropy', metrics=['accuracy'], optimizer='adam')
print("Created model and loaded weights from file")

```

Created model and loaded weights from file

In [315]:

```

results.loc[index,['Architecture','Dropout','Loss Fn', 'LR']] = ['ANN: MLP',0.1, 'Cross-Entropy',0.0001]

```

### Evaluation: Training and Validation

In [316]:

```

evaluation_train_val(model,X_train,Y_train,X_val,Y_val,results, index)

```

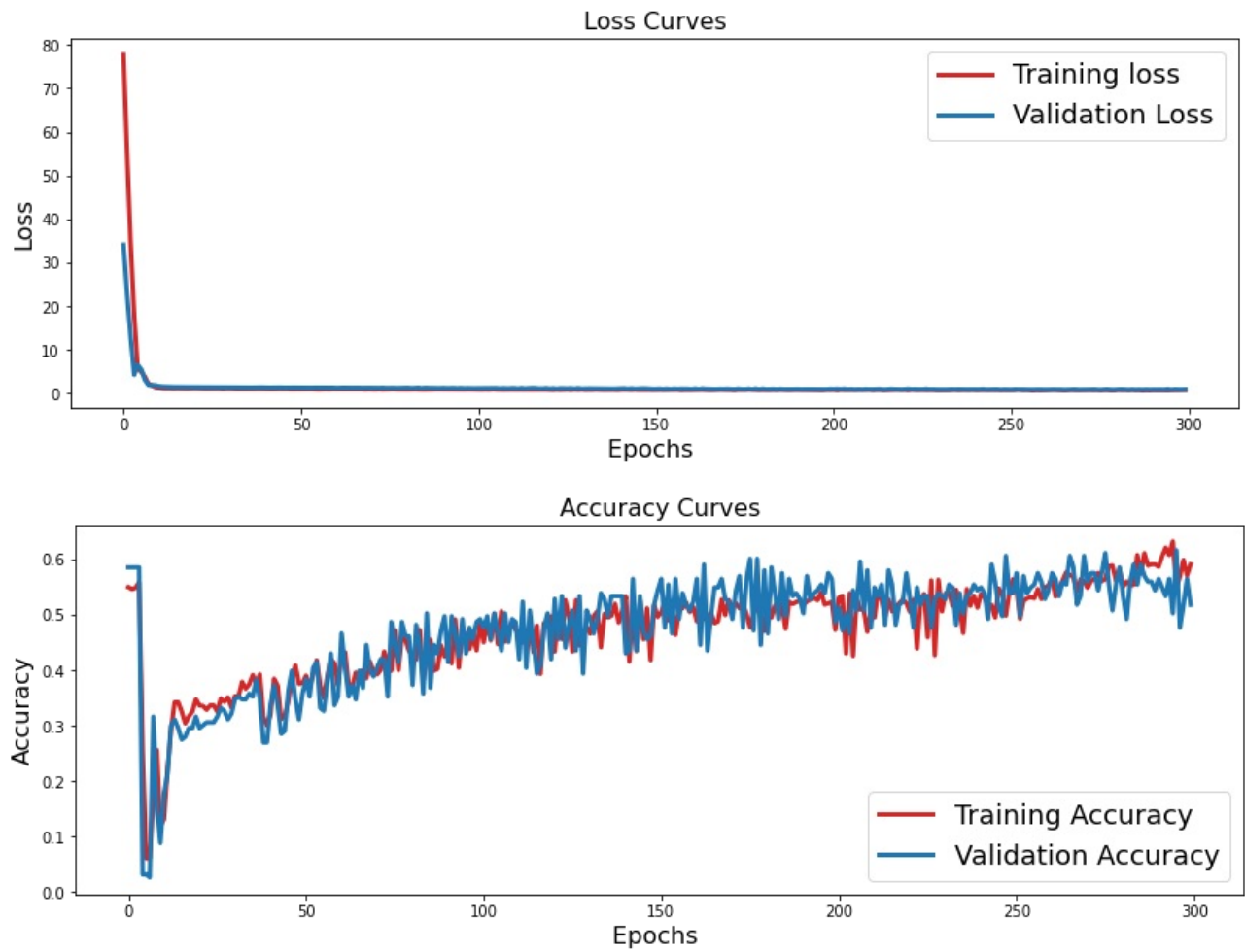
```

Training Accuracy: 0.642463207244873
Training Loss: 0.8273573517799377
Validation Accuracy: 0.6994818449020386
Validation Loss: 0.7287982106208801

```

In [317]:

```
plotfn(history)
```



Evaluation: Testing

In [318]:

```
evaluation_test(model, X_test, Y_test, results, index)
```

7/7 [=====] - 0s 2ms/step - loss: 0.9861 - accuracy: 0.5648  
Test accuracy: 0.5647668242454529  
Test loss: 0.9860582947731018

Evaluation Metrics

F1 score

In [319]:

```
_,_,_, val_f1 = predictfn(model, X_val,Y_val)
```

7/7 [=====] - 0s 2ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.83	0.91	18
extrastole	0.73	0.36	0.48	22
murmur	0.84	0.60	0.70	77
normal	0.59	0.87	0.70	76
accuracy			0.70	193
macro avg	0.79	0.67	0.70	193
weighted avg	0.74	0.70	0.69	193

In [320]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model,X_test,Y_test)
```

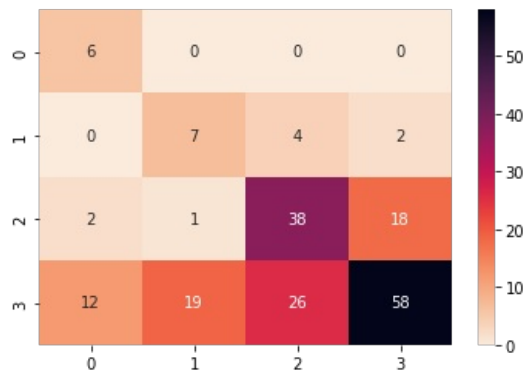
7/7 [=====] - 0s 2ms/step

	precision	recall	f1-score	support
extrahls	1.00	0.30	0.46	20
extrastole	0.54	0.26	0.35	27
murmur	0.64	0.56	0.60	68
normal	0.50	0.74	0.60	78
accuracy			0.56	193
macro avg	0.67	0.47	0.50	193
weighted avg	0.61	0.56	0.55	193

Confusion Matrix

In [321]:

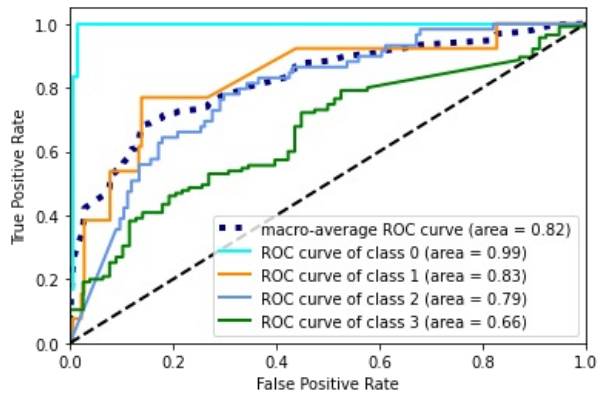
```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

In [322]:

```
roc = plot_ROC(Y_test,predictions)
```



```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547
3	CNN 2D	0.0001	0.2	KL divergence	0.984358	0.079908	0.911917	0.285003	0.797927	0.508575	0.911012	0.799109	0.958595
4	CNN 2D	0.001	0.2	Cross-Entropy	0.994413	0.021668	0.917098	0.27322	0.834197	0.566831	0.91787	0.837258	0.960526
5	CNN 1D	0.0001	0.2	Cross-Entropy	0.832402	0.413392	0.699482	1.062132	0.61658	1.164043	0.705761	0.607259	0.791756
6	ANN: MLP	0.0001	0.1	Cross-Entropy	0.642463	0.827357	0.699482	0.728798	0.564767	0.986058	0.694605	0.550542	0.822062

```
y_pred = model.predict(X_test)
y_pred=np.argmax(y_pred, axis=1)
y_pred = to_categorical(y_pred)
```

### Predicting a sample's label

```
model_name = "heartbeat_classifierMLP.h5"
model.save(model_name)
```

```
test.iloc[5]
```

[illegible]

```
sample_predict(model_name,5)
```

### Predicting a Normal sample

```
test.iloc[50]
```

```
filename      /content/set_a/normal__201101151127.wav  
label          normal  
offset         3  
Name: 165, dtype: object
```

In [329]:

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 0s 98ms/step
Label Prediction Probabilities: [[4.6350519e-04 4.4754567e-03 2.5066785e-03 9.9255437e-01]]
-----
Label:
Normal heartbeat
confidence: 0.99255437
```

### ***Predicting an Extrahls sample***

In [332]:

```
test.iloc[77]
```

Out[332]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [331]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 123ms/step
Label Prediction Probabilities: [[9.8158789e-01 2.3945267e-04 4.5780740e-03 1.3594598e-02]]
-----
Label:
Extrahls heartbeat
confidence: 0.9815879
```

### ***Predicting a Extrasystole sample***

In [377]:

```
test.iloc[24]
```

Out[377]:

```
filename    /content/set_b/extrastole__191_1308077299430_A...
label                               extrastole
offset                                           7
Name: 626, dtype: object
```

In [338]:

```
sample_predict(model_name,24)
```

```
1/1 [=====] - 0s 123ms/step
Label Prediction Probabilities: [[0.00204702 0.7384129 0.05717043 0.20236965]]
-----
Label:
Extrasystole heartbeat
confidence: 0.7384129
```

## **ANN Experiment 2:**

### ***Changing Parameters:***

Using a diff loss function like Poisson Loss or KL Divergence Loss didn't improve the accuracy. Therefore, we changed the **Learning Rate**.



In [349]:

```
model = Sequential()
model.add(Dense(32, input_shape = (X_train[1].shape), activation = "relu" ))
model.add(Dense(16, activation = "relu"))
model.add(Dense(8, activation = "relu"))
model.add(Dense(4, activation = "relu"))
model.add(Dropout(0.1))
model.add(Dense(len(encoder.classes_), activation = "softmax"))
model.summary()
```

Model: "sequential\_17"

Layer (type)	Output Shape	Param #
dense_43 (Dense)	(None, 32)	1312
dense_44 (Dense)	(None, 16)	528
dense_45 (Dense)	(None, 8)	136
dense_46 (Dense)	(None, 4)	36
dropout_41 (Dropout)	(None, 4)	0
dense_47 (Dense)	(None, 4)	20
Total params: 2,032		
Trainable params: 2,032		
Non-trainable params: 0		

In [350]:

```
adam = keras.optimizers.Adam(learning_rate=0.001)
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
filepath="/content/weightsMLP2.best.hdf5"
checkpoint = ModelCheckpoint(filepath, monitor='val_accuracy', verbose=1, save_best_only=True, mode='max')
history = model.fit(X_train, Y_train, epochs=300, verbose=1, validation_split=0.17647059, shuffle=True, callbacks
= [checkpoint], class_weight=classWeights)
```

Epoch 1/300

20/28 [=====>.....] - ETA: 0s - loss: 9.6734 - accuracy: 0.2797

Epoch 1: val\_accuracy improved from -inf to 0.21244, saving model to /content/weightsMLP2.best.hdf5

28/28 [=====>.....] - 1s 11ms/step - loss: 7.8571 - accuracy: 0.2626 - val\_loss:

1.4963 - val\_accuracy: 0.2124

Epoch 2/300

27/28 [=====>..] - ETA: 0s - loss: 1.5291 - accuracy: 0.3623

Epoch 2: val\_accuracy did not improve from 0.21244

28/28 [=====>.....] - 0s 4ms/step - loss: 1.5274 - accuracy: 0.3542 - val\_loss: 1

.3965 - val\_accuracy: 0.1192

Epoch 3/300

26/28 [=====>...] - ETA: 0s - loss: 1.4638 - accuracy: 0.2260

Epoch 3: val\_accuracy improved from 0.21244 to 0.24352, saving model to /content/weightsMLP2.best.hdf5

28/28 [=====>.....] - 0s 5ms/step - loss: 1.4655 - accuracy: 0.2268 - val\_loss: 1

.3594 - val\_accuracy: 0.2435

Epoch 4/300

20/28 [=====>.....] - ETA: 0s - loss: 1.4124 - accuracy: 0.2672

Epoch 4: val\_accuracy improved from 0.24352 to 0.40933, saving model to /content/weightsMLP2.best.hdf5

28/28 [=====>.....] - 0s 5ms/step - loss: 1.4504 - accuracy: 0.2916 - val\_loss: 1

.3034 - val\_accuracy: 0.4093

Epoch 5/300

26/28 [=====>...] - ETA: 0s - loss: 1.4051 - accuracy: 0.4591

Epoch 5: val\_accuracy improved from 0.40933 to 0.50777, saving model to /content/weightsMLP2.best.hdf5

28/28 [=====>.....] - 0s 4ms/step - loss: 1.4317 - accuracy: 0.4570 - val\_loss: 1

.2261 - val\_accuracy: 0.5078

Epoch 6/300

25/28 [=====>....] - ETA: 0s - loss: 1.3992 - accuracy: 0.5013

Epoch 6: val\_accuracy did not improve from 0.50777

28/28 [=====>.....] - 0s 3ms/step - loss: 1.4111 - accuracy: 0.5028 - val\_loss: 1

.2313 - val\_accuracy: 0.4767

Epoch 7/300

26/28 [=====>...] - ETA: 0s - loss: 1.3920 - accuracy: 0.4964

Epoch 7: val\_accuracy did not improve from 0.50777

28/28 [=====>.....] - 0s 3ms/step - loss: 1.3931 - accuracy: 0.4994 - val\_loss: 1

.2322 - val\_accuracy: 0.4819

Epoch 8/300

24/28 [=====>.....] - ETA: 0s - loss: 1.4084 - accuracy: 0.4935

Epoch 8: val\_accuracy did not improve from 0.50777

28/28 [=====] - 0s 4ms/step - loss: 1.3862 - accuracy: 0.4972 - val\_loss: 1.1970 - val\_accuracy: 0.4974  
Epoch 9/300  
27/28 [=====>..] - ETA: 0s - loss: 1.3717 - accuracy: 0.5127  
Epoch 9: val\_accuracy improved from 0.50777 to 0.51813, saving model to /content/weightsMLP2.best.hdf5  
28/28 [=====] - 0s 5ms/step - loss: 1.3676 - accuracy: 0.5106 - val\_loss: 1.1292 - val\_accuracy: 0.5181  
Epoch 10/300  
27/28 [=====>..] - ETA: 0s - loss: 1.3479 - accuracy: 0.5104  
Epoch 10: val\_accuracy did not improve from 0.51813  
28/28 [=====] - 0s 3ms/step - loss: 1.3588 - accuracy: 0.5140 - val\_loss: 1.1158 - val\_accuracy: 0.5181  
Epoch 11/300  
19/28 [=====>.....] - ETA: 0s - loss: 1.2674 - accuracy: 0.5230  
Epoch 11: val\_accuracy did not improve from 0.51813  
28/28 [=====] - 0s 4ms/step - loss: 1.3470 - accuracy: 0.5106 - val\_loss: 1.1412 - val\_accuracy: 0.5130  
Epoch 12/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.3647 - accuracy: 0.5014  
Epoch 12: val\_accuracy did not improve from 0.51813  
28/28 [=====] - 0s 4ms/step - loss: 1.3363 - accuracy: 0.5084 - val\_loss: 1.1125 - val\_accuracy: 0.5181  
Epoch 13/300  
26/28 [=====>...] - ETA: 0s - loss: 1.3556 - accuracy: 0.5192  
Epoch 13: val\_accuracy improved from 0.51813 to 0.52332, saving model to /content/weightsMLP2.best.hdf5  
28/28 [=====] - 0s 4ms/step - loss: 1.3220 - accuracy: 0.5207 - val\_loss: 1.0944 - val\_accuracy: 0.5233  
Epoch 14/300  
19/28 [=====>.....] - ETA: 0s - loss: 1.3587 - accuracy: 0.5099  
Epoch 14: val\_accuracy did not improve from 0.52332  
28/28 [=====] - 0s 5ms/step - loss: 1.3173 - accuracy: 0.5173 - val\_loss: 1.1247 - val\_accuracy: 0.5181  
Epoch 15/300  
16/28 [=====>.....] - ETA: 0s - loss: 1.3729 - accuracy: 0.5176  
Epoch 15: val\_accuracy did not improve from 0.52332  
28/28 [=====] - 0s 5ms/step - loss: 1.3034 - accuracy: 0.5296 - val\_loss: 1.1275 - val\_accuracy: 0.5181  
Epoch 16/300  
26/28 [=====>...] - ETA: 0s - loss: 1.3156 - accuracy: 0.5192  
Epoch 16: val\_accuracy did not improve from 0.52332  
28/28 [=====] - 0s 6ms/step - loss: 1.2972 - accuracy: 0.5151 - val\_loss: 1.1186 - val\_accuracy: 0.5233  
Epoch 17/300  
15/28 [=====>.....] - ETA: 0s - loss: 1.2440 - accuracy: 0.5104  
Epoch 17: val\_accuracy improved from 0.52332 to 0.52850, saving model to /content/weightsMLP2.best.hdf5  
28/28 [=====] - 0s 7ms/step - loss: 1.2850 - accuracy: 0.5263 - val\_loss: 1.1083 - val\_accuracy: 0.5285  
Epoch 18/300  
16/28 [=====>.....] - ETA: 0s - loss: 1.1970 - accuracy: 0.5332  
Epoch 18: val\_accuracy did not improve from 0.52850  
28/28 [=====] - 0s 5ms/step - loss: 1.2713 - accuracy: 0.5296 - val\_loss: 1.1059 - val\_accuracy: 0.5233  
Epoch 19/300  
27/28 [=====>..] - ETA: 0s - loss: 1.2729 - accuracy: 0.5324  
Epoch 19: val\_accuracy did not improve from 0.52850  
28/28 [=====] - 0s 6ms/step - loss: 1.2607 - accuracy: 0.5307 - val\_loss: 1.0946 - val\_accuracy: 0.5233  
Epoch 20/300  
28/28 [=====] - ETA: 0s - loss: 1.2545 - accuracy: 0.5173  
Epoch 20: val\_accuracy did not improve from 0.52850  
28/28 [=====] - 0s 7ms/step - loss: 1.2545 - accuracy: 0.5173 - val\_loss: 1.1021 - val\_accuracy: 0.5233  
Epoch 21/300  
25/28 [=====>...] - ETA: 0s - loss: 1.2688 - accuracy: 0.5088  
Epoch 21: val\_accuracy did not improve from 0.52850  
28/28 [=====] - 0s 7ms/step - loss: 1.2460 - accuracy: 0.5162 - val\_loss: 1.1371 - val\_accuracy: 0.5130  
Epoch 22/300  
27/28 [=====>..] - ETA: 0s - loss: 1.2126 - accuracy: 0.5220  
Epoch 22: val\_accuracy did not improve from 0.52850  
28/28 [=====] - 0s 6ms/step - loss: 1.2326 - accuracy: 0.5251 - val\_loss: 1.1156 - val\_accuracy: 0.5233  
Epoch 23/300  
26/28 [=====>...] - ETA: 0s - loss: 1.2271 - accuracy: 0.5192  
Epoch 23: val\_accuracy did not improve from 0.52850  
28/28 [=====] - 0s 6ms/step - loss: 1.2189 - accuracy: 0.5240 - val\_loss: 1.1203 - val\_accuracy: 0.5181  
Epoch 24/300  
25/28 [=====>...] - ETA: 0s - loss: 1.1873 - accuracy: 0.5275  
Epoch 24: val\_accuracy improved from 0.52850 to 0.53368, saving model to /content/weightsMLP2.best.hdf5

```
df5
28/28 [=====] - 0s 8ms/step - loss: 1.2177 - accuracy: 0.5318 - val_loss: 1
.1597 - val_accuracy: 0.5337
Epoch 25/300
15/28 [=====>.....] - ETA: 0s - loss: 1.1960 - accuracy: 0.5375
Epoch 25: val_accuracy did not improve from 0.53368
28/28 [=====] - 0s 5ms/step - loss: 1.2015 - accuracy: 0.5330 - val_loss: 1
.1002 - val_accuracy: 0.5130
Epoch 26/300
14/28 [=====>.....] - ETA: 0s - loss: 1.1901 - accuracy: 0.5201
Epoch 26: val_accuracy did not improve from 0.53368
28/28 [=====] - 0s 5ms/step - loss: 1.1900 - accuracy: 0.5184 - val_loss: 1
.1101 - val_accuracy: 0.5233
Epoch 27/300
26/28 [=====>...] - ETA: 0s - loss: 1.1866 - accuracy: 0.5048
Epoch 27: val_accuracy did not improve from 0.53368
28/28 [=====] - 0s 6ms/step - loss: 1.1855 - accuracy: 0.5073 - val_loss: 1
.1073 - val_accuracy: 0.5233
Epoch 28/300
28/28 [=====] - ETA: 0s - loss: 1.1712 - accuracy: 0.5218
Epoch 28: val_accuracy did not improve from 0.53368
28/28 [=====] - 0s 6ms/step - loss: 1.1712 - accuracy: 0.5218 - val_loss: 1
.1093 - val_accuracy: 0.5181
Epoch 29/300
24/28 [=====>....] - ETA: 0s - loss: 1.1785 - accuracy: 0.5104
Epoch 29: val_accuracy did not improve from 0.53368
28/28 [=====] - 0s 7ms/step - loss: 1.1680 - accuracy: 0.5307 - val_loss: 1
.1592 - val_accuracy: 0.5026
Epoch 30/300
22/28 [=====>.....] - ETA: 0s - loss: 1.1699 - accuracy: 0.5597
Epoch 30: val_accuracy did not improve from 0.53368
28/28 [=====] - 0s 7ms/step - loss: 1.1590 - accuracy: 0.5564 - val_loss: 1
.0891 - val_accuracy: 0.5181
Epoch 31/300
27/28 [=====>..] - ETA: 0s - loss: 1.1521 - accuracy: 0.5556
Epoch 31: val_accuracy improved from 0.53368 to 0.58031, saving model to /content/weightsMLP2.best.h
df5
28/28 [=====] - 0s 8ms/step - loss: 1.1569 - accuracy: 0.5587 - val_loss: 1
.1217 - val_accuracy: 0.5803
Epoch 32/300
24/28 [=====>....] - ETA: 0s - loss: 1.1289 - accuracy: 0.5391
Epoch 32: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 7ms/step - loss: 1.1535 - accuracy: 0.5486 - val_loss: 1
.1322 - val_accuracy: 0.5337
Epoch 33/300
27/28 [=====>..] - ETA: 0s - loss: 1.1461 - accuracy: 0.5394
Epoch 33: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 6ms/step - loss: 1.1415 - accuracy: 0.5352 - val_loss: 1
.1098 - val_accuracy: 0.5233
Epoch 34/300
15/28 [=====>.....] - ETA: 0s - loss: 1.1822 - accuracy: 0.5104
Epoch 34: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 6ms/step - loss: 1.1387 - accuracy: 0.5318 - val_loss: 1
.1029 - val_accuracy: 0.5389
Epoch 35/300
26/28 [=====>...] - ETA: 0s - loss: 1.1127 - accuracy: 0.5925
Epoch 35: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 8ms/step - loss: 1.1261 - accuracy: 0.5855 - val_loss: 1
.1034 - val_accuracy: 0.5596
Epoch 36/300
26/28 [=====>...] - ETA: 0s - loss: 1.1419 - accuracy: 0.5300
Epoch 36: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 6ms/step - loss: 1.1351 - accuracy: 0.5352 - val_loss: 1
.1102 - val_accuracy: 0.5233
Epoch 37/300
28/28 [=====] - ETA: 0s - loss: 1.1141 - accuracy: 0.5598
Epoch 37: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 6ms/step - loss: 1.1141 - accuracy: 0.5598 - val_loss: 1
.1048 - val_accuracy: 0.5026
Epoch 38/300
27/28 [=====>..] - ETA: 0s - loss: 1.1005 - accuracy: 0.5718
Epoch 38: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 6ms/step - loss: 1.1078 - accuracy: 0.5698 - val_loss: 1
.1137 - val_accuracy: 0.5337
Epoch 39/300
19/28 [=====>.....] - ETA: 0s - loss: 1.1344 - accuracy: 0.4803
Epoch 39: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 5ms/step - loss: 1.1187 - accuracy: 0.4816 - val_loss: 1
.1190 - val_accuracy: 0.4456
Epoch 40/300
25/28 [=====>....] - ETA: 0s - loss: 1.1321 - accuracy: 0.5537
Epoch 40: val_accuracy did not improve from 0.58031
28/28 [=====] - 0s 4ms/step - loss: 1.1147 - accuracy: 0.5430 - val_loss: 1
```

.1351 - val\_accuracy: 0.4611  
Epoch 41/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.1193 - accuracy: 0.5653  
Epoch 41: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 5ms/step - loss: 1.1065 - accuracy: 0.5609 - val\_loss: 1.1083 - val\_accuracy: 0.5337  
Epoch 42/300  
16/28 [=====>.....] - ETA: 0s - loss: 1.0618 - accuracy: 0.5957  
Epoch 42: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0983 - accuracy: 0.5810 - val\_loss: 1.1044 - val\_accuracy: 0.5389  
Epoch 43/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.1265 - accuracy: 0.5426  
Epoch 43: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 5ms/step - loss: 1.0908 - accuracy: 0.5251 - val\_loss: 1.1176 - val\_accuracy: 0.4767  
Epoch 44/300  
24/28 [=====>.....] - ETA: 0s - loss: 1.0613 - accuracy: 0.5885  
Epoch 44: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0787 - accuracy: 0.5721 - val\_loss: 1.1322 - val\_accuracy: 0.4404  
Epoch 45/300  
21/28 [=====>.....] - ETA: 0s - loss: 1.0532 - accuracy: 0.5387  
Epoch 45: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0892 - accuracy: 0.5330 - val\_loss: 1.1196 - val\_accuracy: 0.4715  
Epoch 46/300  
24/28 [=====>.....] - ETA: 0s - loss: 1.0427 - accuracy: 0.5182  
Epoch 46: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0705 - accuracy: 0.5128 - val\_loss: 1.1089 - val\_accuracy: 0.4663  
Epoch 47/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0868 - accuracy: 0.4957  
Epoch 47: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0716 - accuracy: 0.4793 - val\_loss: 1.1114 - val\_accuracy: 0.4404  
Epoch 48/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0727 - accuracy: 0.5327  
Epoch 48: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0695 - accuracy: 0.5296 - val\_loss: 1.1117 - val\_accuracy: 0.4560  
Epoch 49/300  
23/28 [=====>.....] - ETA: 0s - loss: 1.0447 - accuracy: 0.5312  
Epoch 49: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0849 - accuracy: 0.5508 - val\_loss: 1.1114 - val\_accuracy: 0.5492  
Epoch 50/300  
14/28 [=====>.....] - ETA: 0s - loss: 1.0543 - accuracy: 0.6317  
Epoch 50: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 5ms/step - loss: 1.0756 - accuracy: 0.6067 - val\_loss: 1.1015 - val\_accuracy: 0.5803  
Epoch 51/300  
20/28 [=====>.....] - ETA: 0s - loss: 1.0523 - accuracy: 0.5734  
Epoch 51: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0645 - accuracy: 0.5877 - val\_loss: 1.1032 - val\_accuracy: 0.5285  
Epoch 52/300  
21/28 [=====>.....] - ETA: 0s - loss: 1.0503 - accuracy: 0.5312  
Epoch 52: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0680 - accuracy: 0.5073 - val\_loss: 1.1365 - val\_accuracy: 0.3212  
Epoch 53/300  
23/28 [=====>.....] - ETA: 0s - loss: 1.0556 - accuracy: 0.4823  
Epoch 53: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0683 - accuracy: 0.4961 - val\_loss: 1.1026 - val\_accuracy: 0.5389  
Epoch 54/300  
18/28 [=====>.....] - ETA: 0s - loss: 1.0810 - accuracy: 0.4931  
Epoch 54: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 5ms/step - loss: 1.0573 - accuracy: 0.4648 - val\_loss: 1.1256 - val\_accuracy: 0.3886  
Epoch 55/300  
21/28 [=====>.....] - ETA: 0s - loss: 1.0208 - accuracy: 0.5759  
Epoch 55: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0462 - accuracy: 0.5709 - val\_loss: 1.1130 - val\_accuracy: 0.5130  
Epoch 56/300  
16/28 [=====>.....] - ETA: 0s - loss: 1.0600 - accuracy: 0.4492  
Epoch 56: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0614 - accuracy: 0.4536 - val\_loss: 1.1090 - val\_accuracy: 0.5181  
Epoch 57/300  
25/28 [=====>....] - ETA: 0s - loss: 1.0521 - accuracy: 0.4563

Epoch 57: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0402 - accuracy: 0.4626 - val\_loss: 1.1072 - val\_accuracy: 0.4715  
Epoch 58/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.9844 - accuracy: 0.5292  
Epoch 58: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 5ms/step - loss: 1.0446 - accuracy: 0.5721 - val\_loss: 1.1018 - val\_accuracy: 0.5440  
Epoch 59/300  
23/28 [=====>.....] - ETA: 0s - loss: 1.0512 - accuracy: 0.4266  
Epoch 59: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0438 - accuracy: 0.4447 - val\_loss: 1.1087 - val\_accuracy: 0.4715  
Epoch 60/300  
18/28 [=====>.....] - ETA: 0s - loss: 1.0595 - accuracy: 0.4705  
Epoch 60: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 5ms/step - loss: 1.0516 - accuracy: 0.4804 - val\_loss: 1.1058 - val\_accuracy: 0.4922  
Epoch 61/300  
24/28 [=====>.....] - ETA: 0s - loss: 1.0183 - accuracy: 0.5677  
Epoch 61: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 6ms/step - loss: 1.0260 - accuracy: 0.5296 - val\_loss: 1.1444 - val\_accuracy: 0.2746  
Epoch 62/300  
19/28 [=====>.....] - ETA: 0s - loss: 1.0345 - accuracy: 0.4079  
Epoch 62: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0409 - accuracy: 0.4391 - val\_loss: 1.1092 - val\_accuracy: 0.5026  
Epoch 63/300  
20/28 [=====>.....] - ETA: 0s - loss: 1.0277 - accuracy: 0.4797  
Epoch 63: val\_accuracy did not improve from 0.58031  
28/28 [=====] - 0s 4ms/step - loss: 1.0470 - accuracy: 0.4838 - val\_loss: 1.1022 - val\_accuracy: 0.5389  
Epoch 64/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0600 - accuracy: 0.5582  
Epoch 64: val\_accuracy improved from 0.58031 to 0.62176, saving model to /content/weightsMLP2.best.hdf5  
28/28 [=====] - 0s 5ms/step - loss: 1.0453 - accuracy: 0.5743 - val\_loss: 1.0917 - val\_accuracy: 0.6218  
Epoch 65/300  
20/28 [=====>.....] - ETA: 0s - loss: 1.0675 - accuracy: 0.5719  
Epoch 65: val\_accuracy did not improve from 0.62176  
28/28 [=====] - 0s 4ms/step - loss: 1.0247 - accuracy: 0.4782 - val\_loss: 1.1153 - val\_accuracy: 0.3627  
Epoch 66/300  
21/28 [=====>.....] - ETA: 0s - loss: 1.0452 - accuracy: 0.3304  
Epoch 66: val\_accuracy did not improve from 0.62176  
28/28 [=====] - 0s 4ms/step - loss: 1.0415 - accuracy: 0.3464 - val\_loss: 1.1037 - val\_accuracy: 0.4922  
Epoch 67/300  
23/28 [=====>.....] - ETA: 0s - loss: 1.0304 - accuracy: 0.4552  
Epoch 67: val\_accuracy did not improve from 0.62176  
28/28 [=====] - 0s 4ms/step - loss: 1.0279 - accuracy: 0.4458 - val\_loss: 1.1020 - val\_accuracy: 0.5026  
Epoch 68/300  
24/28 [=====>.....] - ETA: 0s - loss: 1.0305 - accuracy: 0.5625  
Epoch 68: val\_accuracy improved from 0.62176 to 0.64249, saving model to /content/weightsMLP2.best.hdf5  
28/28 [=====] - 0s 5ms/step - loss: 1.0292 - accuracy: 0.5687 - val\_loss: 1.0840 - val\_accuracy: 0.6425  
Epoch 69/300  
18/28 [=====>.....] - ETA: 0s - loss: 1.0616 - accuracy: 0.6111  
Epoch 69: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0335 - accuracy: 0.5944 - val\_loss: 1.1007 - val\_accuracy: 0.4922  
Epoch 70/300  
25/28 [=====>.....] - ETA: 0s - loss: 1.0317 - accuracy: 0.5200  
Epoch 70: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0260 - accuracy: 0.5341 - val\_loss: 1.0933 - val\_accuracy: 0.5596  
Epoch 71/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0003 - accuracy: 0.4560  
Epoch 71: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0068 - accuracy: 0.4034 - val\_loss: 1.1140 - val\_accuracy: 0.2642  
Epoch 72/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0539 - accuracy: 0.2713  
Epoch 72: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0336 - accuracy: 0.2615 - val\_loss: 1.1410 - val\_accuracy: 0.2746  
Epoch 73/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.9865 - accuracy: 0.4154  
Epoch 73: val\_accuracy did not improve from 0.64249

28/28 [=====] - 0s 5ms/step - loss: 1.0265 - accuracy: 0.4883 - val\_loss: 1.0982 - val\_accuracy: 0.5855  
Epoch 74/300  
26/28 [=====>...] - ETA: 0s - loss: 1.0100 - accuracy: 0.5120  
Epoch 74: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0033 - accuracy: 0.4883 - val\_loss: 1.1167 - val\_accuracy: 0.2746  
Epoch 75/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0169 - accuracy: 0.2301  
Epoch 75: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0110 - accuracy: 0.2313 - val\_loss: 1.1168 - val\_accuracy: 0.2746  
Epoch 76/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.9761 - accuracy: 0.2917  
Epoch 76: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9850 - accuracy: 0.3218 - val\_loss: 1.1049 - val\_accuracy: 0.2850  
Epoch 77/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0182 - accuracy: 0.2599  
Epoch 77: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0173 - accuracy: 0.2771 - val\_loss: 1.1027 - val\_accuracy: 0.2902  
Epoch 78/300  
21/28 [=====>.....] - ETA: 0s - loss: 1.0572 - accuracy: 0.2693  
Epoch 78: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0208 - accuracy: 0.2547 - val\_loss: 1.1078 - val\_accuracy: 0.2850  
Epoch 79/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9865 - accuracy: 0.3719  
Epoch 79: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9931 - accuracy: 0.3810 - val\_loss: 1.1189 - val\_accuracy: 0.3627  
Epoch 80/300  
24/28 [=====>.....] - ETA: 0s - loss: 1.0366 - accuracy: 0.2839  
Epoch 80: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0218 - accuracy: 0.3095 - val\_loss: 1.0964 - val\_accuracy: 0.5440  
Epoch 81/300  
15/28 [=====>.....] - ETA: 0s - loss: 1.0333 - accuracy: 0.5813  
Epoch 81: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9980 - accuracy: 0.4525 - val\_loss: 1.1155 - val\_accuracy: 0.2850  
Epoch 82/300  
22/28 [=====>.....] - ETA: 0s - loss: 1.0004 - accuracy: 0.2429  
Epoch 82: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9954 - accuracy: 0.2335 - val\_loss: 1.1032 - val\_accuracy: 0.2850  
Epoch 83/300  
25/28 [=====>.....] - ETA: 0s - loss: 1.0087 - accuracy: 0.4700  
Epoch 83: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 3ms/step - loss: 0.9968 - accuracy: 0.4726 - val\_loss: 1.0866 - val\_accuracy: 0.4249  
Epoch 84/300  
19/28 [=====>.....] - ETA: 0s - loss: 1.0069 - accuracy: 0.2533  
Epoch 84: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9905 - accuracy: 0.2458 - val\_loss: 1.1005 - val\_accuracy: 0.3005  
Epoch 85/300  
24/28 [=====>.....] - ETA: 0s - loss: 0.9780 - accuracy: 0.3555  
Epoch 85: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9741 - accuracy: 0.3341 - val\_loss: 1.1046 - val\_accuracy: 0.2902  
Epoch 86/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9713 - accuracy: 0.2554  
Epoch 86: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9851 - accuracy: 0.2682 - val\_loss: 1.0859 - val\_accuracy: 0.2798  
Epoch 87/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9885 - accuracy: 0.2232  
Epoch 87: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9815 - accuracy: 0.2380 - val\_loss: 1.1016 - val\_accuracy: 0.2850  
Epoch 88/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9177 - accuracy: 0.2530  
Epoch 88: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9632 - accuracy: 0.2682 - val\_loss: 1.0941 - val\_accuracy: 0.3109  
Epoch 89/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.9922 - accuracy: 0.2372  
Epoch 89: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0070 - accuracy: 0.2480 - val\_loss: 1.0961 - val\_accuracy: 0.3264  
Epoch 90/300

22/28 [=====>.....] - ETA: 0s - loss: 0.9809 - accuracy: 0.3082  
Epoch 90: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9771 - accuracy: 0.2983 - val\_loss: 1  
.1230 - val\_accuracy: 0.2953  
Epoch 91/300  
18/28 [=====>.....] - ETA: 0s - loss: 1.0242 - accuracy: 0.2326  
Epoch 91: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9982 - accuracy: 0.2346 - val\_loss: 1  
.0990 - val\_accuracy: 0.3161  
Epoch 92/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9710 - accuracy: 0.2434  
Epoch 92: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9724 - accuracy: 0.2559 - val\_loss: 1  
.0986 - val\_accuracy: 0.2902  
Epoch 93/300  
23/28 [=====>.....] - ETA: 0s - loss: 1.0020 - accuracy: 0.2649  
Epoch 93: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9838 - accuracy: 0.2559 - val\_loss: 1  
.1129 - val\_accuracy: 0.3005  
Epoch 94/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.9525 - accuracy: 0.2514  
Epoch 94: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9569 - accuracy: 0.2670 - val\_loss: 1  
.0919 - val\_accuracy: 0.3316  
Epoch 95/300  
23/28 [=====>.....] - ETA: 0s - loss: 1.0238 - accuracy: 0.2609  
Epoch 95: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 1.0025 - accuracy: 0.2682 - val\_loss: 1  
.1001 - val\_accuracy: 0.3472  
Epoch 96/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.9499 - accuracy: 0.2552  
Epoch 96: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9785 - accuracy: 0.2715 - val\_loss: 1  
.0929 - val\_accuracy: 0.3005  
Epoch 97/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.9637 - accuracy: 0.2768  
Epoch 97: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9635 - accuracy: 0.2816 - val\_loss: 1  
.0920 - val\_accuracy: 0.3005  
Epoch 98/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9276 - accuracy: 0.2875  
Epoch 98: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9610 - accuracy: 0.2793 - val\_loss: 1  
.1010 - val\_accuracy: 0.3005  
Epoch 99/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9337 - accuracy: 0.2485  
Epoch 99: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9700 - accuracy: 0.2659 - val\_loss: 1  
.0928 - val\_accuracy: 0.3316  
Epoch 100/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9723 - accuracy: 0.2797  
Epoch 100: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9771 - accuracy: 0.2827 - val\_loss: 1  
.0971 - val\_accuracy: 0.3109  
Epoch 101/300  
24/28 [=====>.....] - ETA: 0s - loss: 0.9459 - accuracy: 0.2708  
Epoch 101: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9391 - accuracy: 0.2771 - val\_loss: 1  
.1236 - val\_accuracy: 0.3161  
Epoch 102/300  
26/28 [=====>...] - ETA: 0s - loss: 0.9835 - accuracy: 0.2837  
Epoch 102: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9724 - accuracy: 0.2760 - val\_loss: 1  
.1008 - val\_accuracy: 0.3420  
Epoch 103/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9793 - accuracy: 0.3063  
Epoch 103: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9957 - accuracy: 0.2916 - val\_loss: 1  
.2073 - val\_accuracy: 0.2746  
Epoch 104/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9562 - accuracy: 0.2296  
Epoch 104: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9639 - accuracy: 0.2413 - val\_loss: 1  
.1013 - val\_accuracy: 0.3109  
Epoch 105/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.9333 - accuracy: 0.2812  
Epoch 105: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9487 - accuracy: 0.2827 - val\_loss: 1  
.1258 - val\_accuracy: 0.3005  
Epoch 106/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9401 - accuracy: 0.2649  
Epoch 106: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9448 - accuracy: 0.2737 - val\_loss: 1

.0916 - val\_accuracy: 0.3627  
Epoch 107/300  
12/28 [=====>.....] - ETA: 0s - loss: 0.9561 - accuracy: 0.4245  
Epoch 107: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9996 - accuracy: 0.5307 - val\_loss: 1  
.0509 - val\_accuracy: 0.5855  
Epoch 108/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.9479 - accuracy: 0.2926  
Epoch 108: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9702 - accuracy: 0.2916 - val\_loss: 1  
.0914 - val\_accuracy: 0.3523  
Epoch 109/300  
24/28 [=====>.....] - ETA: 0s - loss: 0.9463 - accuracy: 0.2904  
Epoch 109: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9407 - accuracy: 0.2872 - val\_loss: 1  
.0748 - val\_accuracy: 0.3627  
Epoch 110/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9099 - accuracy: 0.3289  
Epoch 110: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9337 - accuracy: 0.3274 - val\_loss: 1  
.1074 - val\_accuracy: 0.3472  
Epoch 111/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9720 - accuracy: 0.2908  
Epoch 111: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9443 - accuracy: 0.2804 - val\_loss: 1  
.0857 - val\_accuracy: 0.3420  
Epoch 112/300  
24/28 [=====>.....] - ETA: 0s - loss: 0.9507 - accuracy: 0.3815  
Epoch 112: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9539 - accuracy: 0.3587 - val\_loss: 1  
.0826 - val\_accuracy: 0.3523  
Epoch 113/300  
14/28 [=====>.....] - ETA: 0s - loss: 1.0197 - accuracy: 0.3036  
Epoch 113: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9662 - accuracy: 0.2849 - val\_loss: 1  
.0951 - val\_accuracy: 0.3679  
Epoch 114/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.9635 - accuracy: 0.3292  
Epoch 114: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9515 - accuracy: 0.3788 - val\_loss: 1  
.0768 - val\_accuracy: 0.3886  
Epoch 115/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9736 - accuracy: 0.3383  
Epoch 115: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9687 - accuracy: 0.3363 - val\_loss: 1  
.1195 - val\_accuracy: 0.3212  
Epoch 116/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9311 - accuracy: 0.3000  
Epoch 116: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9293 - accuracy: 0.2894 - val\_loss: 1  
.1044 - val\_accuracy: 0.3368  
Epoch 117/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9367 - accuracy: 0.2664  
Epoch 117: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9646 - accuracy: 0.2849 - val\_loss: 1  
.0839 - val\_accuracy: 0.3523  
Epoch 118/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9003 - accuracy: 0.3140  
Epoch 118: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9183 - accuracy: 0.3084 - val\_loss: 1  
.1010 - val\_accuracy: 0.3420  
Epoch 119/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9442 - accuracy: 0.2747  
Epoch 119: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9441 - accuracy: 0.3039 - val\_loss: 1  
.0689 - val\_accuracy: 0.3886  
Epoch 120/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9674 - accuracy: 0.2826  
Epoch 120: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9618 - accuracy: 0.2894 - val\_loss: 1  
.0843 - val\_accuracy: 0.3731  
Epoch 121/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9001 - accuracy: 0.3505  
Epoch 121: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9302 - accuracy: 0.3464 - val\_loss: 1  
.0752 - val\_accuracy: 0.3627  
Epoch 122/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9240 - accuracy: 0.3065  
Epoch 122: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9310 - accuracy: 0.2983 - val\_loss: 1  
.0708 - val\_accuracy: 0.3938  
Epoch 123/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.9255 - accuracy: 0.3594



Epoch 123: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8996 - accuracy: 0.3475 - val\_loss: 1.0875 - val\_accuracy: 0.3679  
Epoch 124/300  
18/28 [=====>.....] - ETA: 0s - loss: 1.0170 - accuracy: 0.2934  
Epoch 124: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9634 - accuracy: 0.3095 - val\_loss: 1.0681 - val\_accuracy: 0.4611  
Epoch 125/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9284 - accuracy: 0.3656  
Epoch 125: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9292 - accuracy: 0.3564 - val\_loss: 1.0901 - val\_accuracy: 0.3523  
Epoch 126/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9610 - accuracy: 0.3356  
Epoch 126: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9618 - accuracy: 0.3408 - val\_loss: 1.0611 - val\_accuracy: 0.4249  
Epoch 127/300  
24/28 [=====>.....] - ETA: 0s - loss: 0.9444 - accuracy: 0.3333  
Epoch 127: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9358 - accuracy: 0.3352 - val\_loss: 1.0770 - val\_accuracy: 0.3782  
Epoch 128/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8545 - accuracy: 0.2910  
Epoch 128: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8919 - accuracy: 0.3095 - val\_loss: 1.0802 - val\_accuracy: 0.3782  
Epoch 129/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9028 - accuracy: 0.3063  
Epoch 129: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9098 - accuracy: 0.3128 - val\_loss: 1.0778 - val\_accuracy: 0.3938  
Epoch 130/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9586 - accuracy: 0.3527  
Epoch 130: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9315 - accuracy: 0.3352 - val\_loss: 1.0924 - val\_accuracy: 0.4041  
Epoch 131/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8816 - accuracy: 0.3182  
Epoch 131: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8938 - accuracy: 0.3251 - val\_loss: 1.0627 - val\_accuracy: 0.3834  
Epoch 132/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9526 - accuracy: 0.3342  
Epoch 132: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9215 - accuracy: 0.3274 - val\_loss: 1.0734 - val\_accuracy: 0.4145  
Epoch 133/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.9354 - accuracy: 0.3438  
Epoch 133: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9389 - accuracy: 0.3419 - val\_loss: 1.0671 - val\_accuracy: 0.3679  
Epoch 134/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.8961 - accuracy: 0.3333  
Epoch 134: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9071 - accuracy: 0.3531 - val\_loss: 1.0648 - val\_accuracy: 0.3938  
Epoch 135/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9238 - accuracy: 0.3516  
Epoch 135: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9191 - accuracy: 0.3564 - val\_loss: 1.0587 - val\_accuracy: 0.4093  
Epoch 136/300  
27/28 [=====>..] - ETA: 0s - loss: 0.8888 - accuracy: 0.3438  
Epoch 136: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8968 - accuracy: 0.3397 - val\_loss: 1.0622 - val\_accuracy: 0.4145  
Epoch 137/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.9261 - accuracy: 0.3594  
Epoch 137: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9101 - accuracy: 0.3408 - val\_loss: 1.0460 - val\_accuracy: 0.4093  
Epoch 138/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9029 - accuracy: 0.3766  
Epoch 138: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8950 - accuracy: 0.3676 - val\_loss: 1.0536 - val\_accuracy: 0.4145  
Epoch 139/300  
28/28 [=====] - ETA: 0s - loss: 0.8933 - accuracy: 0.3832  
Epoch 139: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8933 - accuracy: 0.3832 - val\_loss: 1.0633 - val\_accuracy: 0.3782

Epoch 140/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.8592 - accuracy: 0.3413  
Epoch 140: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8816 - accuracy: 0.3598 - val\_loss: 1.0745 - val\_accuracy: 0.4093  
Epoch 141/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.8644 - accuracy: 0.3229  
Epoch 141: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8862 - accuracy: 0.3430 - val\_loss: 1.0512 - val\_accuracy: 0.4145  
Epoch 142/300  
11/28 [=====>.....] - ETA: 0s - loss: 0.8885 - accuracy: 0.4176  
Epoch 142: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9165 - accuracy: 0.3687 - val\_loss: 1.0479 - val\_accuracy: 0.4145  
Epoch 143/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.9065 - accuracy: 0.3603  
Epoch 143: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9073 - accuracy: 0.3520 - val\_loss: 1.0592 - val\_accuracy: 0.4093  
Epoch 144/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.9279 - accuracy: 0.3698  
Epoch 144: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9030 - accuracy: 0.3587 - val\_loss: 1.0513 - val\_accuracy: 0.3886  
Epoch 145/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8951 - accuracy: 0.3651  
Epoch 145: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9018 - accuracy: 0.3531 - val\_loss: 1.0529 - val\_accuracy: 0.4197  
Epoch 146/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9426 - accuracy: 0.4062  
Epoch 146: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9314 - accuracy: 0.3922 - val\_loss: 1.0123 - val\_accuracy: 0.4870  
Epoch 147/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9383 - accuracy: 0.4095  
Epoch 147: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9148 - accuracy: 0.3966 - val\_loss: 1.0629 - val\_accuracy: 0.4249  
Epoch 148/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8911 - accuracy: 0.3559  
Epoch 148: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8728 - accuracy: 0.3609 - val\_loss: 1.0617 - val\_accuracy: 0.4041  
Epoch 149/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.8982 - accuracy: 0.3690  
Epoch 149: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8905 - accuracy: 0.3587 - val\_loss: 1.0407 - val\_accuracy: 0.4093  
Epoch 150/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.9074 - accuracy: 0.3728  
Epoch 150: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8857 - accuracy: 0.3419 - val\_loss: 1.0430 - val\_accuracy: 0.4249  
Epoch 151/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.8976 - accuracy: 0.3732  
Epoch 151: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9293 - accuracy: 0.3933 - val\_loss: 1.0236 - val\_accuracy: 0.4456  
Epoch 152/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8691 - accuracy: 0.4309  
Epoch 152: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8926 - accuracy: 0.4078 - val\_loss: 1.0414 - val\_accuracy: 0.4145  
Epoch 153/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8784 - accuracy: 0.3767  
Epoch 153: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9021 - accuracy: 0.3765 - val\_loss: 1.0466 - val\_accuracy: 0.4508  
Epoch 154/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9177 - accuracy: 0.3914  
Epoch 154: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9478 - accuracy: 0.3978 - val\_loss: 1.0285 - val\_accuracy: 0.4508  
Epoch 155/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9121 - accuracy: 0.3859  
Epoch 155: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9072 - accuracy: 0.3855 - val\_loss: 1.0270 - val\_accuracy: 0.4663  
Epoch 156/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.9339 - accuracy: 0.4103  
Epoch 156: val\_accuracy did not improve from 0.64249

28/28 [=====] - 0s 4ms/step - loss: 0.9150 - accuracy: 0.4168 - val\_loss: 1  
.0187 - val\_accuracy: 0.4456  
Epoch 157/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8865 - accuracy: 0.3935  
Epoch 157: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8806 - accuracy: 0.3866 - val\_loss: 1  
.0347 - val\_accuracy: 0.4301  
Epoch 158/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.8877 - accuracy: 0.3817  
Epoch 158: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8562 - accuracy: 0.3888 - val\_loss: 1  
.0233 - val\_accuracy: 0.4560  
Epoch 159/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.8821 - accuracy: 0.4078  
Epoch 159: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8807 - accuracy: 0.3933 - val\_loss: 1  
.0286 - val\_accuracy: 0.4352  
Epoch 160/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.8488 - accuracy: 0.4062  
Epoch 160: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8650 - accuracy: 0.4022 - val\_loss: 1  
.0476 - val\_accuracy: 0.4093  
Epoch 161/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.8635 - accuracy: 0.4078  
Epoch 161: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8370 - accuracy: 0.4000 - val\_loss: 1  
.0444 - val\_accuracy: 0.4301  
Epoch 162/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.9512 - accuracy: 0.3854  
Epoch 162: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9383 - accuracy: 0.3922 - val\_loss: 1  
.0151 - val\_accuracy: 0.4352  
Epoch 163/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.9384 - accuracy: 0.3887  
Epoch 163: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9028 - accuracy: 0.4123 - val\_loss: 1  
.0186 - val\_accuracy: 0.4508  
Epoch 164/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8514 - accuracy: 0.4102  
Epoch 164: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8647 - accuracy: 0.4056 - val\_loss: 1  
.0144 - val\_accuracy: 0.4404  
Epoch 165/300  
25/28 [=====>....] - ETA: 0s - loss: 0.8714 - accuracy: 0.4150  
Epoch 165: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8802 - accuracy: 0.4123 - val\_loss: 1  
.0993 - val\_accuracy: 0.4145  
Epoch 166/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.8927 - accuracy: 0.3844  
Epoch 166: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8919 - accuracy: 0.3911 - val\_loss: 0  
.9998 - val\_accuracy: 0.4715  
Epoch 167/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7962 - accuracy: 0.3887  
Epoch 167: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8949 - accuracy: 0.4078 - val\_loss: 1  
.0232 - val\_accuracy: 0.4611  
Epoch 168/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8807 - accuracy: 0.4740  
Epoch 168: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8871 - accuracy: 0.4436 - val\_loss: 1  
.0028 - val\_accuracy: 0.4508  
Epoch 169/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8931 - accuracy: 0.4323  
Epoch 169: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9191 - accuracy: 0.4324 - val\_loss: 0  
.9996 - val\_accuracy: 0.4715  
Epoch 170/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.8245 - accuracy: 0.4359  
Epoch 170: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8409 - accuracy: 0.4391 - val\_loss: 1  
.0276 - val\_accuracy: 0.4404  
Epoch 171/300  
26/28 [=====>...] - ETA: 0s - loss: 0.9663 - accuracy: 0.3786  
Epoch 171: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9471 - accuracy: 0.3844 - val\_loss: 0  
.9962 - val\_accuracy: 0.5544  
Epoch 172/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8320 - accuracy: 0.4622  
Epoch 172: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8596 - accuracy: 0.4581 - val\_loss: 0  
.9844 - val\_accuracy: 0.4663  
Epoch 173/300

11/28 [=====>.....] - ETA: 0s - loss: 0.8877 - accuracy: 0.3778  
Epoch 173: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 1.0090 - accuracy: 0.3296 - val\_loss: 1  
.0331 - val\_accuracy: 0.4352  
Epoch 174/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.8999 - accuracy: 0.4351  
Epoch 174: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9047 - accuracy: 0.4358 - val\_loss: 1  
.0046 - val\_accuracy: 0.4715  
Epoch 175/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8672 - accuracy: 0.4201  
Epoch 175: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9064 - accuracy: 0.4056 - val\_loss: 1  
.0246 - val\_accuracy: 0.4301  
Epoch 176/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.9318 - accuracy: 0.3926  
Epoch 176: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8869 - accuracy: 0.4145 - val\_loss: 0  
.9841 - val\_accuracy: 0.5699  
Epoch 177/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9339 - accuracy: 0.4128  
Epoch 177: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9395 - accuracy: 0.4480 - val\_loss: 0  
.9721 - val\_accuracy: 0.5440  
Epoch 178/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8782 - accuracy: 0.4323  
Epoch 178: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8618 - accuracy: 0.4156 - val\_loss: 1  
.0343 - val\_accuracy: 0.4041  
Epoch 179/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8832 - accuracy: 0.3976  
Epoch 179: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8998 - accuracy: 0.3933 - val\_loss: 1  
.0166 - val\_accuracy: 0.4352  
Epoch 180/300  
11/28 [=====>.....] - ETA: 0s - loss: 0.8460 - accuracy: 0.4119  
Epoch 180: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8596 - accuracy: 0.3955 - val\_loss: 0  
.9825 - val\_accuracy: 0.5130  
Epoch 181/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9658 - accuracy: 0.4441  
Epoch 181: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9283 - accuracy: 0.4525 - val\_loss: 0  
.9990 - val\_accuracy: 0.4508  
Epoch 182/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9192 - accuracy: 0.4453  
Epoch 182: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8965 - accuracy: 0.4302 - val\_loss: 0  
.9914 - val\_accuracy: 0.4560  
Epoch 183/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8770 - accuracy: 0.4391  
Epoch 183: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8556 - accuracy: 0.4112 - val\_loss: 0  
.9843 - val\_accuracy: 0.4974  
Epoch 184/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.9092 - accuracy: 0.4048  
Epoch 184: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8799 - accuracy: 0.4257 - val\_loss: 0  
.9744 - val\_accuracy: 0.5492  
Epoch 185/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8946 - accuracy: 0.4062  
Epoch 185: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8833 - accuracy: 0.4302 - val\_loss: 0  
.9887 - val\_accuracy: 0.4715  
Epoch 186/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8320 - accuracy: 0.4253  
Epoch 186: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8559 - accuracy: 0.4335 - val\_loss: 1  
.0247 - val\_accuracy: 0.4404  
Epoch 187/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.8938 - accuracy: 0.4397  
Epoch 187: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8808 - accuracy: 0.4369 - val\_loss: 0  
.9827 - val\_accuracy: 0.4870  
Epoch 188/300  
25/28 [=====>....] - ETA: 0s - loss: 0.8217 - accuracy: 0.4162  
Epoch 188: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8372 - accuracy: 0.4123 - val\_loss: 0  
.9824 - val\_accuracy: 0.5130  
Epoch 189/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.8750 - accuracy: 0.4375  
Epoch 189: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8969 - accuracy: 0.4536 - val\_loss: 0

.9700 - val\_accuracy: 0.5130  
Epoch 190/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.9491 - accuracy: 0.4023  
Epoch 190: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9072 - accuracy: 0.4302 - val\_loss: 0  
.9733 - val\_accuracy: 0.5130  
Epoch 191/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9140 - accuracy: 0.4422  
Epoch 191: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9127 - accuracy: 0.4648 - val\_loss: 0  
.9697 - val\_accuracy: 0.5440  
Epoch 192/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8613 - accuracy: 0.4318  
Epoch 192: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8576 - accuracy: 0.4514 - val\_loss: 0  
.9732 - val\_accuracy: 0.5130  
Epoch 193/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9367 - accuracy: 0.4547  
Epoch 193: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8948 - accuracy: 0.4603 - val\_loss: 0  
.9606 - val\_accuracy: 0.5699  
Epoch 194/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.9453 - accuracy: 0.4122  
Epoch 194: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.9526 - accuracy: 0.4223 - val\_loss: 0  
.9864 - val\_accuracy: 0.4715  
Epoch 195/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.9313 - accuracy: 0.4135  
Epoch 195: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8841 - accuracy: 0.4480 - val\_loss: 1  
.0239 - val\_accuracy: 0.4560  
Epoch 196/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8972 - accuracy: 0.4375  
Epoch 196: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8824 - accuracy: 0.4447 - val\_loss: 0  
.9653 - val\_accuracy: 0.5233  
Epoch 197/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.8621 - accuracy: 0.4708  
Epoch 197: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8655 - accuracy: 0.4693 - val\_loss: 0  
.9742 - val\_accuracy: 0.4870  
Epoch 198/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.9373 - accuracy: 0.4422  
Epoch 198: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9112 - accuracy: 0.4413 - val\_loss: 1  
.0052 - val\_accuracy: 0.4560  
Epoch 199/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8847 - accuracy: 0.4503  
Epoch 199: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8535 - accuracy: 0.4525 - val\_loss: 1  
.0361 - val\_accuracy: 0.4456  
Epoch 200/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.8310 - accuracy: 0.4706  
Epoch 200: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9049 - accuracy: 0.4335 - val\_loss: 0  
.9793 - val\_accuracy: 0.4922  
Epoch 201/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.8284 - accuracy: 0.4979  
Epoch 201: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8388 - accuracy: 0.4715 - val\_loss: 0  
.9780 - val\_accuracy: 0.5130  
Epoch 202/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8469 - accuracy: 0.4490  
Epoch 202: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8362 - accuracy: 0.4447 - val\_loss: 0  
.9655 - val\_accuracy: 0.5389  
Epoch 203/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8229 - accuracy: 0.4635  
Epoch 203: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8316 - accuracy: 0.4682 - val\_loss: 0  
.9633 - val\_accuracy: 0.5233  
Epoch 204/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9046 - accuracy: 0.4901  
Epoch 204: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8852 - accuracy: 0.4592 - val\_loss: 1  
.0087 - val\_accuracy: 0.4560  
Epoch 205/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.7907 - accuracy: 0.4631  
Epoch 205: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8164 - accuracy: 0.4592 - val\_loss: 0  
.9687 - val\_accuracy: 0.5130  
Epoch 206/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.8517 - accuracy: 0.4327

Epoch 206: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.9190 - accuracy: 0.4380 - val\_loss: 0.9591 - val\_accuracy: 0.5492  
Epoch 207/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8916 - accuracy: 0.4336  
Epoch 207: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8343 - accuracy: 0.4391 - val\_loss: 0.9644 - val\_accuracy: 0.5233  
Epoch 208/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8579 - accuracy: 0.4902  
Epoch 208: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8611 - accuracy: 0.4559 - val\_loss: 0.9597 - val\_accuracy: 0.5648  
Epoch 209/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8574 - accuracy: 0.4601  
Epoch 209: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8772 - accuracy: 0.4894 - val\_loss: 0.9616 - val\_accuracy: 0.5389  
Epoch 210/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8908 - accuracy: 0.4824  
Epoch 210: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8566 - accuracy: 0.4570 - val\_loss: 0.9784 - val\_accuracy: 0.5130  
Epoch 211/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8816 - accuracy: 0.4355  
Epoch 211: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8982 - accuracy: 0.4559 - val\_loss: 0.9403 - val\_accuracy: 0.5803  
Epoch 212/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8403 - accuracy: 0.4566  
Epoch 212: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8148 - accuracy: 0.4749 - val\_loss: 0.9579 - val\_accuracy: 0.5492  
Epoch 213/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8525 - accuracy: 0.4539  
Epoch 213: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8728 - accuracy: 0.4648 - val\_loss: 0.9538 - val\_accuracy: 0.5492  
Epoch 214/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.8226 - accuracy: 0.4609  
Epoch 214: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8173 - accuracy: 0.4749 - val\_loss: 0.9656 - val\_accuracy: 0.5233  
Epoch 215/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.7826 - accuracy: 0.4732  
Epoch 215: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8824 - accuracy: 0.4648 - val\_loss: 0.9473 - val\_accuracy: 0.5596  
Epoch 216/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.9088 - accuracy: 0.4671  
Epoch 216: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8792 - accuracy: 0.4737 - val\_loss: 0.9797 - val\_accuracy: 0.4819  
Epoch 217/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.8210 - accuracy: 0.4313  
Epoch 217: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8757 - accuracy: 0.4436 - val\_loss: 0.9899 - val\_accuracy: 0.4767  
Epoch 218/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8336 - accuracy: 0.4868  
Epoch 218: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8457 - accuracy: 0.4715 - val\_loss: 0.9931 - val\_accuracy: 0.4560  
Epoch 219/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.9127 - accuracy: 0.4583  
Epoch 219: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.9095 - accuracy: 0.4682 - val\_loss: 0.9763 - val\_accuracy: 0.5026  
Epoch 220/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8278 - accuracy: 0.4293  
Epoch 220: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8227 - accuracy: 0.4369 - val\_loss: 0.9548 - val\_accuracy: 0.5492  
Epoch 221/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.7896 - accuracy: 0.4836  
Epoch 221: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7948 - accuracy: 0.4872 - val\_loss: 1.0426 - val\_accuracy: 0.4611  
Epoch 222/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.8750 - accuracy: 0.4651  
Epoch 222: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8758 - accuracy: 0.4648 - val\_loss: 0.9974 - val\_accuracy: 0.4715

Epoch 223/300  
23/28 [=====>.....] - ETA: 0s - loss: 0.8349 - accuracy: 0.4470  
Epoch 223: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8329 - accuracy: 0.4514 - val\_loss: 0.9583 - val\_accuracy: 0.5337  
Epoch 224/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.7422 - accuracy: 0.4631  
Epoch 224: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7799 - accuracy: 0.4648 - val\_loss: 0.9502 - val\_accuracy: 0.5440  
Epoch 225/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.8424 - accuracy: 0.4851  
Epoch 225: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8038 - accuracy: 0.4994 - val\_loss: 0.9735 - val\_accuracy: 0.4819  
Epoch 226/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.8110 - accuracy: 0.4609  
Epoch 226: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8267 - accuracy: 0.4682 - val\_loss: 0.9688 - val\_accuracy: 0.5285  
Epoch 227/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.8240 - accuracy: 0.4297  
Epoch 227: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8018 - accuracy: 0.4559 - val\_loss: 0.9478 - val\_accuracy: 0.5181  
Epoch 228/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.8978 - accuracy: 0.4479  
Epoch 228: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8352 - accuracy: 0.4749 - val\_loss: 0.9531 - val\_accuracy: 0.5751  
Epoch 229/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.8026 - accuracy: 0.4418  
Epoch 229: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7941 - accuracy: 0.4592 - val\_loss: 0.9674 - val\_accuracy: 0.5907  
Epoch 230/300  
27/28 [=====>..] - ETA: 0s - loss: 0.8439 - accuracy: 0.4583  
Epoch 230: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8427 - accuracy: 0.4581 - val\_loss: 1.0211 - val\_accuracy: 0.4560  
Epoch 231/300  
27/28 [=====>..] - ETA: 0s - loss: 0.8345 - accuracy: 0.4630  
Epoch 231: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8287 - accuracy: 0.4603 - val\_loss: 0.9895 - val\_accuracy: 0.4870  
Epoch 232/300  
28/28 [=====] - ETA: 0s - loss: 0.8287 - accuracy: 0.4547  
Epoch 232: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.8287 - accuracy: 0.4547 - val\_loss: 0.9711 - val\_accuracy: 0.5337  
Epoch 233/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.7430 - accuracy: 0.4952  
Epoch 233: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7820 - accuracy: 0.4860 - val\_loss: 0.9623 - val\_accuracy: 0.5648  
Epoch 234/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.7857 - accuracy: 0.5000  
Epoch 234: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7658 - accuracy: 0.4737 - val\_loss: 0.9956 - val\_accuracy: 0.5130  
Epoch 235/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.7937 - accuracy: 0.4761  
Epoch 235: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7953 - accuracy: 0.4827 - val\_loss: 0.9685 - val\_accuracy: 0.5233  
Epoch 236/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.7583 - accuracy: 0.4784  
Epoch 236: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7895 - accuracy: 0.4994 - val\_loss: 0.9876 - val\_accuracy: 0.5285  
Epoch 237/300  
28/28 [=====] - ETA: 0s - loss: 0.8059 - accuracy: 0.5028  
Epoch 237: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8059 - accuracy: 0.5028 - val\_loss: 0.9968 - val\_accuracy: 0.5337  
Epoch 238/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7609 - accuracy: 0.4805  
Epoch 238: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.8064 - accuracy: 0.4525 - val\_loss: 0.9704 - val\_accuracy: 0.5440  
Epoch 239/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.8467 - accuracy: 0.4625  
Epoch 239: val\_accuracy did not improve from 0.64249

28/28 [=====] - 0s 5ms/step - loss: 0.7823 - accuracy: 0.4581 - val\_loss: 0.9598 - val\_accuracy: 0.5544  
Epoch 240/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7857 - accuracy: 0.4707  
Epoch 240: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7691 - accuracy: 0.4615 - val\_loss: 0.9442 - val\_accuracy: 0.5959  
Epoch 241/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.8277 - accuracy: 0.4856  
Epoch 241: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7481 - accuracy: 0.4927 - val\_loss: 0.9774 - val\_accuracy: 0.5285  
Epoch 242/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.8096 - accuracy: 0.5000  
Epoch 242: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7834 - accuracy: 0.4659 - val\_loss: 0.9974 - val\_accuracy: 0.5026  
Epoch 243/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8208 - accuracy: 0.4688  
Epoch 243: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7987 - accuracy: 0.4749 - val\_loss: 0.9893 - val\_accuracy: 0.4974  
Epoch 244/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.7398 - accuracy: 0.4688  
Epoch 244: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7397 - accuracy: 0.4648 - val\_loss: 0.9938 - val\_accuracy: 0.5440  
Epoch 245/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.8537 - accuracy: 0.4613  
Epoch 245: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8235 - accuracy: 0.4581 - val\_loss: 0.9703 - val\_accuracy: 0.5233  
Epoch 246/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.7105 - accuracy: 0.5052  
Epoch 246: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7441 - accuracy: 0.5028 - val\_loss: 0.9629 - val\_accuracy: 0.5233  
Epoch 247/300  
27/28 [=====>..] - ETA: 0s - loss: 0.7958 - accuracy: 0.4884  
Epoch 247: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7961 - accuracy: 0.4816 - val\_loss: 0.9981 - val\_accuracy: 0.5078  
Epoch 248/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7377 - accuracy: 0.4707  
Epoch 248: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7411 - accuracy: 0.4749 - val\_loss: 0.9635 - val\_accuracy: 0.5337  
Epoch 249/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7583 - accuracy: 0.4824  
Epoch 249: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.8095 - accuracy: 0.4872 - val\_loss: 0.9649 - val\_accuracy: 0.5855  
Epoch 250/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.7673 - accuracy: 0.4872  
Epoch 250: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7878 - accuracy: 0.4872 - val\_loss: 0.9832 - val\_accuracy: 0.5130  
Epoch 251/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.7526 - accuracy: 0.4576  
Epoch 251: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7317 - accuracy: 0.4872 - val\_loss: 0.9592 - val\_accuracy: 0.5389  
Epoch 252/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.7989 - accuracy: 0.4836  
Epoch 252: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7829 - accuracy: 0.4737 - val\_loss: 0.9736 - val\_accuracy: 0.5130  
Epoch 253/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.7362 - accuracy: 0.4757  
Epoch 253: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7416 - accuracy: 0.4905 - val\_loss: 0.9359 - val\_accuracy: 0.5959  
Epoch 254/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.8133 - accuracy: 0.4890  
Epoch 254: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7964 - accuracy: 0.4570 - val\_loss: 0.9639 - val\_accuracy: 0.5596  
Epoch 255/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.7601 - accuracy: 0.5156  
Epoch 255: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7736 - accuracy: 0.5006 - val\_loss: 0.9541 - val\_accuracy: 0.5699  
Epoch 256/300



19/28 [=====>.....] - ETA: 0s - loss: 0.7243 - accuracy: 0.5016  
Epoch 256: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7966 - accuracy: 0.4849 - val\_loss: 0.9702 - val\_accuracy: 0.5699  
Epoch 257/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.7095 - accuracy: 0.4948  
Epoch 257: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7165 - accuracy: 0.5006 - val\_loss: 1.0074 - val\_accuracy: 0.5026  
Epoch 258/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.6957 - accuracy: 0.4859  
Epoch 258: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7121 - accuracy: 0.4972 - val\_loss: 0.9597 - val\_accuracy: 0.5492  
Epoch 259/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.7078 - accuracy: 0.5172  
Epoch 259: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7684 - accuracy: 0.4916 - val\_loss: 0.9966 - val\_accuracy: 0.5026  
Epoch 260/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.8162 - accuracy: 0.4720  
Epoch 260: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7906 - accuracy: 0.4838 - val\_loss: 0.9585 - val\_accuracy: 0.5492  
Epoch 261/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.6954 - accuracy: 0.5089  
Epoch 261: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7245 - accuracy: 0.5073 - val\_loss: 0.9643 - val\_accuracy: 0.5492  
Epoch 262/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.6932 - accuracy: 0.5184  
Epoch 262: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7158 - accuracy: 0.4994 - val\_loss: 0.9700 - val\_accuracy: 0.5596  
Epoch 263/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.8469 - accuracy: 0.4669  
Epoch 263: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7721 - accuracy: 0.4950 - val\_loss: 0.9584 - val\_accuracy: 0.5337  
Epoch 264/300  
22/28 [=====>.....] - ETA: 0s - loss: 0.7531 - accuracy: 0.4915  
Epoch 264: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7360 - accuracy: 0.4961 - val\_loss: 0.9684 - val\_accuracy: 0.5389  
Epoch 265/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.7082 - accuracy: 0.5129  
Epoch 265: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7080 - accuracy: 0.5274 - val\_loss: 0.9382 - val\_accuracy: 0.5751  
Epoch 266/300  
21/28 [=====>.....] - ETA: 0s - loss: 0.7404 - accuracy: 0.4568  
Epoch 266: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7244 - accuracy: 0.4860 - val\_loss: 0.9530 - val\_accuracy: 0.5544  
Epoch 267/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.6922 - accuracy: 0.5188  
Epoch 267: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7601 - accuracy: 0.4905 - val\_loss: 0.9638 - val\_accuracy: 0.5492  
Epoch 268/300  
18/28 [=====>.....] - ETA: 0s - loss: 0.7349 - accuracy: 0.4878  
Epoch 268: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7692 - accuracy: 0.4860 - val\_loss: 0.9518 - val\_accuracy: 0.5544  
Epoch 269/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7893 - accuracy: 0.5156  
Epoch 269: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7329 - accuracy: 0.4983 - val\_loss: 0.9211 - val\_accuracy: 0.5907  
Epoch 270/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.7428 - accuracy: 0.4945  
Epoch 270: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7359 - accuracy: 0.4961 - val\_loss: 0.9426 - val\_accuracy: 0.5751  
Epoch 271/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.6970 - accuracy: 0.5333  
Epoch 271: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7424 - accuracy: 0.5073 - val\_loss: 0.9618 - val\_accuracy: 0.5544  
Epoch 272/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.7205 - accuracy: 0.5083  
Epoch 272: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7208 - accuracy: 0.4927 - val\_loss: 0

.9885 - val\_accuracy: 0.4922  
Epoch 273/300  
17/28 [=====>.....] - ETA: 0s - loss: 0.7844 - accuracy: 0.4761  
Epoch 273: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7978 - accuracy: 0.4816 - val\_loss: 0  
.9539 - val\_accuracy: 0.5751  
Epoch 274/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.7780 - accuracy: 0.4938  
Epoch 274: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7168 - accuracy: 0.5095 - val\_loss: 0  
.9441 - val\_accuracy: 0.5492  
Epoch 275/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.7657 - accuracy: 0.5417  
Epoch 275: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7076 - accuracy: 0.5095 - val\_loss: 0  
.9627 - val\_accuracy: 0.5544  
Epoch 276/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.6462 - accuracy: 0.5234  
Epoch 276: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.6917 - accuracy: 0.5106 - val\_loss: 0  
.9843 - val\_accuracy: 0.5130  
Epoch 277/300  
13/28 [=====>.....] - ETA: 0s - loss: 0.7145 - accuracy: 0.5264  
Epoch 277: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7146 - accuracy: 0.5050 - val\_loss: 0  
.9310 - val\_accuracy: 0.5751  
Epoch 278/300  
28/28 [=====] - ETA: 0s - loss: 0.7315 - accuracy: 0.4994  
Epoch 278: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.7315 - accuracy: 0.4994 - val\_loss: 1  
.0063 - val\_accuracy: 0.5389  
Epoch 279/300  
14/28 [=====>.....] - ETA: 0s - loss: 0.7747 - accuracy: 0.5045  
Epoch 279: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7726 - accuracy: 0.4972 - val\_loss: 0  
.9999 - val\_accuracy: 0.5389  
Epoch 280/300  
25/28 [=====>....] - ETA: 0s - loss: 0.6963 - accuracy: 0.4863  
Epoch 280: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.7310 - accuracy: 0.4816 - val\_loss: 1  
.0284 - val\_accuracy: 0.4663  
Epoch 281/300  
16/28 [=====>.....] - ETA: 0s - loss: 0.7535 - accuracy: 0.5039  
Epoch 281: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7364 - accuracy: 0.4994 - val\_loss: 0  
.9068 - val\_accuracy: 0.5803  
Epoch 282/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.7962 - accuracy: 0.4875  
Epoch 282: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7271 - accuracy: 0.5095 - val\_loss: 0  
.9193 - val\_accuracy: 0.5907  
Epoch 283/300  
19/28 [=====>.....] - ETA: 0s - loss: 0.6514 - accuracy: 0.5263  
Epoch 283: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.6588 - accuracy: 0.5117 - val\_loss: 0  
.9718 - val\_accuracy: 0.5389  
Epoch 284/300  
12/28 [=====>.....] - ETA: 0s - loss: 0.7483 - accuracy: 0.4609  
Epoch 284: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7264 - accuracy: 0.5073 - val\_loss: 0  
.9832 - val\_accuracy: 0.5130  
Epoch 285/300  
27/28 [=====>..] - ETA: 0s - loss: 0.7589 - accuracy: 0.4826  
Epoch 285: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.7598 - accuracy: 0.4860 - val\_loss: 0  
.9567 - val\_accuracy: 0.5648  
Epoch 286/300  
25/28 [=====>....] - ETA: 0s - loss: 0.7339 - accuracy: 0.4875  
Epoch 286: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 6ms/step - loss: 0.7262 - accuracy: 0.4950 - val\_loss: 0  
.9462 - val\_accuracy: 0.5492  
Epoch 287/300  
15/28 [=====>.....] - ETA: 0s - loss: 0.6672 - accuracy: 0.4708  
Epoch 287: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 5ms/step - loss: 0.7084 - accuracy: 0.5039 - val\_loss: 0  
.9255 - val\_accuracy: 0.5907  
Epoch 288/300  
20/28 [=====>.....] - ETA: 0s - loss: 0.7065 - accuracy: 0.4922  
Epoch 288: val\_accuracy did not improve from 0.64249  
28/28 [=====] - 0s 4ms/step - loss: 0.7322 - accuracy: 0.5073 - val\_loss: 0  
.9575 - val\_accuracy: 0.5596  
Epoch 289/300  
28/28 [=====] - ETA: 0s - loss: 0.7373 - accuracy: 0.4793

```

Epoch 289: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 6ms/step - loss: 0.7373 - accuracy: 0.4793 - val_loss: 0.9269 - val_accuracy: 0.5959
Epoch 290/300
14/28 [=====>.....] - ETA: 0s - loss: 0.7150 - accuracy: 0.5156
Epoch 290: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.6910 - accuracy: 0.5117 - val_loss: 0.9395 - val_accuracy: 0.5648
Epoch 291/300
27/28 [=====>..] - ETA: 0s - loss: 0.7240 - accuracy: 0.5023
Epoch 291: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 6ms/step - loss: 0.7285 - accuracy: 0.4972 - val_loss: 0.9424 - val_accuracy: 0.5648
Epoch 292/300
28/28 [=====] - ETA: 0s - loss: 0.7191 - accuracy: 0.5140
Epoch 292: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.7191 - accuracy: 0.5140 - val_loss: 0.9431 - val_accuracy: 0.5596
Epoch 293/300
23/28 [=====>.....] - ETA: 0s - loss: 0.7292 - accuracy: 0.5041
Epoch 293: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 6ms/step - loss: 0.7287 - accuracy: 0.5061 - val_loss: 0.9557 - val_accuracy: 0.5285
Epoch 294/300
15/28 [=====>.....] - ETA: 0s - loss: 0.6799 - accuracy: 0.5229
Epoch 294: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.7273 - accuracy: 0.5128 - val_loss: 0.9228 - val_accuracy: 0.5907
Epoch 295/300
14/28 [=====>.....] - ETA: 0s - loss: 0.6820 - accuracy: 0.5536
Epoch 295: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.6998 - accuracy: 0.5352 - val_loss: 1.0586 - val_accuracy: 0.4663
Epoch 296/300
13/28 [=====>.....] - ETA: 0s - loss: 0.7041 - accuracy: 0.5144
Epoch 296: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 6ms/step - loss: 0.7261 - accuracy: 0.5128 - val_loss: 0.9848 - val_accuracy: 0.5233
Epoch 297/300
14/28 [=====>.....] - ETA: 0s - loss: 0.8107 - accuracy: 0.5000
Epoch 297: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.7802 - accuracy: 0.5106 - val_loss: 0.9219 - val_accuracy: 0.5751
Epoch 298/300
14/28 [=====>.....] - ETA: 0s - loss: 0.6993 - accuracy: 0.5089
Epoch 298: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.6985 - accuracy: 0.5117 - val_loss: 0.9261 - val_accuracy: 0.5699
Epoch 299/300
22/28 [=====>.....] - ETA: 0s - loss: 0.7461 - accuracy: 0.5085
Epoch 299: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 7ms/step - loss: 0.7128 - accuracy: 0.5140 - val_loss: 0.9119 - val_accuracy: 0.5907
Epoch 300/300
14/28 [=====>.....] - ETA: 0s - loss: 0.6928 - accuracy: 0.5156
Epoch 300: val_accuracy did not improve from 0.64249
28/28 [=====] - 0s 5ms/step - loss: 0.7203 - accuracy: 0.5207 - val_loss: 0.9260 - val_accuracy: 0.5440

```

In [351]:

```

model.load_weights("/content/weightsMLP2.best.hdf5")
adam = keras.optimizers.Adam(learning_rate=0.001)
model.compile(loss='categorical_crossentropy', metrics=['accuracy'], optimizer='adam')
print("Created model and loaded weights from file")

```

Created model and loaded weights from file

In [352]:

```

results.loc[index,['Architecture','Dropout','Loss Fn', 'LR']] = ['ANN: MLP',0.1, 'Cross-Entropy',0.001]

```

**Evaluation:** Training and Validation

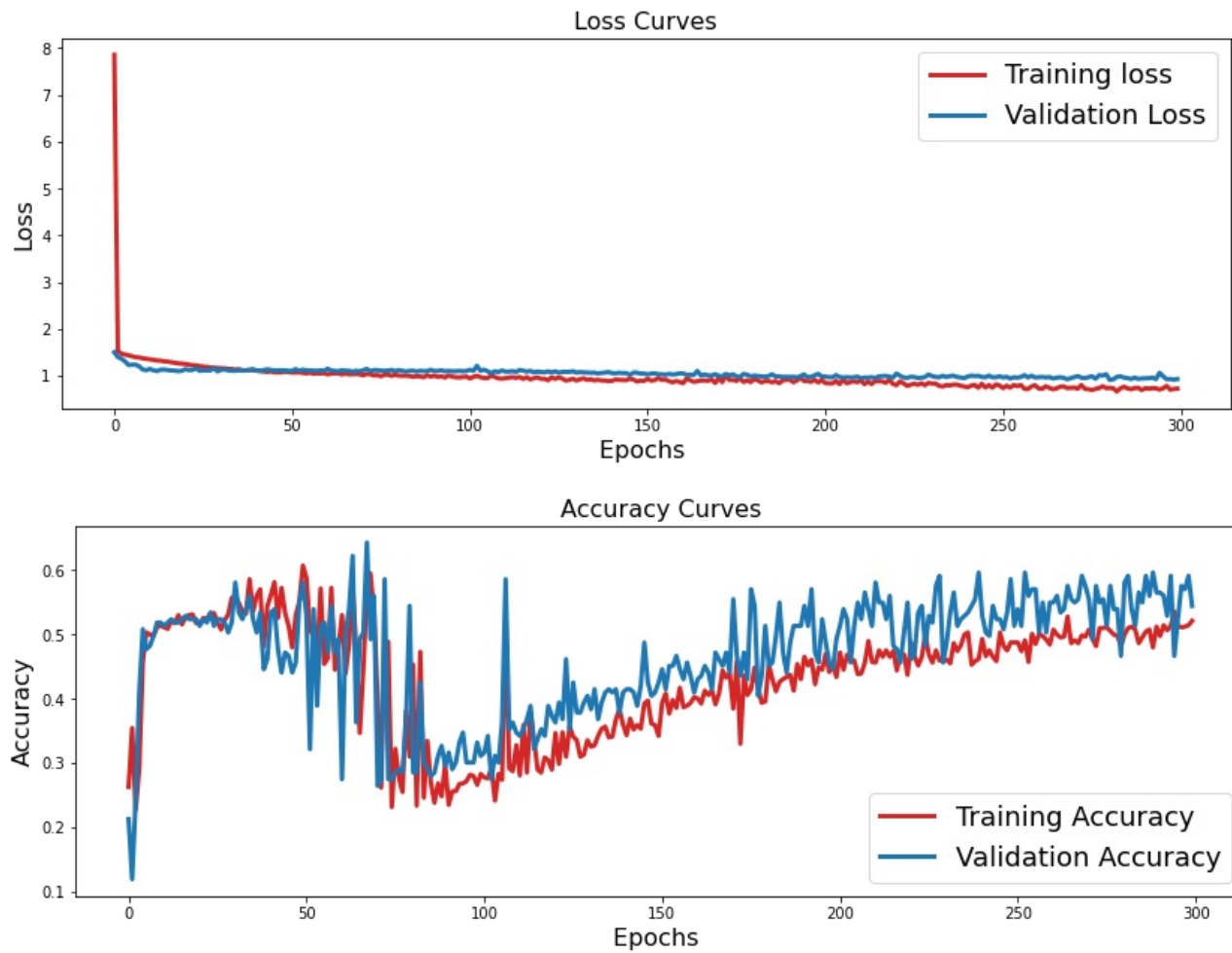
In [353]:

```
evaluation_train_val(model, X_train, Y_train, X_val, Y_val, results, index)
```

Training Accuracy: 0.6746323704719543  
Training Loss: 1.0598829984664917  
Validation Accuracy: 0.7202072739601135  
Validation Loss: 1.0006788969039917

In [354]:

```
plotfn(history)
```



Evaluation: Testing

In [355]:

```
evaluation_test(model, X_test, Y_test, results, index)
```

7/7 [=====] - 0s 3ms/step - loss: 1.1034 - accuracy: 0.6528  
Test accuracy: 0.6528497338294983  
Test loss: 1.1034021377563477

## Evaluation Metrics

F1 score

In [356]:

```
_,_,_, val_f1 = predictfn(model, X_val, Y_val)
```

```
7/7 [=====] - 0s 4ms/step
      precision    recall  f1-score   support

extrahls      1.00      0.68      0.81        22
extrastole    0.09      0.17      0.12         6
murmur        0.51      0.70      0.59        40
normal        0.85      0.76      0.80       125

accuracy              0.72       193
macro avg           0.61      0.58      0.58       193
weighted avg        0.77      0.72      0.74       193
```

In [357]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model,X_test,Y_test)
```

```
7/7 [=====] - 0s 2ms/step
      precision    recall  f1-score   support

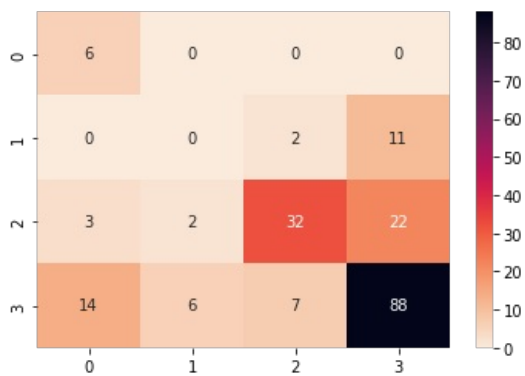
extrahls      1.00      0.26      0.41        23
extrastole    0.00      0.00      0.00         8
murmur        0.54      0.78      0.64        41
normal        0.77      0.73      0.75       121

accuracy              0.65       193
macro avg           0.58      0.44      0.45       193
weighted avg        0.71      0.65      0.65       193
```

Confusion Matrix

In [358]:

```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



## COMMENTS

This model is not good at classifying all classes as class 1 and 2 are almost always misclassified. Therefore, the earlier MLP version was better.

ROC and AUC

```
roc = plot_ROC(Y_test,predictions)
```



```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

```
model_name = "heartbeat_classifierMLP.h5"
model.save(model_name)
```

```
test.iloc[5]
```

[illegible]

In [367]:

```
sample_predict(model_name,5)
```

```
1/1 [=====] - 0s 140ms/step
Label Prediction Probabilities: [[7.3190015e-05 3.3656955e-01 3.3715203e-01 3.2620528e-01]]
-----
Label:
Murmur heartbeat
confidence: 0.33715203
```

#### ***Predicting a Normal sample***

In [369]:

```
test.iloc[10]
```

Out[369]:

```
filename    /content/set_b/normal_noisynormal_141_13065201...
label                               normal
offset                                           3
Name: 488, dtype: object
```

In [370]:

```
sample_predict(model_name,10)
```

```
1/1 [=====] - 0s 127ms/step
Label Prediction Probabilities: [[3.0636352e-07 3.5694864e-01 2.7347854e-01 3.6957249e-01]]
-----
Label:
Normal heartbeat
confidence: 0.3695725
```

#### ***Predicting an Extrahls sample***

In [373]:

```
test.iloc[77]
```

Out[373]:

```
filename    /content/set_a/extrahls__201101241433.wav
label                               extrahls
offset                                           3
Name: 47, dtype: object
```

In [372]:

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 0s 97ms/step
Label Prediction Probabilities: [[0.5893133 0.11770125 0.19179145 0.10119393]]
-----
Label:
Extrahls heartbeat
confidence: 0.5893133
```

## **RNN Experiment: LSTM**

In [394]:

```
model = Sequential()  
model.add(LSTM(units=64, dropout=0.05, recurrent_dropout=0.20, return_sequences=True, input_shape=(x_train.shape[1], x_train.shape[2])))  
model.add(LSTM(units=32, dropout=0.05, recurrent_dropout=0.20, return_sequences=False))  
model.add(Dense(4, activation='softmax'))  
model.summary()
```

Model: "sequential\_25"

Layer (type)	Output Shape	Param #
lstm_7 (LSTM)	(None, 40, 64)	49920
lstm_8 (LSTM)	(None, 32)	12416
dense_68 (Dense)	(None, 4)	132

=====  
Total params: 62,468  
Trainable params: 62,468  
Non-trainable params: 0  
=====

In [395]:

```
adam = keras.optimizers.Adam(learning_rate=0.0001)  
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])  
filepath="/content/weights.best.hdf5"  
checkpoint = ModelCheckpoint(filepath, monitor='val_accuracy', verbose=1, save_best_only=True, mode='max')  
history = model.fit(x_train, y_train, batch_size=100, epochs=150, verbose=1, validation_data=(x_val, y_val), shuffle=True, callbacks=[checkpoint], class_weight=class_Weights)
```

Epoch 1/150

9/9 [=====] - ETA: 0s - loss: 1.3680 - accuracy: 0.3553  
Epoch 1: val\_accuracy improved from -inf to 0.40415, saving model to /content/weights.best.hdf5  
9/9 [=====] - 8s 276ms/step - loss: 1.3680 - accuracy: 0.3553 - val\_loss: 1.3119 - val\_accuracy: 0.4041

Epoch 2/150

9/9 [=====] - ETA: 0s - loss: 1.1558 - accuracy: 0.3296  
Epoch 2: val\_accuracy did not improve from 0.40415  
9/9 [=====] - 2s 177ms/step - loss: 1.1558 - accuracy: 0.3296 - val\_loss: 1.2829 - val\_accuracy: 0.3316

Epoch 3/150

9/9 [=====] - ETA: 0s - loss: 0.9942 - accuracy: 0.3039  
Epoch 3: val\_accuracy did not improve from 0.40415  
9/9 [=====] - 2s 166ms/step - loss: 0.9942 - accuracy: 0.3039 - val\_loss: 1.2306 - val\_accuracy: 0.3057

Epoch 4/150

9/9 [=====] - ETA: 0s - loss: 0.8867 - accuracy: 0.3587  
Epoch 4: val\_accuracy did not improve from 0.40415  
9/9 [=====] - 2s 176ms/step - loss: 0.8867 - accuracy: 0.3587 - val\_loss: 1.1453 - val\_accuracy: 0.3834

Epoch 5/150

9/9 [=====] - ETA: 0s - loss: 0.8070 - accuracy: 0.5251  
Epoch 5: val\_accuracy improved from 0.40415 to 0.47668, saving model to /content/weights.best.hdf5  
9/9 [=====] - 2s 187ms/step - loss: 0.8070 - accuracy: 0.5251 - val\_loss: 1.0654 - val\_accuracy: 0.4767

Epoch 6/150

9/9 [=====] - ETA: 0s - loss: 0.7187 - accuracy: 0.6358  
Epoch 6: val\_accuracy did not improve from 0.47668  
9/9 [=====] - 2s 187ms/step - loss: 0.7187 - accuracy: 0.6358 - val\_loss: 1.0540 - val\_accuracy: 0.4560

Epoch 7/150

9/9 [=====] - ETA: 0s - loss: 0.6314 - accuracy: 0.6324  
Epoch 7: val\_accuracy did not improve from 0.47668  
9/9 [=====] - 2s 190ms/step - loss: 0.6314 - accuracy: 0.6324 - val\_loss: 1.0387 - val\_accuracy: 0.4404

Epoch 8/150

9/9 [=====] - ETA: 0s - loss: 0.5425 - accuracy: 0.6927  
Epoch 8: val\_accuracy improved from 0.47668 to 0.54404, saving model to /content/weights.best.hdf5  
9/9 [=====] - 2s 188ms/step - loss: 0.5425 - accuracy: 0.6927 - val\_loss: 1.0239 - val\_accuracy: 0.5440

Epoch 9/150

9/9 [=====] - ETA: 0s - loss: 0.4437 - accuracy: 0.7564  
Epoch 9: val\_accuracy improved from 0.54404 to 0.56995, saving model to /content/weights.best.hdf5  
9/9 [=====] - 2s 189ms/step - loss: 0.4437 - accuracy: 0.7564 - val\_loss: 1.0430 - val\_accuracy: 0.5699

Epoch 10/150

9/9 [=====] - ETA: 0s - loss: 0.3696 - accuracy: 0.8145  
Epoch 10: val\_accuracy did not improve from 0.56995  
9/9 [=====] - 2s 188ms/step - loss: 0.3696 - accuracy: 0.8145 - val\_loss: 1.0430 - val\_accuracy: 0.5699



```
.1224 - val_accuracy: 0.4508
Epoch 11/150
9/9 [=====] - ETA: 0s - loss: 0.3517 - accuracy: 0.8380
Epoch 11: val_accuracy improved from 0.56995 to 0.58031, saving model to /content/weights.best.hdf5
9/9 [=====] - 2s 192ms/step - loss: 0.3517 - accuracy: 0.8380 - val_loss: 0
.9651 - val_accuracy: 0.5803
Epoch 12/150
9/9 [=====] - ETA: 0s - loss: 0.2981 - accuracy: 0.8246
Epoch 12: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 188ms/step - loss: 0.2981 - accuracy: 0.8246 - val_loss: 0
.9732 - val_accuracy: 0.5389
Epoch 13/150
9/9 [=====] - ETA: 0s - loss: 0.2474 - accuracy: 0.9028
Epoch 13: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 185ms/step - loss: 0.2474 - accuracy: 0.9028 - val_loss: 0
.9954 - val_accuracy: 0.5492
Epoch 14/150
9/9 [=====] - ETA: 0s - loss: 0.1912 - accuracy: 0.9207
Epoch 14: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 186ms/step - loss: 0.1912 - accuracy: 0.9207 - val_loss: 1
.0511 - val_accuracy: 0.5492
Epoch 15/150
9/9 [=====] - ETA: 0s - loss: 0.1611 - accuracy: 0.9318
Epoch 15: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 193ms/step - loss: 0.1611 - accuracy: 0.9318 - val_loss: 1
.1365 - val_accuracy: 0.5233
Epoch 16/150
9/9 [=====] - ETA: 0s - loss: 0.1203 - accuracy: 0.9531
Epoch 16: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 180ms/step - loss: 0.1203 - accuracy: 0.9531 - val_loss: 1
.1859 - val_accuracy: 0.5233
Epoch 17/150
9/9 [=====] - ETA: 0s - loss: 0.0971 - accuracy: 0.9698
Epoch 17: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 189ms/step - loss: 0.0971 - accuracy: 0.9698 - val_loss: 1
.1953 - val_accuracy: 0.5751
Epoch 18/150
9/9 [=====] - ETA: 0s - loss: 0.0825 - accuracy: 0.9698
Epoch 18: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 187ms/step - loss: 0.0825 - accuracy: 0.9698 - val_loss: 1
.2528 - val_accuracy: 0.5648
Epoch 19/150
9/9 [=====] - ETA: 0s - loss: 0.0618 - accuracy: 0.9788
Epoch 19: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 185ms/step - loss: 0.0618 - accuracy: 0.9788 - val_loss: 1
.3131 - val_accuracy: 0.5596
Epoch 20/150
9/9 [=====] - ETA: 0s - loss: 0.0466 - accuracy: 0.9922
Epoch 20: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 177ms/step - loss: 0.0466 - accuracy: 0.9922 - val_loss: 1
.4123 - val_accuracy: 0.5285
Epoch 21/150
9/9 [=====] - ETA: 0s - loss: 0.0404 - accuracy: 0.9922
Epoch 21: val_accuracy did not improve from 0.58031
9/9 [=====] - 1s 167ms/step - loss: 0.0404 - accuracy: 0.9922 - val_loss: 1
.4105 - val_accuracy: 0.5389
Epoch 22/150
9/9 [=====] - ETA: 0s - loss: 0.0335 - accuracy: 0.9944
Epoch 22: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 184ms/step - loss: 0.0335 - accuracy: 0.9944 - val_loss: 1
.6463 - val_accuracy: 0.5078
Epoch 23/150
9/9 [=====] - ETA: 0s - loss: 0.0612 - accuracy: 0.9855
Epoch 23: val_accuracy did not improve from 0.58031
9/9 [=====] - 2s 189ms/step - loss: 0.0612 - accuracy: 0.9855 - val_loss: 1
.4321 - val_accuracy: 0.5181
Epoch 24/150
9/9 [=====] - ETA: 0s - loss: 0.0644 - accuracy: 0.9676
Epoch 24: val_accuracy improved from 0.58031 to 0.64249, saving model to /content/weights.best.hdf5
9/9 [=====] - 2s 203ms/step - loss: 0.0644 - accuracy: 0.9676 - val_loss: 1
.2565 - val_accuracy: 0.6425
Epoch 25/150
9/9 [=====] - ETA: 0s - loss: 0.0610 - accuracy: 0.9743
Epoch 25: val_accuracy did not improve from 0.64249
9/9 [=====] - 2s 187ms/step - loss: 0.0610 - accuracy: 0.9743 - val_loss: 1
.2591 - val_accuracy: 0.6321
Epoch 26/150
9/9 [=====] - ETA: 0s - loss: 0.0519 - accuracy: 0.9821
Epoch 26: val_accuracy did not improve from 0.64249
9/9 [=====] - 2s 200ms/step - loss: 0.0519 - accuracy: 0.9821 - val_loss: 1
.4045 - val_accuracy: 0.5440
Epoch 27/150
9/9 [=====] - ETA: 0s - loss: 0.0337 - accuracy: 0.9933
```

Epoch 27: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 365ms/step - loss: 0.0337 - accuracy: 0.9933 - val\_loss: 1.3777 - val\_accuracy: 0.6010

Epoch 28/150  
9/9 [=====] - ETA: 0s - loss: 0.0270 - accuracy: 0.9944  
Epoch 28: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 326ms/step - loss: 0.0270 - accuracy: 0.9944 - val\_loss: 1.4520 - val\_accuracy: 0.5959

Epoch 29/150  
9/9 [=====] - ETA: 0s - loss: 0.0327 - accuracy: 0.9855  
Epoch 29: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 194ms/step - loss: 0.0327 - accuracy: 0.9855 - val\_loss: 1.5305 - val\_accuracy: 0.6010

Epoch 30/150  
9/9 [=====] - ETA: 0s - loss: 0.0245 - accuracy: 0.9966  
Epoch 30: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0245 - accuracy: 0.9966 - val\_loss: 1.6124 - val\_accuracy: 0.5803

Epoch 31/150  
9/9 [=====] - ETA: 0s - loss: 0.0199 - accuracy: 0.9978  
Epoch 31: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 293ms/step - loss: 0.0199 - accuracy: 0.9978 - val\_loss: 1.5655 - val\_accuracy: 0.6114

Epoch 32/150  
9/9 [=====] - ETA: 0s - loss: 0.0179 - accuracy: 0.9989  
Epoch 32: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 289ms/step - loss: 0.0179 - accuracy: 0.9989 - val\_loss: 1.6487 - val\_accuracy: 0.5699

Epoch 33/150  
9/9 [=====] - ETA: 0s - loss: 0.0145 - accuracy: 1.0000  
Epoch 33: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 189ms/step - loss: 0.0145 - accuracy: 1.0000 - val\_loss: 1.5789 - val\_accuracy: 0.6010

Epoch 34/150  
9/9 [=====] - ETA: 0s - loss: 0.0123 - accuracy: 1.0000  
Epoch 34: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 190ms/step - loss: 0.0123 - accuracy: 1.0000 - val\_loss: 1.6404 - val\_accuracy: 0.5907

Epoch 35/150  
9/9 [=====] - ETA: 0s - loss: 0.0115 - accuracy: 1.0000  
Epoch 35: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 4s 483ms/step - loss: 0.0115 - accuracy: 1.0000 - val\_loss: 1.6437 - val\_accuracy: 0.5855

Epoch 36/150  
9/9 [=====] - ETA: 0s - loss: 0.0111 - accuracy: 0.9989  
Epoch 36: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 381ms/step - loss: 0.0111 - accuracy: 0.9989 - val\_loss: 1.6779 - val\_accuracy: 0.5855

Epoch 37/150  
9/9 [=====] - ETA: 0s - loss: 0.0104 - accuracy: 0.9989  
Epoch 37: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 4s 424ms/step - loss: 0.0104 - accuracy: 0.9989 - val\_loss: 1.7061 - val\_accuracy: 0.5959

Epoch 38/150  
9/9 [=====] - ETA: 0s - loss: 0.0088 - accuracy: 1.0000  
Epoch 38: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 356ms/step - loss: 0.0088 - accuracy: 1.0000 - val\_loss: 1.7253 - val\_accuracy: 0.5959

Epoch 39/150  
9/9 [=====] - ETA: 0s - loss: 0.0120 - accuracy: 0.9978  
Epoch 39: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 4s 485ms/step - loss: 0.0120 - accuracy: 0.9978 - val\_loss: 1.7698 - val\_accuracy: 0.5751

Epoch 40/150  
9/9 [=====] - ETA: 0s - loss: 0.0106 - accuracy: 0.9989  
Epoch 40: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 302ms/step - loss: 0.0106 - accuracy: 0.9989 - val\_loss: 1.7390 - val\_accuracy: 0.5907

Epoch 41/150  
9/9 [=====] - ETA: 0s - loss: 0.0084 - accuracy: 1.0000  
Epoch 41: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0084 - accuracy: 1.0000 - val\_loss: 1.7694 - val\_accuracy: 0.5751

Epoch 42/150  
9/9 [=====] - ETA: 0s - loss: 0.0073 - accuracy: 1.0000  
Epoch 42: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0073 - accuracy: 1.0000 - val\_loss: 1.7486 - val\_accuracy: 0.5699

Epoch 43/150  
9/9 [=====] - ETA: 0s - loss: 0.0073 - accuracy: 1.0000  
Epoch 43: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0073 - accuracy: 1.0000 - val\_loss: 1.7932 - val\_accuracy: 0.5803

Epoch 44/150  
9/9 [=====] - ETA: 0s - loss: 0.0082 - accuracy: 0.9978  
Epoch 44: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 192ms/step - loss: 0.0082 - accuracy: 0.9978 - val\_loss: 1.8056 - val\_accuracy: 0.5855  
Epoch 45/150  
9/9 [=====] - ETA: 0s - loss: 0.0060 - accuracy: 1.0000  
Epoch 45: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 335ms/step - loss: 0.0060 - accuracy: 1.0000 - val\_loss: 1.8088 - val\_accuracy: 0.6114  
Epoch 46/150  
9/9 [=====] - ETA: 0s - loss: 0.0059 - accuracy: 1.0000  
Epoch 46: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 283ms/step - loss: 0.0059 - accuracy: 1.0000 - val\_loss: 1.8500 - val\_accuracy: 0.5751  
Epoch 47/150  
9/9 [=====] - ETA: 0s - loss: 0.0052 - accuracy: 1.0000  
Epoch 47: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 182ms/step - loss: 0.0052 - accuracy: 1.0000 - val\_loss: 1.8761 - val\_accuracy: 0.5699  
Epoch 48/150  
9/9 [=====] - ETA: 0s - loss: 0.0053 - accuracy: 1.0000  
Epoch 48: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 372ms/step - loss: 0.0053 - accuracy: 1.0000 - val\_loss: 1.8971 - val\_accuracy: 0.5855  
Epoch 49/150  
9/9 [=====] - ETA: 0s - loss: 0.0052 - accuracy: 1.0000  
Epoch 49: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 314ms/step - loss: 0.0052 - accuracy: 1.0000 - val\_loss: 1.9316 - val\_accuracy: 0.5699  
Epoch 50/150  
9/9 [=====] - ETA: 0s - loss: 0.0067 - accuracy: 0.9989  
Epoch 50: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 198ms/step - loss: 0.0067 - accuracy: 0.9989 - val\_loss: 1.8354 - val\_accuracy: 0.5699  
Epoch 51/150  
9/9 [=====] - ETA: 0s - loss: 0.0060 - accuracy: 0.9989  
Epoch 51: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 199ms/step - loss: 0.0060 - accuracy: 0.9989 - val\_loss: 1.8567 - val\_accuracy: 0.5803  
Epoch 52/150  
9/9 [=====] - ETA: 0s - loss: 0.0056 - accuracy: 1.0000  
Epoch 52: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 191ms/step - loss: 0.0056 - accuracy: 1.0000 - val\_loss: 1.9544 - val\_accuracy: 0.5803  
Epoch 53/150  
9/9 [=====] - ETA: 0s - loss: 0.0057 - accuracy: 0.9978  
Epoch 53: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 255ms/step - loss: 0.0057 - accuracy: 0.9978 - val\_loss: 1.8702 - val\_accuracy: 0.6010  
Epoch 54/150  
9/9 [=====] - ETA: 0s - loss: 0.0047 - accuracy: 1.0000  
Epoch 54: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 359ms/step - loss: 0.0047 - accuracy: 1.0000 - val\_loss: 1.9096 - val\_accuracy: 0.5751  
Epoch 55/150  
9/9 [=====] - ETA: 0s - loss: 0.0048 - accuracy: 1.0000  
Epoch 55: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 281ms/step - loss: 0.0048 - accuracy: 1.0000 - val\_loss: 1.9723 - val\_accuracy: 0.5751  
Epoch 56/150  
9/9 [=====] - ETA: 0s - loss: 0.0050 - accuracy: 0.9989  
Epoch 56: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 362ms/step - loss: 0.0050 - accuracy: 0.9989 - val\_loss: 1.8745 - val\_accuracy: 0.6062  
Epoch 57/150  
9/9 [=====] - ETA: 0s - loss: 0.0058 - accuracy: 1.0000  
Epoch 57: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0058 - accuracy: 1.0000 - val\_loss: 1.7519 - val\_accuracy: 0.6321  
Epoch 58/150  
9/9 [=====] - ETA: 0s - loss: 0.0073 - accuracy: 0.9966  
Epoch 58: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0073 - accuracy: 0.9966 - val\_loss: 1.8280 - val\_accuracy: 0.6010  
Epoch 59/150  
9/9 [=====] - ETA: 0s - loss: 0.0079 - accuracy: 0.9989  
Epoch 59: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 186ms/step - loss: 0.0079 - accuracy: 0.9989 - val\_loss: 1.9469 - val\_accuracy: 0.5855  
Epoch 60/150  
9/9 [=====] - ETA: 0s - loss: 0.0086 - accuracy: 0.9966  
Epoch 60: val\_accuracy did not improve from 0.64249

9/9 [=====] - 2s 188ms/step - loss: 0.0086 - accuracy: 0.9966 - val\_loss: 1.9089 - val\_accuracy: 0.6321  
Epoch 61/150  
9/9 [=====] - ETA: 0s - loss: 0.0067 - accuracy: 0.9989  
Epoch 61: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 186ms/step - loss: 0.0067 - accuracy: 0.9989 - val\_loss: 1.9380 - val\_accuracy: 0.5544  
Epoch 62/150  
9/9 [=====] - ETA: 0s - loss: 0.0247 - accuracy: 0.9855  
Epoch 62: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 184ms/step - loss: 0.0247 - accuracy: 0.9855 - val\_loss: 1.7470 - val\_accuracy: 0.6425  
Epoch 63/150  
9/9 [=====] - ETA: 0s - loss: 0.0311 - accuracy: 0.9899  
Epoch 63: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 185ms/step - loss: 0.0311 - accuracy: 0.9899 - val\_loss: 1.8613 - val\_accuracy: 0.5907  
Epoch 64/150  
9/9 [=====] - ETA: 0s - loss: 0.0239 - accuracy: 0.9899  
Epoch 64: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 185ms/step - loss: 0.0239 - accuracy: 0.9899 - val\_loss: 2.0404 - val\_accuracy: 0.5544  
Epoch 65/150  
9/9 [=====] - ETA: 0s - loss: 0.0497 - accuracy: 0.9877  
Epoch 65: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 187ms/step - loss: 0.0497 - accuracy: 0.9877 - val\_loss: 1.7068 - val\_accuracy: 0.5751  
Epoch 66/150  
9/9 [=====] - ETA: 0s - loss: 0.0486 - accuracy: 0.9754  
Epoch 66: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 186ms/step - loss: 0.0486 - accuracy: 0.9754 - val\_loss: 1.7597 - val\_accuracy: 0.5492  
Epoch 67/150  
9/9 [=====] - ETA: 0s - loss: 0.0428 - accuracy: 0.9788  
Epoch 67: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 190ms/step - loss: 0.0428 - accuracy: 0.9788 - val\_loss: 1.6322 - val\_accuracy: 0.5855  
Epoch 68/150  
9/9 [=====] - ETA: 0s - loss: 0.0342 - accuracy: 0.9844  
Epoch 68: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 179ms/step - loss: 0.0342 - accuracy: 0.9844 - val\_loss: 1.7139 - val\_accuracy: 0.6010  
Epoch 69/150  
9/9 [=====] - ETA: 0s - loss: 0.0241 - accuracy: 0.9877  
Epoch 69: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 189ms/step - loss: 0.0241 - accuracy: 0.9877 - val\_loss: 1.7153 - val\_accuracy: 0.5648  
Epoch 70/150  
9/9 [=====] - ETA: 0s - loss: 0.0150 - accuracy: 0.9978  
Epoch 70: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 184ms/step - loss: 0.0150 - accuracy: 0.9978 - val\_loss: 1.6809 - val\_accuracy: 0.6166  
Epoch 71/150  
9/9 [=====] - ETA: 0s - loss: 0.0116 - accuracy: 1.0000  
Epoch 71: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 190ms/step - loss: 0.0116 - accuracy: 1.0000 - val\_loss: 1.7199 - val\_accuracy: 0.5803  
Epoch 72/150  
9/9 [=====] - ETA: 0s - loss: 0.0090 - accuracy: 0.9989  
Epoch 72: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 183ms/step - loss: 0.0090 - accuracy: 0.9989 - val\_loss: 1.7877 - val\_accuracy: 0.5803  
Epoch 73/150  
9/9 [=====] - ETA: 0s - loss: 0.0060 - accuracy: 1.0000  
Epoch 73: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 189ms/step - loss: 0.0060 - accuracy: 1.0000 - val\_loss: 1.8266 - val\_accuracy: 0.5699  
Epoch 74/150  
9/9 [=====] - ETA: 0s - loss: 0.0059 - accuracy: 1.0000  
Epoch 74: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 194ms/step - loss: 0.0059 - accuracy: 1.0000 - val\_loss: 1.8635 - val\_accuracy: 0.5907  
Epoch 75/150  
9/9 [=====] - ETA: 0s - loss: 0.0055 - accuracy: 0.9989  
Epoch 75: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 191ms/step - loss: 0.0055 - accuracy: 0.9989 - val\_loss: 1.9175 - val\_accuracy: 0.5648  
Epoch 76/150  
9/9 [=====] - ETA: 0s - loss: 0.0057 - accuracy: 0.9989  
Epoch 76: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 190ms/step - loss: 0.0057 - accuracy: 0.9989 - val\_loss: 1.9338 - val\_accuracy: 0.5855  
Epoch 77/150

9/9 [=====] - ETA: 0s - loss: 0.0058 - accuracy: 0.9989  
Epoch 77: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 189ms/step - loss: 0.0058 - accuracy: 0.9989 - val\_loss: 1.9496 - val\_accuracy: 0.5907  
Epoch 78/150  
9/9 [=====] - ETA: 0s - loss: 0.0058 - accuracy: 0.9978  
Epoch 78: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 190ms/step - loss: 0.0058 - accuracy: 0.9978 - val\_loss: 2.0087 - val\_accuracy: 0.5699  
Epoch 79/150  
9/9 [=====] - ETA: 0s - loss: 0.0102 - accuracy: 0.9978  
Epoch 79: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 193ms/step - loss: 0.0102 - accuracy: 0.9978 - val\_loss: 1.9433 - val\_accuracy: 0.6114  
Epoch 80/150  
9/9 [=====] - ETA: 0s - loss: 0.0045 - accuracy: 0.9989  
Epoch 80: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 3s 352ms/step - loss: 0.0045 - accuracy: 0.9989 - val\_loss: 1.9074 - val\_accuracy: 0.5544  
Epoch 81/150  
9/9 [=====] - ETA: 0s - loss: 0.0038 - accuracy: 1.0000  
Epoch 81: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 192ms/step - loss: 0.0038 - accuracy: 1.0000 - val\_loss: 1.8765 - val\_accuracy: 0.6010  
Epoch 82/150  
9/9 [=====] - ETA: 0s - loss: 0.0036 - accuracy: 1.0000  
Epoch 82: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 173ms/step - loss: 0.0036 - accuracy: 1.0000 - val\_loss: 1.8788 - val\_accuracy: 0.6062  
Epoch 83/150  
9/9 [=====] - ETA: 0s - loss: 0.0031 - accuracy: 1.0000  
Epoch 83: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 191ms/step - loss: 0.0031 - accuracy: 1.0000 - val\_loss: 1.8781 - val\_accuracy: 0.5803  
Epoch 84/150  
9/9 [=====] - ETA: 0s - loss: 0.0030 - accuracy: 1.0000  
Epoch 84: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 194ms/step - loss: 0.0030 - accuracy: 1.0000 - val\_loss: 1.8884 - val\_accuracy: 0.5855  
Epoch 85/150  
9/9 [=====] - ETA: 0s - loss: 0.0032 - accuracy: 1.0000  
Epoch 85: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 185ms/step - loss: 0.0032 - accuracy: 1.0000 - val\_loss: 1.9309 - val\_accuracy: 0.6062  
Epoch 86/150  
9/9 [=====] - ETA: 0s - loss: 0.0023 - accuracy: 1.0000  
Epoch 86: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 196ms/step - loss: 0.0023 - accuracy: 1.0000 - val\_loss: 1.9982 - val\_accuracy: 0.5699  
Epoch 87/150  
9/9 [=====] - ETA: 0s - loss: 0.0024 - accuracy: 1.0000  
Epoch 87: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0024 - accuracy: 1.0000 - val\_loss: 2.0191 - val\_accuracy: 0.6010  
Epoch 88/150  
9/9 [=====] - ETA: 0s - loss: 0.0022 - accuracy: 1.0000  
Epoch 88: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 174ms/step - loss: 0.0022 - accuracy: 1.0000 - val\_loss: 2.0334 - val\_accuracy: 0.6114  
Epoch 89/150  
9/9 [=====] - ETA: 0s - loss: 0.0022 - accuracy: 1.0000  
Epoch 89: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 191ms/step - loss: 0.0022 - accuracy: 1.0000 - val\_loss: 2.0437 - val\_accuracy: 0.6218  
Epoch 90/150  
9/9 [=====] - ETA: 0s - loss: 0.0024 - accuracy: 1.0000  
Epoch 90: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 194ms/step - loss: 0.0024 - accuracy: 1.0000 - val\_loss: 2.0482 - val\_accuracy: 0.5907  
Epoch 91/150  
9/9 [=====] - ETA: 0s - loss: 0.0023 - accuracy: 1.0000  
Epoch 91: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 186ms/step - loss: 0.0023 - accuracy: 1.0000 - val\_loss: 2.0646 - val\_accuracy: 0.5855  
Epoch 92/150  
9/9 [=====] - ETA: 0s - loss: 0.0019 - accuracy: 1.0000  
Epoch 92: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 188ms/step - loss: 0.0019 - accuracy: 1.0000 - val\_loss: 2.0721 - val\_accuracy: 0.6114  
Epoch 93/150  
9/9 [=====] - ETA: 0s - loss: 0.0018 - accuracy: 1.0000  
Epoch 93: val\_accuracy did not improve from 0.64249  
9/9 [=====] - 2s 183ms/step - loss: 0.0018 - accuracy: 1.0000 - val\_loss: 2

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.0855 - val_accuracy: 0.6114
Epoch 94/150
9/9 [=====] - ETA: 0s - loss: 0.0017 - accuracy: 1.0000
Epoch 94: val_accuracy did not improve from 0.64249
9/9 [=====] - 1s 166ms/step - loss: 0.0017 - accuracy: 1.0000 - val_loss: 2
.0945 - val_accuracy: 0.6166
Epoch 95/150
9/9 [=====] - ETA: 0s - loss: 0.0029 - accuracy: 0.9989
Epoch 95: val_accuracy improved from 0.64249 to 0.65285, saving model to /content/weights.best.hdf5
9/9 [=====] - 2s 237ms/step - loss: 0.0029 - accuracy: 0.9989 - val_loss: 2
.1241 - val_accuracy: 0.6528
Epoch 96/150
9/9 [=====] - ETA: 0s - loss: 0.0024 - accuracy: 1.0000
Epoch 96: val_accuracy did not improve from 0.65285
9/9 [=====] - 3s 300ms/step - loss: 0.0024 - accuracy: 1.0000 - val_loss: 2
.0517 - val_accuracy: 0.6218
Epoch 97/150
9/9 [=====] - ETA: 0s - loss: 0.0017 - accuracy: 1.0000
Epoch 97: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 205ms/step - loss: 0.0017 - accuracy: 1.0000 - val_loss: 2
.0401 - val_accuracy: 0.5751
Epoch 98/150
9/9 [=====] - ETA: 0s - loss: 0.0020 - accuracy: 1.0000
Epoch 98: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 187ms/step - loss: 0.0020 - accuracy: 1.0000 - val_loss: 2
.0395 - val_accuracy: 0.5699
Epoch 99/150
9/9 [=====] - ETA: 0s - loss: 0.0023 - accuracy: 0.9989
Epoch 99: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 190ms/step - loss: 0.0023 - accuracy: 0.9989 - val_loss: 2
.0296 - val_accuracy: 0.6218
Epoch 100/150
9/9 [=====] - ETA: 0s - loss: 0.0023 - accuracy: 1.0000
Epoch 100: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 191ms/step - loss: 0.0023 - accuracy: 1.0000 - val_loss: 2
.0107 - val_accuracy: 0.6425
Epoch 101/150
9/9 [=====] - ETA: 0s - loss: 0.0040 - accuracy: 1.0000
Epoch 101: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 189ms/step - loss: 0.0040 - accuracy: 1.0000 - val_loss: 2
.0282 - val_accuracy: 0.6477
Epoch 102/150
9/9 [=====] - ETA: 0s - loss: 0.0050 - accuracy: 0.9978
Epoch 102: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 191ms/step - loss: 0.0050 - accuracy: 0.9978 - val_loss: 2
.0163 - val_accuracy: 0.5492
Epoch 103/150
9/9 [=====] - ETA: 0s - loss: 0.0046 - accuracy: 0.9966
Epoch 103: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 193ms/step - loss: 0.0046 - accuracy: 0.9966 - val_loss: 1
.9127 - val_accuracy: 0.5855
Epoch 104/150
9/9 [=====] - ETA: 0s - loss: 0.0023 - accuracy: 1.0000
Epoch 104: val_accuracy did not improve from 0.65285
9/9 [=====] - 3s 365ms/step - loss: 0.0023 - accuracy: 1.0000 - val_loss: 1
.9001 - val_accuracy: 0.6477
Epoch 105/150
9/9 [=====] - ETA: 0s - loss: 0.0030 - accuracy: 1.0000
Epoch 105: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 188ms/step - loss: 0.0030 - accuracy: 1.0000 - val_loss: 1
.8982 - val_accuracy: 0.6373
Epoch 106/150
9/9 [=====] - ETA: 0s - loss: 0.0018 - accuracy: 1.0000
Epoch 106: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 186ms/step - loss: 0.0018 - accuracy: 1.0000 - val_loss: 1
.8848 - val_accuracy: 0.6166
Epoch 107/150
9/9 [=====] - ETA: 0s - loss: 0.0017 - accuracy: 1.0000
Epoch 107: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 191ms/step - loss: 0.0017 - accuracy: 1.0000 - val_loss: 1
.8946 - val_accuracy: 0.6114
Epoch 108/150
9/9 [=====] - ETA: 0s - loss: 0.0022 - accuracy: 0.9989
Epoch 108: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 190ms/step - loss: 0.0022 - accuracy: 0.9989 - val_loss: 1
.9040 - val_accuracy: 0.6218
Epoch 109/150
9/9 [=====] - ETA: 0s - loss: 0.0021 - accuracy: 0.9989
Epoch 109: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 180ms/step - loss: 0.0021 - accuracy: 0.9989 - val_loss: 1
.9544 - val_accuracy: 0.6477
Epoch 110/150
9/9 [=====] - ETA: 0s - loss: 0.0124 - accuracy: 0.9955
```

Epoch 110: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 183ms/step - loss: 0.0124 - accuracy: 0.9955 - val\_loss: 2.3007 - val\_accuracy: 0.4922  
Epoch 111/150  
9/9 [=====] - ETA: 0s - loss: 0.0161 - accuracy: 0.9911  
Epoch 111: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 193ms/step - loss: 0.0161 - accuracy: 0.9911 - val\_loss: 2.0972 - val\_accuracy: 0.6166  
Epoch 112/150  
9/9 [=====] - ETA: 0s - loss: 0.0282 - accuracy: 0.9978  
Epoch 112: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 187ms/step - loss: 0.0282 - accuracy: 0.9978 - val\_loss: 2.1490 - val\_accuracy: 0.5389  
Epoch 113/150  
9/9 [=====] - ETA: 0s - loss: 0.0204 - accuracy: 0.9832  
Epoch 113: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 197ms/step - loss: 0.0204 - accuracy: 0.9832 - val\_loss: 2.0492 - val\_accuracy: 0.5751  
Epoch 114/150  
9/9 [=====] - ETA: 0s - loss: 0.0131 - accuracy: 0.9966  
Epoch 114: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 189ms/step - loss: 0.0131 - accuracy: 0.9966 - val\_loss: 1.9727 - val\_accuracy: 0.5803  
Epoch 115/150  
9/9 [=====] - ETA: 0s - loss: 0.0281 - accuracy: 0.9877  
Epoch 115: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 189ms/step - loss: 0.0281 - accuracy: 0.9877 - val\_loss: 1.8858 - val\_accuracy: 0.5803  
Epoch 116/150  
9/9 [=====] - ETA: 0s - loss: 0.0147 - accuracy: 0.9899  
Epoch 116: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 190ms/step - loss: 0.0147 - accuracy: 0.9899 - val\_loss: 2.0573 - val\_accuracy: 0.5648  
Epoch 117/150  
9/9 [=====] - ETA: 0s - loss: 0.0110 - accuracy: 0.9966  
Epoch 117: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 191ms/step - loss: 0.0110 - accuracy: 0.9966 - val\_loss: 2.0637 - val\_accuracy: 0.5803  
Epoch 118/150  
9/9 [=====] - ETA: 0s - loss: 0.0232 - accuracy: 0.9899  
Epoch 118: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 188ms/step - loss: 0.0232 - accuracy: 0.9899 - val\_loss: 2.0095 - val\_accuracy: 0.5440  
Epoch 119/150  
9/9 [=====] - ETA: 0s - loss: 0.0231 - accuracy: 0.9855  
Epoch 119: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 194ms/step - loss: 0.0231 - accuracy: 0.9855 - val\_loss: 1.7878 - val\_accuracy: 0.5751  
Epoch 120/150  
9/9 [=====] - ETA: 0s - loss: 0.0135 - accuracy: 0.9944  
Epoch 120: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 183ms/step - loss: 0.0135 - accuracy: 0.9944 - val\_loss: 1.8892 - val\_accuracy: 0.5440  
Epoch 121/150  
9/9 [=====] - ETA: 0s - loss: 0.0124 - accuracy: 0.9978  
Epoch 121: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 186ms/step - loss: 0.0124 - accuracy: 0.9978 - val\_loss: 2.0622 - val\_accuracy: 0.5492  
Epoch 122/150  
9/9 [=====] - ETA: 0s - loss: 0.0075 - accuracy: 0.9989  
Epoch 122: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 189ms/step - loss: 0.0075 - accuracy: 0.9989 - val\_loss: 2.0769 - val\_accuracy: 0.5440  
Epoch 123/150  
9/9 [=====] - ETA: 0s - loss: 0.0060 - accuracy: 0.9989  
Epoch 123: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 188ms/step - loss: 0.0060 - accuracy: 0.9989 - val\_loss: 2.0533 - val\_accuracy: 0.5596  
Epoch 124/150  
9/9 [=====] - ETA: 0s - loss: 0.0047 - accuracy: 0.9989  
Epoch 124: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 182ms/step - loss: 0.0047 - accuracy: 0.9989 - val\_loss: 2.0434 - val\_accuracy: 0.5959  
Epoch 125/150  
9/9 [=====] - ETA: 0s - loss: 0.0034 - accuracy: 1.0000  
Epoch 125: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 183ms/step - loss: 0.0034 - accuracy: 1.0000 - val\_loss: 2.0571 - val\_accuracy: 0.5751  
Epoch 126/150  
9/9 [=====] - ETA: 0s - loss: 0.0035 - accuracy: 1.0000  
Epoch 126: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 194ms/step - loss: 0.0035 - accuracy: 1.0000 - val\_loss: 2.0818 - val\_accuracy: 0.5751

Epoch 127/150  
9/9 [=====] - ETA: 0s - loss: 0.0037 - accuracy: 0.9989  
Epoch 127: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 192ms/step - loss: 0.0037 - accuracy: 0.9989 - val\_loss: 2.1488 - val\_accuracy: 0.5699  
Epoch 128/150  
9/9 [=====] - ETA: 0s - loss: 0.0028 - accuracy: 1.0000  
Epoch 128: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 191ms/step - loss: 0.0028 - accuracy: 1.0000 - val\_loss: 2.1620 - val\_accuracy: 0.5648  
Epoch 129/150  
9/9 [=====] - ETA: 0s - loss: 0.0021 - accuracy: 1.0000  
Epoch 129: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 188ms/step - loss: 0.0021 - accuracy: 1.0000 - val\_loss: 2.1818 - val\_accuracy: 0.5855  
Epoch 130/150  
9/9 [=====] - ETA: 0s - loss: 0.0018 - accuracy: 1.0000  
Epoch 130: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 188ms/step - loss: 0.0018 - accuracy: 1.0000 - val\_loss: 2.1931 - val\_accuracy: 0.5855  
Epoch 131/150  
9/9 [=====] - ETA: 0s - loss: 0.0023 - accuracy: 0.9989  
Epoch 131: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 186ms/step - loss: 0.0023 - accuracy: 0.9989 - val\_loss: 2.1787 - val\_accuracy: 0.5803  
Epoch 132/150  
9/9 [=====] - ETA: 0s - loss: 0.0017 - accuracy: 1.0000  
Epoch 132: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 189ms/step - loss: 0.0017 - accuracy: 1.0000 - val\_loss: 2.1591 - val\_accuracy: 0.5907  
Epoch 133/150  
9/9 [=====] - ETA: 0s - loss: 0.0015 - accuracy: 1.0000  
Epoch 133: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 184ms/step - loss: 0.0015 - accuracy: 1.0000 - val\_loss: 2.1493 - val\_accuracy: 0.5907  
Epoch 134/150  
9/9 [=====] - ETA: 0s - loss: 0.0016 - accuracy: 1.0000  
Epoch 134: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 184ms/step - loss: 0.0016 - accuracy: 1.0000 - val\_loss: 2.1499 - val\_accuracy: 0.5959  
Epoch 135/150  
9/9 [=====] - ETA: 0s - loss: 0.0021 - accuracy: 1.0000  
Epoch 135: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 189ms/step - loss: 0.0021 - accuracy: 1.0000 - val\_loss: 2.1528 - val\_accuracy: 0.5959  
Epoch 136/150  
9/9 [=====] - ETA: 0s - loss: 0.0017 - accuracy: 1.0000  
Epoch 136: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 192ms/step - loss: 0.0017 - accuracy: 1.0000 - val\_loss: 2.2382 - val\_accuracy: 0.5648  
Epoch 137/150  
9/9 [=====] - ETA: 0s - loss: 0.0015 - accuracy: 1.0000  
Epoch 137: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 188ms/step - loss: 0.0015 - accuracy: 1.0000 - val\_loss: 2.2614 - val\_accuracy: 0.5596  
Epoch 138/150  
9/9 [=====] - ETA: 0s - loss: 0.0017 - accuracy: 0.9989  
Epoch 138: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 195ms/step - loss: 0.0017 - accuracy: 0.9989 - val\_loss: 2.2380 - val\_accuracy: 0.5855  
Epoch 139/150  
9/9 [=====] - ETA: 0s - loss: 0.0012 - accuracy: 1.0000  
Epoch 139: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 191ms/step - loss: 0.0012 - accuracy: 1.0000 - val\_loss: 2.2466 - val\_accuracy: 0.5959  
Epoch 140/150  
9/9 [=====] - ETA: 0s - loss: 0.0014 - accuracy: 1.0000  
Epoch 140: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 185ms/step - loss: 0.0014 - accuracy: 1.0000 - val\_loss: 2.2436 - val\_accuracy: 0.5959  
Epoch 141/150  
9/9 [=====] - ETA: 0s - loss: 0.0011 - accuracy: 1.0000  
Epoch 141: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 194ms/step - loss: 0.0011 - accuracy: 1.0000 - val\_loss: 2.2383 - val\_accuracy: 0.6010  
Epoch 142/150  
9/9 [=====] - ETA: 0s - loss: 0.0012 - accuracy: 1.0000  
Epoch 142: val\_accuracy did not improve from 0.65285  
9/9 [=====] - 2s 189ms/step - loss: 0.0012 - accuracy: 1.0000 - val\_loss: 2.2361 - val\_accuracy: 0.6010  
Epoch 143/150  
9/9 [=====] - ETA: 0s - loss: 0.0012 - accuracy: 1.0000  
Epoch 143: val\_accuracy did not improve from 0.65285



```

9/9 [=====] - 2s 186ms/step - loss: 0.0012 - accuracy: 1.0000 - val_loss: 2
.2376 - val_accuracy: 0.5959
Epoch 144/150
9/9 [=====] - ETA: 0s - loss: 0.0010 - accuracy: 1.0000
Epoch 144: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 191ms/step - loss: 0.0010 - accuracy: 1.0000 - val_loss: 2
.2447 - val_accuracy: 0.5855
Epoch 145/150
9/9 [=====] - ETA: 0s - loss: 0.0010 - accuracy: 1.0000
Epoch 145: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 170ms/step - loss: 0.0010 - accuracy: 1.0000 - val_loss: 2
.2481 - val_accuracy: 0.5855
Epoch 146/150
9/9 [=====] - ETA: 0s - loss: 9.2204e-04 - accuracy: 1.0000
Epoch 146: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 184ms/step - loss: 9.2204e-04 - accuracy: 1.0000 - val_loss: 2.2495 - val_accuracy: 0.5907
Epoch 147/150
9/9 [=====] - ETA: 0s - loss: 9.1218e-04 - accuracy: 1.0000
Epoch 147: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 190ms/step - loss: 9.1218e-04 - accuracy: 1.0000 - val_loss: 2.2549 - val_accuracy: 0.5907
Epoch 148/150
9/9 [=====] - ETA: 0s - loss: 0.0015 - accuracy: 0.9989
Epoch 148: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 190ms/step - loss: 0.0015 - accuracy: 0.9989 - val_loss: 2.2597 - val_accuracy: 0.6062
Epoch 149/150
9/9 [=====] - ETA: 0s - loss: 8.9260e-04 - accuracy: 1.0000
Epoch 149: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 196ms/step - loss: 8.9260e-04 - accuracy: 1.0000 - val_loss: 2.2716 - val_accuracy: 0.6269
Epoch 150/150
9/9 [=====] - ETA: 0s - loss: 0.0010 - accuracy: 1.0000
Epoch 150: val_accuracy did not improve from 0.65285
9/9 [=====] - 2s 177ms/step - loss: 0.0010 - accuracy: 1.0000 - val_loss: 2.2862 - val_accuracy: 0.6321

```

In [438]:

```

results.loc[index,['Architecture','Dropout','Loss Fn', 'LR']] = ['RNN: LSTM','0.05 & 0.2', 'Cross-Entropy',0.0001]

```

#### Evaluation: Training and Validation

In [439]:

```

evaluation_train_val(model, x_train, y_train, x_val, y_val, results, index)

```

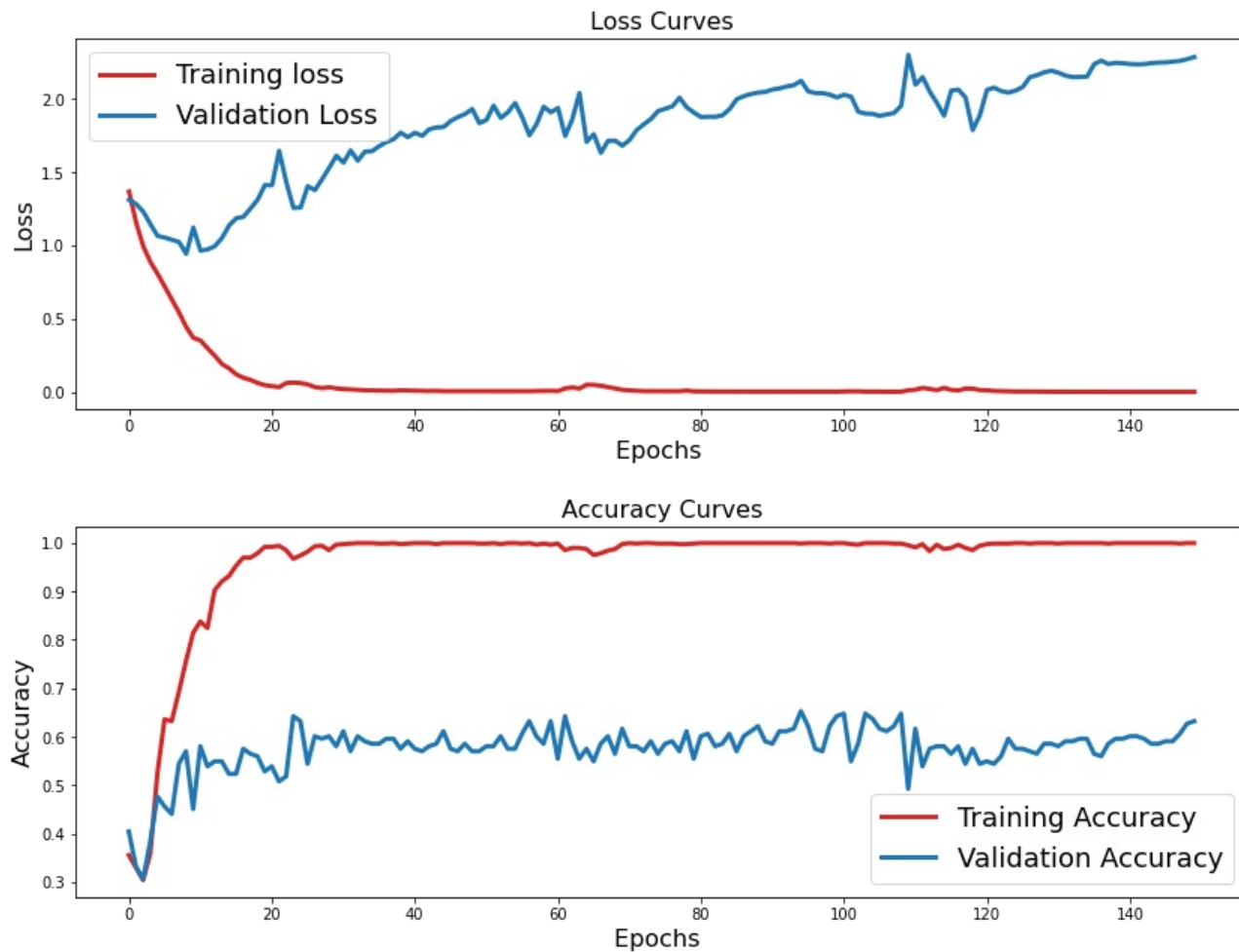
```

Training Accuracy: 1.0
Training Loss: 0.0004262325819581747
Validation Accuracy: 0.6321243643760681
Validation Loss: 2.286165952682495

```

In [440]:

```
plotfn(history)
```



**Evaluation: Testing**

In [441]:

```
evaluation_test(model, x_test, y_test, results, index)
```

7/7 [=====] - 0s 19ms/step - loss: 2.3156 - accuracy: 0.5959  
Test accuracy: 0.5958549380302429  
Test loss: 2.315556287765503

### COMMENTS

It is quite obvious that this model is overfitting, maybe our RNN model needs some adjustments. But we added it just to see various architectures and their accuracies.

## Evaluation Metrics

F1 score

In [442]:

```
_,_,_, val_f1 = predictfn(model, x_val, y_val)
```

7/7 [=====] - 0s 20ms/step

	precision	recall	f1-score	support
extrahls	0.53	1.00	0.70	8
extrastole	0.00	0.00	0.00	6
murmur	0.33	0.58	0.42	31
normal	0.86	0.65	0.74	148
accuracy			0.63	193
macro avg	0.43	0.56	0.46	193
weighted avg	0.73	0.63	0.66	193

In [443]:

```
predictions,y_pred , y_true, test_f1 = predictfn(model,x_test,y_test)
```

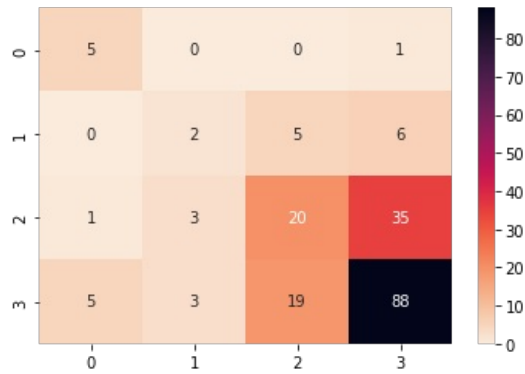
7/7 [=====] - 0s 16ms/step

	precision	recall	f1-score	support
extrahls	0.83	0.45	0.59	11
extrastole	0.15	0.25	0.19	8
murmur	0.34	0.45	0.39	44
normal	0.77	0.68	0.72	130
accuracy			0.60	193
macro avg	0.52	0.46	0.47	193
weighted avg	0.65	0.60	0.61	193

Confusion Matrix

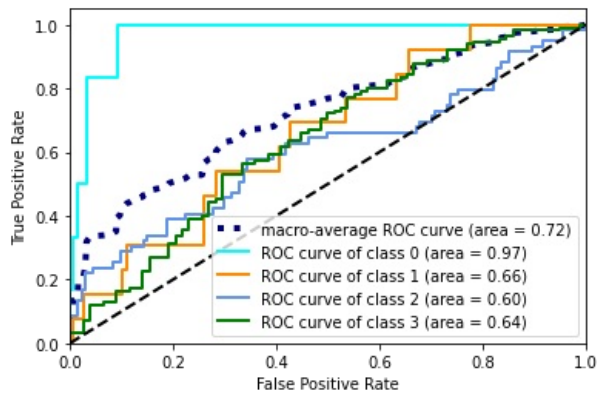
In [444]:

```
matrix = confusion_matrix(y_true ,y_pred)
ax = sns.heatmap(matrix, annot=True, fmt="d", cmap = 'rocket_r')
```



ROC and AUC

```
roc = plot_ROC(Y_test,predictions)
```



```
results.loc[index,['Val f1','Test f1', 'Average ROC']] = [val_f1, test_f1, roc]
index = index + 1
results
```

Out[446]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547
3	CNN 2D	0.0001	0.2	KL divergence	0.984358	0.079908	0.911917	0.285003	0.797927	0.508575	0.911012	0.799109	0.958595
4	CNN 2D	0.001	0.2	Cross-Entropy	0.994413	0.021668	0.917098	0.27322	0.834197	0.566831	0.91787	0.837258	0.960526
5	CNN 1D	0.0001	0.2	Cross-Entropy	0.832402	0.413392	0.699482	1.062132	0.61658	1.164043	0.705761	0.607259	0.791756
6	ANN: MLP	0.0001	0.1	Cross-Entropy	0.642463	0.827357	0.699482	0.728798	0.564767	0.986058	0.694605	0.550542	0.822062
7	ANN: MLP	0.001	0.1	Cross-Entropy	0.674632	1.059883	0.720207	1.000679	0.65285	1.103402	0.73748	0.652821	0.764952
8	RNN: LSTM	0.0001	0.05 & 0.2	Cross-Entropy	1.0	0.000426	0.632124	2.286166	0.595855	2.315556	0.662354	0.613832	0.721467

## Predicting a sample's label

```
model_name = "heartbeat_classifierLSTM.h5"
model.save(model_name)
```

### Predicting a Murmur sample

```
test.iloc[55]
```

Out[414]:

[illegible]

```
sample_predict(model_name,55)
```

### Predicting a Normal sample

```
test.iloc[50]
```

[illegible]

```
sample_predict(model_name,50)
```

```
1/1 [=====] - 1s 648ms/step
Label Prediction Probabilities: [[0.00100539 0.04062511 0.11192766 0.84644186]]
-----
Label:
Normal heartbeat
confidence: 0.84644186
```

### ***Predicting an Extrahls sample***

```
test.iloc[77]
```

[illegible]

```
sample_predict(model_name,77)
```

```
1/1 [=====] - 1s 658ms/step
Label Prediction Probabilities: [[0.5306326  0.00132648 0.05272905 0.41531187]]
-----
Label:
Extrahls heartbeat
confidence: 0.5306326
```

### Predicting a Extrasystole sample

```
test.iloc[16]
```

[illegible]

In [402]:

```
sample_predict(model_name,96)
```

1/1 [=====] - 1s 1s/step  
Label Prediction Probabilities: [[0.00088884 0.75414175 0.00135688 0.2436126 ]]  
-----  
Label:  
Extrasystole heartbeat  
confidence: 0.75414175

## Final Tabulated Results

In [448]:

```
results
```

Out[448]:

	Architecture	LR	Dropout	Loss Fn	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss	Val f1	Test f1	Average ROC
0	CNN 2D	0.0001	0.2	Cross-Entropy	0.972067	0.093446	0.948187	0.211522	0.813471	0.574236	0.947918	0.809101	0.961442
1	CNN 2D	0.0001	0.2 & 0.4	Cross-Entropy	0.911732	0.306483	0.860104	0.358453	0.797927	0.506057	0.85249	0.788991	0.959572
2	CNN 2D	0.0001	0.2	Poisson	0.994413	0.0239	0.896373	0.336143	0.829016	0.66938	0.896635	0.826424	0.95547
3	CNN 2D	0.0001	0.2	KL divergence	0.984358	0.079908	0.911917	0.285003	0.797927	0.508575	0.911012	0.799109	0.958595
4	CNN 2D	0.001	0.2	Cross-Entropy	0.994413	0.021668	0.917098	0.27322	0.834197	0.566831	0.91787	0.837258	0.960526
5	CNN 1D	0.0001	0.2	Cross-Entropy	0.832402	0.413392	0.699482	1.062132	0.61658	1.164043	0.705761	0.607259	0.791756
6	ANN: MLP	0.0001	0.1	Cross-Entropy	0.642463	0.827357	0.699482	0.728798	0.564767	0.986058	0.694605	0.550542	0.822062
7	ANN: MLP	0.001	0.1	Cross-Entropy	0.674632	1.059883	0.720207	1.000679	0.65285	1.103402	0.73748	0.652821	0.764952
8	RNN: LSTM	0.0001	0.05 & 0.2	Cross-Entropy	1.0	0.000426	0.632124	2.286166	0.595855	2.315556	0.662354	0.613832	0.721467