Appendix

Import Lib

In [1]:
```
import os
from glob import glob
import librosa
import librosa.display
import numpy as np
import matplotlib.pyplot as plt
import ipyparallel as ipp
import time
from warnings import filterwarnings
filterwarnings('ignore')
```

Function to create a spectrogram from an audio file

In [2]:
```
def create_spectrogram(filename, name, store_path):
    plt.interactive(False)
    clip, sample_rate = librosa.load(filename, sr=None)
    fig = plt.figure(figsize=[0.72, 0.72])
    ax = fig.add_subplot(111)
    ax.axes.get_xaxis().set_visible(False)
    ax.axes.get_yaxis().set_visible(False)
    ax.set_frame_on(False)
    S = librosa.feature.melspectrogram(y=clip, sr=sample_rate)
    librosa.display.specshow(librosa.power_to_db(S, ref=np.max))
    filename = os.path.join(store_path, name + '.jpg')
    plt.savefig(filename, dpi=400, bbox_inches='tight', pad_inches=0)
    plt.close()
    fig.clf()
    plt.close(fig)
    plt.close('all')
    del filename, name, clip, sample_rate, fig, ax, S
```

Helper function to process a single audio file

In [3]:
```
def process_audio_file(file, folder_path):
    name = os.path.basename(file)
    create_spectrogram(file, name, folder_path)
```

Convert Audio files to spectrogram JPG files with ipyparallel

In [4]:
```
def Convert_Audio_File_to_jpg_file(filename, store_filepath, number_of_worker):
    """
    Convert audio files to spectrogram JPG files using ipyparallel.

    Parameters:
        filename (str): Path to the main directory containing audio files and number of worker.
    """
    # Set up ipyparallel cluster
    Execution_time = 0
    rc = ipp.Cluster(n=number_of_worker).start_and_connect_sync()  # Start and connect cluster with 4 workers
    dview = rc[:]  # Create a direct view to all workers

    dview.push({"create_spectrogram": create_spectrogram})
    dview.push({"process_audio_file": process_audio_file})
    dview.execute("import os")
    dview.execute("import librosa")
    dview.execute("import librosa.display")
    dview.execute("import numpy as np")
    dview.execute("import matplotlib.pyplot as plt")
    dview.execute("import time")

    start_time = time.time()
    # Make a dictionary for given class and their file path names
    file_list = glob(os.path.join(filename, "*"))
    file_dic = {}
    for file in file_list:
        all_files = []
```

```
        for root, dirs, files in os.walk(file):
            for file_ in files:
                # Join the root directory with the file name to get the full path
                all_files.append(os.path.join(root, file_))
        file_dic[file] = all_files

    # Create file directories to store the converted audio files into JPG
    file_path = []
    for folder in file_dic.keys():
        folder_rot = os.path.join(store_filepath, os.path.basename(folder))
        file_path.append(folder_rot)
        os.makedirs(folder_rot, exist_ok=True)

    # Delegate work to workers using dview.map_sync()
    for i, folder in enumerate(file_dic.keys()):
        music_files = file_dic[folder]
        folder_path = file_path[i]
        # Map the processing function across music files with ipyparallel
        dview.map_sync(lambda file: process_audio_file(file, folder_path), music_files)
    end_time = time.time()
    elapsed_time = end_time - start_time
    Execution_time = elapsed_time
    print(f"Execution time: {elapsed_time:.2f} seconds")
    # Shut down the cluster after processing
    rc.shutdown()

    return Execution_time
```

Convert Audio File to jpg file

In [5]:
```
Audio_Data_Path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\genres"
Spectro_jpg_Path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
Convert_Audio_File_to_jpg_file(Audio_Data_Path,Spectro_jpg_Path ,number_of_worker = 4)
```

```
Starting 4 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/4 [00:00<?, ?engine/s]
Execution time: 43.02 seconds
```

Out[5]:
```
43.01757502555847
```

```
engine set stopped 1733365864: {'engines': {'2': {'exit_code': 0, 'pid': 20512, 'identifier': '2'}, '0': {'exit_code': 0, 'pid': 21332,
'identifier': '0'}, '3': {'exit_code': 0, 'pid': 10848, 'identifier': '3'}, '1': {'exit_code': 0, 'pid': 18488, 'identifier': '1'}}, 'e
xit_code': 0}
```

Experiment with Core

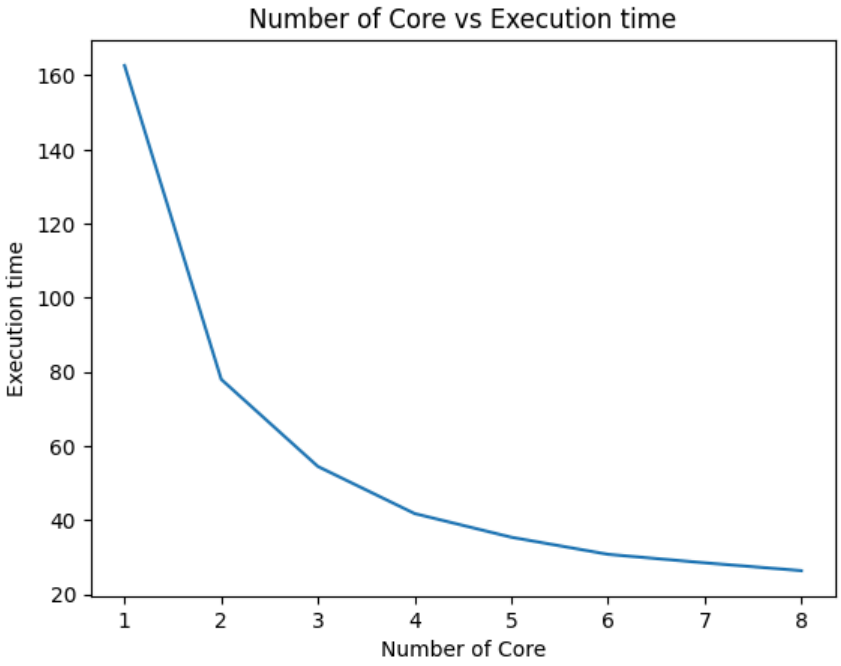
In [6]:
```
Execution_time = []
Cores = range(1,9)
for number_of_worker in Cores:
   Execution_time.append(Convert_Audio_File_to_jpg_file(Audio_Data_Path, Spectro_jpg_Path, number_of_worker = number_of_worker))
```

```
Starting 1 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/1 [00:00<?, ?engine/s]
Execution time: 162.66 seconds
engine set stopped 1733365915: {'engines': {'0': {'exit_code': 0, 'pid': 14416, 'identifier': '0'}}, 'exit_code': 0}
Starting 2 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/2 [00:00<?, ?engine/s]
Execution time: 78.02 seconds
Failed to remove C:\Users\nikhi\.ipython\profile_default\log\ipengine-1733366084-vstu-1733366085-1.log: [WinError 5] Access is denied:
'C:\\Users\\nikhi\\.ipython\\profile_default\\log\\ipengine-1733366084-vstu-1733366085-1.log'
engine set stopped 1733366085: {'engines': {'0': {'exit_code': 0, 'pid': 21460, 'identifier': '0'}, '1': {'exit_code': 0, 'pid': 27340,
'identifier': '1'}}, 'exit_code': 0}
Starting 3 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/3 [00:00<?, ?engine/s]
Execution time: 54.51 seconds
engine set stopped 1733366171: {'engines': {'2': {'exit_code': 0, 'pid': 25728, 'identifier': '2'}, '1': {'exit_code': 0, 'pid': 20336,
'identifier': '1'}, '0': {'exit_code': 0, 'pid': 25376, 'identifier': '0'}}, 'exit_code': 0}
Starting 4 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/4 [00:00<?, ?engine/s]
Execution time: 41.81 seconds
engine set stopped 1733366233: {'engines': {'0': {'exit_code': 0, 'pid': 18900, 'identifier': '0'}, '2': {'exit_code': 0, 'pid': 20572,
'identifier': '2'}, '3': {'exit_code': 0, 'pid': 22864, 'identifier': '3'}, '1': {'exit_code': 0, 'pid': 23844, 'identifier': '1'}}, 'e
xit_code': 0}
Starting 5 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/5 [00:00<?, ?engine/s]
```

```
Execution time: 35.43 seconds
engine set stopped 1733366282: {'engines': {'3': {'exit_code': 0, 'pid': 25924, 'identifier': '3'}, '0': {'exit_code': 0, 'pid': 24580,
'identifier': '0'}, '2': {'exit_code': 0, 'pid': 27620, 'identifier': '2'}, '1': {'exit_code': 0, 'pid': 21080, 'identifier': '1'},
'4': {'exit_code': 0, 'pid': 19184, 'identifier': '4'}}, 'exit_code': 0}
Starting 6 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/6 [00:00<?, ?engine/s]
Execution time: 30.82 seconds
engine set stopped 1733366326: {'engines': {'2': {'exit_code': 0, 'pid': 20140, 'identifier': '2'}, '0': {'exit_code': 0, 'pid': 23164,
'identifier': '0'}, '1': {'exit_code': 0, 'pid': 11856, 'identifier': '1'}, '5': {'exit_code': 0, 'pid': 26344, 'identifier': '5'},
'4': {'exit_code': 0, 'pid': 2152, 'identifier': '4'}, '3': {'exit_code': 0, 'pid': 27152, 'identifier': '3'}}, 'exit_code': 0}
Starting 7 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/7 [00:00<?, ?engine/s]
Execution time: 28.52 seconds
Failed to remove C:\Users\nikhi\.ipython\profile_default\log\ipengine-1733366363-hjat-1733366364-2.log: [WinError 2] The system cannot
find the file specified: 'C:\\Users\\nikhi\\.ipython\\profile_default\\log\\ipengine-1733366363-hjat-1733366364-2.log'
Failed to remove C:\Users\nikhi\.ipython\profile_default\log\ipengine-1733366363-hjat-1733366364-3.log: [WinError 32] The process canno
t access the file because it is being used by another process: 'C:\\Users\\nikhi\\.ipython\\profile_default\\log\\ipengine-1733366363-h
jat-1733366364-3.log'
engine set stopped 1733366364: {'engines': {'1': {'exit_code': 0, 'pid': 23124, 'identifier': '1'}, '2': {'exit_code': 0, 'pid': 23284,
'identifier': '2'}, '3': {'exit_code': 0, 'pid': 10412, 'identifier': '3'}, '4': {'exit_code': 0, 'pid': 11464, 'identifier': '4'},
'5': {'exit_code': 0, 'pid': 1996, 'identifier': '5'}, '0': {'exit_code': 0, 'pid': 13308, 'identifier': '0'}, '6': {'exit_code': 0, 'p
id': 26908, 'identifier': '6'}}, 'exit_code': 0}
Starting 8 engines with <class 'ipyparallel.cluster.launcher.LocalEngineSetLauncher'>
  0%|          | 0/8 [00:00<?, ?engine/s]
Execution time: 26.41 seconds
Failed to remove C:\Users\nikhi\.ipython\profile_default\log\ipengine-1733366400-7yh5-1733366401-1.log: [WinError 2] The system cannot
find the file specified: 'C:\\Users\\nikhi\\.ipython\\profile_default\\log\\ipengine-1733366400-7yh5-1733366401-1.log'
Failed to remove C:\Users\nikhi\.ipython\profile_default\log\ipengine-1733366400-7yh5-1733366401-6.log: [WinError 32] The process canno
t access the file because it is being used by another process: 'C:\\Users\\nikhi\\.ipython\\profile_default\\log\\ipengine-1733366400-7
yh5-1733366401-6.log'
engine set stopped 1733366401: {'engines': {'0': {'exit_code': 0, 'pid': 24628, 'identifier': '0'}, '1': {'exit_code': 0, 'pid': 14832,
'identifier': '1'}, '7': {'exit_code': 0, 'pid': 15012, 'identifier': '7'}, '5': {'exit_code': 0, 'pid': 27244, 'identifier': '5'},
'3': {'exit_code': 0, 'pid': 15744, 'identifier': '3'}, '6': {'exit_code': 0, 'pid': 11516, 'identifier': '6'}, '4': {'exit_code': 0,
'pid': 4368, 'identifier': '4'}, '2': {'exit_code': 0, 'pid': 18236, 'identifier': '2'}}, 'exit_code': 0}
```

Number of Core vs Execution time

In [7]:
```
plt.plot(Cores, Execution_time)
plt.xlabel('Number of Core')
plt.ylabel('Execution time')
plt.title('Number of Core vs Execution time')
plt.show()
```

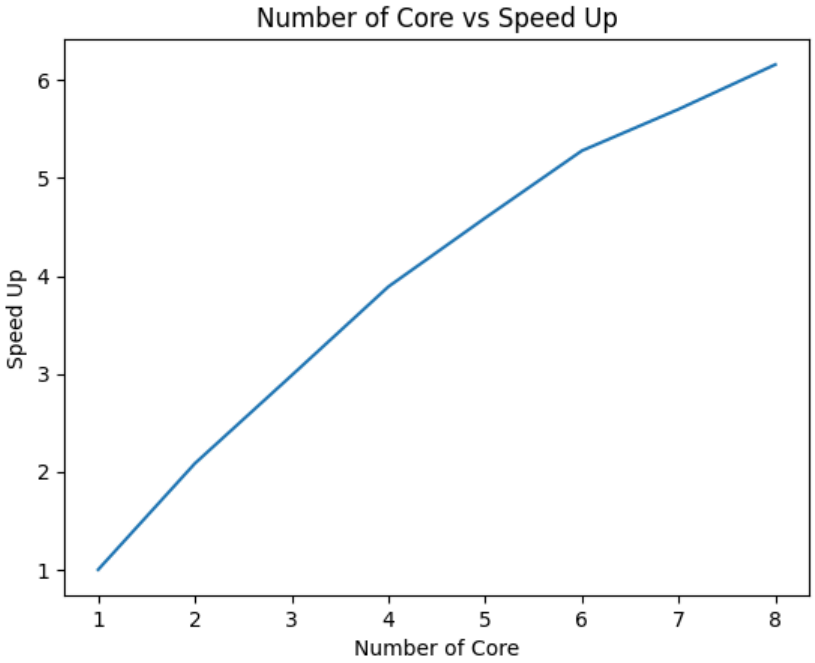


Number of Core vs Speed Up

In [8]:
```
speed_up = []
for i in Cores:
    speed_up.append(Execution_time[0] / Execution_time[i - 1])

plt.plot(Cores, speed_up)
plt.xlabel('Number of Core')
plt.ylabel('Speed Up')
```

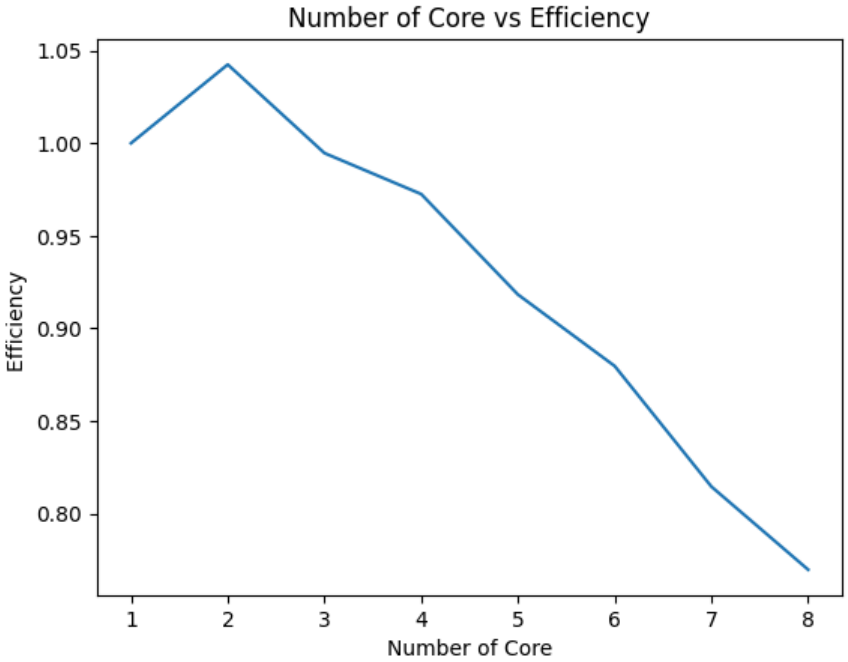
```
plt.title('Number of Core vs Speed Up')
plt.show()
```



Number of Core vs Efficiency

In [9]:
```
Efficiency = []
for num_of_core in Cores:
    Efficiency.append(speed_up[num_of_core - 1] / num_of_core)

plt.plot(Cores, Efficiency)
plt.xlabel('Number of Core')
plt.ylabel('Efficiency ')
plt.title('Number of Core vs Efficiency')
plt.show()
```



In [ ]:

In [1]:
```
import matplotlib.pyplot as plt
import pandas as pd
```

In [2]:
```
data = pd.read_csv(r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt")
```

In [3]:
```
data.sort_values(by = 'Number of Cores', inplace = True,ignore_index= True)
```

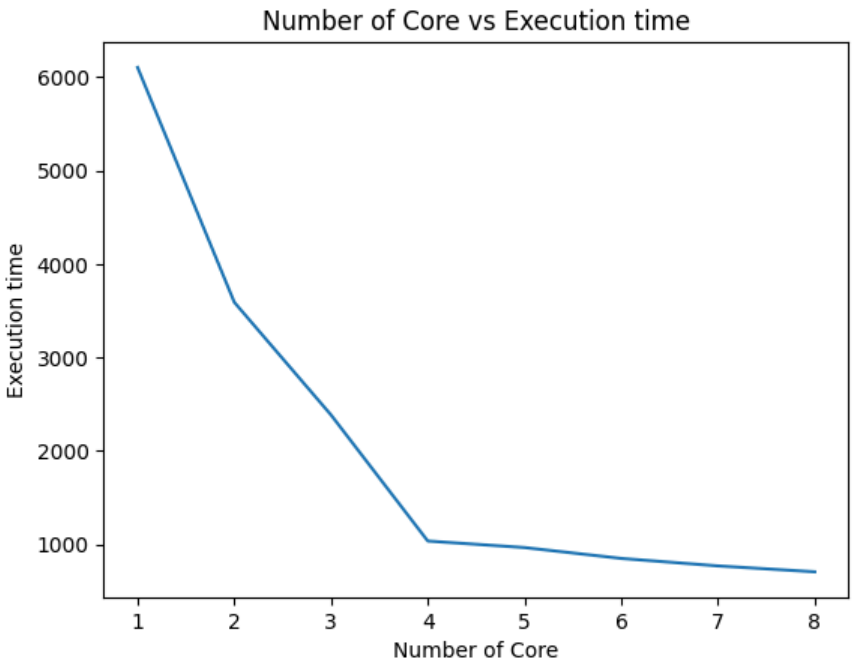
In [4]:
```
data
```

Out[4]:

	Number of Cores	Elapsed Time
0	1	6102.521532
1	2	3590.608773
2	3	2385.136909
3	4	1036.823782
4	5	967.008510
5	6	850.766087
6	7	770.620165
7	8	707.659396

Number of Core vs Execution time

In [5]:
```
plt.plot(data['Number of Cores'], data['Elapsed Time'])
plt.xlabel('Number of Core')
plt.ylabel('Execution time')
plt.title('Number of Core vs Execution time')
plt.show()
```



Number of Core vs Speed Up

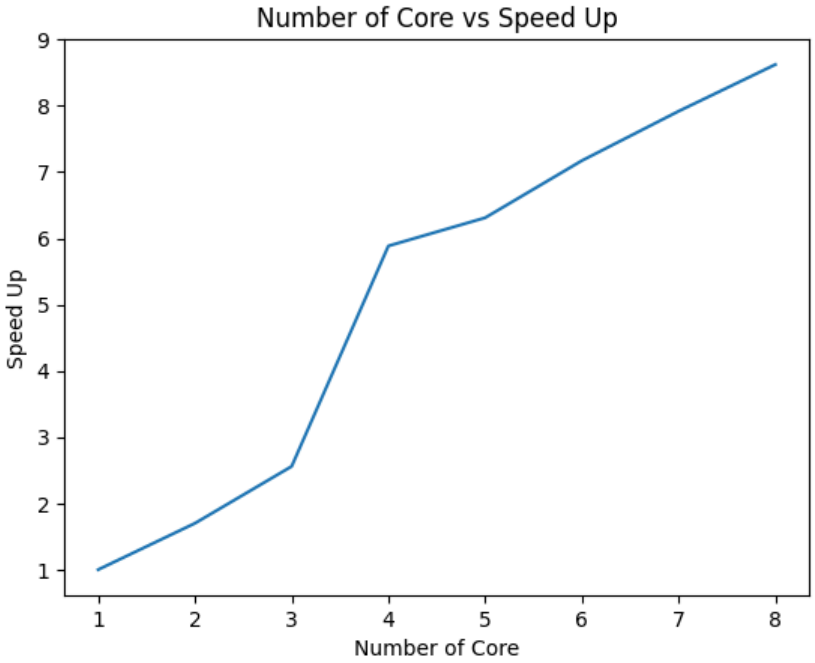
In [6]:
```
data['Elapsed Time'][7]
```

Out[6]:
```
707.6593961715698
```

In [7]:
```
speed_up = []
for i in data['Number of Cores']:
    speed_up.append(data['Elapsed Time'][0] / data['Elapsed Time'][i - 1])

plt.plot(data['Number of Cores'], speed_up)
plt.xlabel('Number of Core')
plt.ylabel('Speed Up')
```

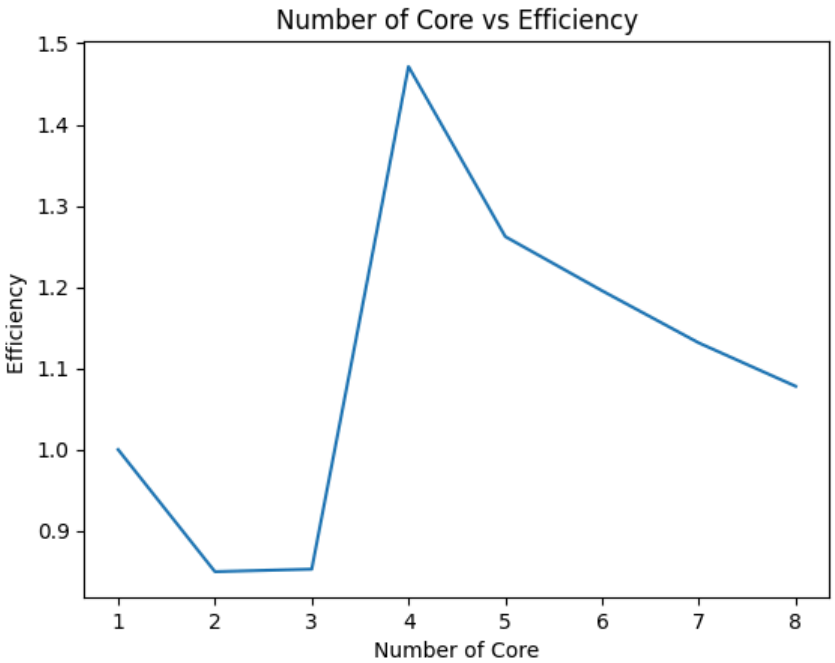
```
plt.title('Number of Core vs Speed Up')
plt.show()
```



Number of Core vs Efficiency

In [8]:
```
Efficiency = []
for num_of_core in data['Number of Cores']:
    Efficiency.append(speed_up[num_of_core - 1] / num_of_core)

plt.plot(data['Number of Cores'], Efficiency)
plt.xlabel('Number of Core')
plt.ylabel('Efficiency ')
plt.title('Number of Core vs Efficiency')
plt.show()
```



In [ ]:

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 1 worker

In [2]:
```
# Set the number of threads
number_of_worker = 1
os.environ['OMP_NUM_THREADS'] = '1'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '1'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '1'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 32s 1s/step - accuracy: 0.1023 - loss: 2.3116 - val_accuracy: 0.1750 - val_loss: 2.2917
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.1221 - loss: 2.2753 - val_accuracy: 0.2100 - val_loss: 2.1145
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.1855 - loss: 2.2138 - val_accuracy: 0.1950 - val_loss: 2.1203
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.1924 - loss: 2.1035 - val_accuracy: 0.2450 - val_loss: 1.9382
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.2253 - loss: 2.0658 - val_accuracy: 0.2900 - val_loss: 1.9680
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.2518 - loss: 2.0428 - val_accuracy: 0.3600 - val_loss: 2.0611
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.2844 - loss: 1.9486 - val_accuracy: 0.3550 - val_loss: 1.8568
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.3084 - loss: 1.8901 - val_accuracy: 0.2650 - val_loss: 2.1513
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.3282 - loss: 1.9096 - val_accuracy: 0.3850 - val_loss: 1.7727
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.3618 - loss: 1.7941 - val_accuracy: 0.4300 - val_loss: 1.6640
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.3581 - loss: 1.7205 - val_accuracy: 0.3650 - val_loss: 1.7061
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.3839 - loss: 1.7241 - val_accuracy: 0.4250 - val_loss: 1.6044
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 25s 1s/step - accuracy: 0.4243 - loss: 1.6182 - val_accuracy: 0.3600 - val_loss: 1.7587
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.4233 - loss: 1.6799 - val_accuracy: 0.4700 - val_loss: 1.5579
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 25s 1s/step - accuracy: 0.4338 - loss: 1.5815 - val_accuracy: 0.4800 - val_loss: 1.5056
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.4718 - loss: 1.4877 - val_accuracy: 0.3650 - val_loss: 1.6719
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 47s 1s/step - accuracy: 0.4637 - loss: 1.5132 - val_accuracy: 0.4750 - val_loss: 1.4645
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.4672 - loss: 1.4364 - val_accuracy: 0.5000 - val_loss: 1.4407
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.4664 - loss: 1.4338 - val_accuracy: 0.4600 - val_loss: 1.4912
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.4846 - loss: 1.3805 - val_accuracy: 0.4950 - val_loss: 1.4114
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.5301 - loss: 1.3195 - val_accuracy: 0.5650 - val_loss: 1.3299
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 39s 1s/step - accuracy: 0.5377 - loss: 1.3187 - val_accuracy: 0.5200 - val_loss: 1.4057
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.5209 - loss: 1.3272 - val_accuracy: 0.5250 - val_loss: 1.3737
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 45s 1s/step - accuracy: 0.5138 - loss: 1.3195 - val_accuracy: 0.4800 - val_loss: 1.3970
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.5613 - loss: 1.2026 - val_accuracy: 0.4850 - val_loss: 1.2982
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.5462 - loss: 1.2349 - val_accuracy: 0.5150 - val_loss: 1.4277
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.4924 - loss: 1.3835 - val_accuracy: 0.5600 - val_loss: 1.2649
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.5781 - loss: 1.2120 - val_accuracy: 0.5400 - val_loss: 1.3177
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.5310 - loss: 1.2935 - val_accuracy: 0.5350 - val_loss: 1.2755
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.5842 - loss: 1.1832 - val_accuracy: 0.5650 - val_loss: 1.2301
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.6170 - loss: 1.1483 - val_accuracy: 0.5300 - val_loss: 1.2360
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.5694 - loss: 1.1414 - val_accuracy: 0.5300 - val_loss: 1.1925
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.5970 - loss: 1.1031 - val_accuracy: 0.5650 - val_loss: 1.1584
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.6325 - loss: 1.0118 - val_accuracy: 0.6000 - val_loss: 1.1658
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.6461 - loss: 1.0089 - val_accuracy: 0.5200 - val_loss: 1.3458
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.6280 - loss: 1.0219 - val_accuracy: 0.5500 - val_loss: 1.2555
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.6563 - loss: 1.0223 - val_accuracy: 0.5600 - val_loss: 1.2584
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.6219 - loss: 1.0022 - val_accuracy: 0.5750 - val_loss: 1.1565
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.6673 - loss: 0.9150 - val_accuracy: 0.6000 - val_loss: 1.1377
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.6545 - loss: 0.9413 - val_accuracy: 0.5750 - val_loss: 1.1518
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.6994 - loss: 0.8533 - val_accuracy: 0.5050 - val_loss: 1.4275
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Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 1s/step - accuracy: 0.6991 - loss: 0.8246 - val_accuracy: 0.5700 - val_loss: 1.1758
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.7177 - loss: 0.7888 - val_accuracy: 0.6200 - val_loss: 1.2086
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.7449 - loss: 0.7547 - val_accuracy: 0.6150 - val_loss: 1.1535
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 1s/step - accuracy: 0.7052 - loss: 0.7935 - val_accuracy: 0.5850 - val_loss: 1.3092
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 39s 1s/step - accuracy: 0.7307 - loss: 0.7758 - val_accuracy: 0.5550 - val_loss: 1.1893
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 1s/step - accuracy: 0.7160 - loss: 0.8295 - val_accuracy: 0.5800 - val_loss: 1.2159
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.7674 - loss: 0.6261 - val_accuracy: 0.6150 - val_loss: 1.2276
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.7672 - loss: 0.6559 - val_accuracy: 0.6100 - val_loss: 1.2374
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.7832 - loss: 0.6168 - val_accuracy: 0.5850 - val_loss: 1.3392
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.7379 - loss: 0.7095 - val_accuracy: 0.5750 - val_loss: 1.4176
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.7792 - loss: 0.5799 - val_accuracy: 0.5300 - val_loss: 1.4030
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.7901 - loss: 0.5600 - val_accuracy: 0.6350 - val_loss: 1.2566
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.7973 - loss: 0.5726 - val_accuracy: 0.5500 - val_loss: 1.3714
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.7668 - loss: 0.7013 - val_accuracy: 0.6250 - val_loss: 1.3406
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.7882 - loss: 0.5294 - val_accuracy: 0.6150 - val_loss: 1.3486
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.8414 - loss: 0.4948 - val_accuracy: 0.5900 - val_loss: 1.4015
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.8212 - loss: 0.4944 - val_accuracy: 0.6150 - val_loss: 1.4117
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 43s 1s/step - accuracy: 0.8479 - loss: 0.4028 - val_accuracy: 0.6050 - val_loss: 1.4449
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.8089 - loss: 0.5510 - val_accuracy: 0.5700 - val_loss: 1.5338
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.8237 - loss: 0.4647 - val_accuracy: 0.5950 - val_loss: 1.4833
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 1s/step - accuracy: 0.8668 - loss: 0.3522 - val_accuracy: 0.5650 - val_loss: 1.4804
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.8646 - loss: 0.4137 - val_accuracy: 0.6200 - val_loss: 1.5929
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.8611 - loss: 0.4100 - val_accuracy: 0.6150 - val_loss: 1.5140
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.8943 - loss: 0.2995 - val_accuracy: 0.5300 - val_loss: 2.0294
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.8659 - loss: 0.3771 - val_accuracy: 0.6100 - val_loss: 1.3474
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.8714 - loss: 0.3636 - val_accuracy: 0.6450 - val_loss: 1.4715
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.8731 - loss: 0.3432 - val_accuracy: 0.6350 - val_loss: 1.5430
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9113 - loss: 0.2766 - val_accuracy: 0.6000 - val_loss: 1.6362
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9115 - loss: 0.2632 - val_accuracy: 0.5900 - val_loss: 1.7935
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.8804 - loss: 0.3234 - val_accuracy: 0.5850 - val_loss: 1.7517
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9097 - loss: 0.2619 - val_accuracy: 0.6050 - val_loss: 1.7657
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 31s 1s/step - accuracy: 0.8978 - loss: 0.2883 - val_accuracy: 0.5900 - val_loss: 1.9864
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.8944 - loss: 0.2651 - val_accuracy: 0.6050 - val_loss: 1.7086
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9287 - loss: 0.2225 - val_accuracy: 0.6150 - val_loss: 1.8275
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9313 - loss: 0.2132 - val_accuracy: 0.5600 - val_loss: 1.9665
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9132 - loss: 0.2315 - val_accuracy: 0.6250 - val_loss: 1.7940
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9298 - loss: 0.2025 - val_accuracy: 0.6100 - val_loss: 1.7548
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.8969 - loss: 0.2864 - val_accuracy: 0.5700 - val_loss: 1.9362
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9037 - loss: 0.2708 - val_accuracy: 0.6050 - val_loss: 1.7875
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9479 - loss: 0.1578 - val_accuracy: 0.6050 - val_loss: 1.9154
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9278 - loss: 0.2297 - val_accuracy: 0.6100 - val_loss: 2.0085
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9603 - loss: 0.1253 - val_accuracy: 0.6050 - val_loss: 1.9944
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9349 - loss: 0.2179 - val_accuracy: 0.5950 - val_loss: 1.7698
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9260 - loss: 0.2480 - val_accuracy: 0.6000 - val_loss: 1.9084
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9385 - loss: 0.1810 - val_accuracy: 0.6050 - val_loss: 1.9800
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 40s 1s/step - accuracy: 0.9315 - loss: 0.2115 - val_accuracy: 0.6000 - val_loss: 1.9982
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9286 - loss: 0.1841 - val_accuracy: 0.6050 - val_loss: 1.8210
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 1s/step - accuracy: 0.9449 - loss: 0.1455 - val_accuracy: 0.6050 - val_loss: 2.1485
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9580 - loss: 0.1347 - val_accuracy: 0.6050 - val_loss: 2.0624
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9658 - loss: 0.1287 - val_accuracy: 0.6050 - val_loss: 2.0623
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 1s/step - accuracy: 0.9296 - loss: 0.2185 - val_accuracy: 0.5750 - val_loss: 2.1836
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 31s 1s/step - accuracy: 0.9534 - loss: 0.1375 - val_accuracy: 0.5700 - val_loss: 2.3075
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9321 - loss: 0.1736 - val_accuracy: 0.5900 - val_loss: 2.0975
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9544 - loss: 0.1090 - val_accuracy: 0.6050 - val_loss: 2.1837
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9666 - loss: 0.1233 - val_accuracy: 0.5250 - val_loss: 2.7924
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9305 - loss: 0.2006 - val_accuracy: 0.5950 - val_loss: 2.1621
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9653 - loss: 0.1326 - val_accuracy: 0.5600 - val_loss: 2.3662
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 40s 1s/step - accuracy: 0.9604 - loss: 0.1206 - val_accuracy: 0.6150 - val_loss: 2.2831
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9483 - loss: 0.1839 - val_accuracy: 0.6150 - val_loss: 1.8584
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9725 - loss: 0.0949 - val_accuracy: 0.5950 - val_loss: 2.1361
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9591 - loss: 0.1132 - val_accuracy: 0.6500 - val_loss: 2.1777
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9600 - loss: 0.1332 - val_accuracy: 0.6000 - val_loss: 3.0784
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9355 - loss: 0.1872 - val_accuracy: 0.5750 - val_loss: 2.4978
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9633 - loss: 0.1094 - val_accuracy: 0.6200 - val_loss: 2.2200
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9577 - loss: 0.1378 - val_accuracy: 0.5850 - val_loss: 2.5441
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 1s/step - accuracy: 0.9277 - loss: 0.2046 - val_accuracy: 0.6250 - val_loss: 2.1615
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9599 - loss: 0.0948 - val_accuracy: 0.5750 - val_loss: 2.4605
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 43s 1s/step - accuracy: 0.9670 - loss: 0.0811 - val_accuracy: 0.5950 - val_loss: 2.5483
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9646 - loss: 0.1045 - val_accuracy: 0.5600 - val_loss: 3.1649
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9542 - loss: 0.1843 - val_accuracy: 0.5850 - val_loss: 2.3699
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 31s 1s/step - accuracy: 0.9595 - loss: 0.0938 - val_accuracy: 0.6200 - val_loss: 2.5488
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9756 - loss: 0.0709 - val_accuracy: 0.6450 - val_loss: 2.7340
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9678 - loss: 0.0969 - val_accuracy: 0.5950 - val_loss: 2.5608
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9566 - loss: 0.1611 - val_accuracy: 0.6350 - val_loss: 2.2199
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9844 - loss: 0.0740 - val_accuracy: 0.5950 - val_loss: 2.5361
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9755 - loss: 0.0631 - val_accuracy: 0.6150 - val_loss: 2.5037
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9773 - loss: 0.0840 - val_accuracy: 0.5650 - val_loss: 2.7249
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9873 - loss: 0.0544 - val_accuracy: 0.6150 - val_loss: 2.7848
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 1s/step - accuracy: 0.9768 - loss: 0.0695 - val_accuracy: 0.6100 - val_loss: 2.9545
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9731 - loss: 0.0767 - val_accuracy: 0.6150 - val_loss: 2.5158
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9797 - loss: 0.0810 - val_accuracy: 0.6100 - val_loss: 2.5275
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9807 - loss: 0.0617 - val_accuracy: 0.5100 - val_loss: 3.4139
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9686 - loss: 0.1716 - val_accuracy: 0.5950 - val_loss: 2.5259
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9579 - loss: 0.1311 - val_accuracy: 0.6000 - val_loss: 2.3598
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9614 - loss: 0.1006 - val_accuracy: 0.6250 - val_loss: 2.3710
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 1s/step - accuracy: 0.9831 - loss: 0.0494 - val_accuracy: 0.5900 - val_loss: 2.4309
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9865 - loss: 0.0413 - val_accuracy: 0.6150 - val_loss: 2.5843
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9723 - loss: 0.0938 - val_accuracy: 0.6200 - val_loss: 2.5107
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 40s 1s/step - accuracy: 0.9890 - loss: 0.0352 - val_accuracy: 0.6250 - val_loss: 2.6177
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 1s/step - accuracy: 0.9732 - loss: 0.1001 - val_accuracy: 0.6350 - val_loss: 2.6362
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9685 - loss: 0.0753 - val_accuracy: 0.6450 - val_loss: 2.7245
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9689 - loss: 0.1208 - val_accuracy: 0.6350 - val_loss: 2.4855
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9775 - loss: 0.0830 - val_accuracy: 0.5800 - val_loss: 2.6929
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.9776 - loss: 0.0684 - val_accuracy: 0.6250 - val_loss: 2.4147
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9900 - loss: 0.0449 - val_accuracy: 0.6200 - val_loss: 2.4069
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9814 - loss: 0.0603 - val_accuracy: 0.6400 - val_loss: 2.3076
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9831 - loss: 0.0480 - val_accuracy: 0.6300 - val_loss: 2.4884
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 29s 1s/step - accuracy: 0.9798 - loss: 0.0811 - val_accuracy: 0.6100 - val_loss: 2.8976
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 30s 1s/step - accuracy: 0.9540 - loss: 0.1233 - val_accuracy: 0.6000 - val_loss: 2.5558
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9726 - loss: 0.0607 - val_accuracy: 0.6150 - val_loss: 2.5155
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 26s 1s/step - accuracy: 0.9861 - loss: 0.0612 - val_accuracy: 0.6150 - val_loss: 2.5438
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 27s 1s/step - accuracy: 0.9839 - loss: 0.0469 - val_accuracy: 0.6150 - val_loss: 2.7714
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9804 - loss: 0.0644 - val_accuracy: 0.6050 - val_loss: 2.6876
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9745 - loss: 0.0825 - val_accuracy: 0.6150 - val_loss: 2.5074
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.9850 - loss: 0.0500 - val_accuracy: 0.5700 - val_loss: 2.7695
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 534ms/step - accuracy: 0.9874 - loss: 0.0435 - val_accuracy: 0.6100 - val_loss: 2.9878
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 516ms/step - accuracy: 0.9890 - loss: 0.0413 - val_accuracy: 0.5550 - val_loss: 2.9865
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 506ms/step - accuracy: 0.9630 - loss: 0.1362 - val_accuracy: 0.5950 - val_loss: 2.6534
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 536ms/step - accuracy: 0.9646 - loss: 0.1046 - val_accuracy: 0.6100 - val_loss: 2.6097
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 516ms/step - accuracy: 0.9851 - loss: 0.0577 - val_accuracy: 0.5700 - val_loss: 3.1224
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 472ms/step - accuracy: 0.9864 - loss: 0.0592 - val_accuracy: 0.6250 - val_loss: 3.0793
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 493ms/step - accuracy: 0.9766 - loss: 0.1038 - val_accuracy: 0.5900 - val_loss: 3.0936
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 545ms/step - accuracy: 0.9854 - loss: 0.0362 - val_accuracy: 0.6250 - val_loss: 2.8501
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 512ms/step - accuracy: 0.9807 - loss: 0.0572 - val_accuracy: 0.6350 - val_loss: 2.8597
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 553ms/step - accuracy: 0.9818 - loss: 0.0439 - val_accuracy: 0.6250 - val_loss: 2.8805
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 523ms/step - accuracy: 0.9693 - loss: 0.1114 - val_accuracy: 0.6150 - val_loss: 2.8996
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 35s 1s/step - accuracy: 0.9876 - loss: 0.0445 - val_accuracy: 0.6100 - val_loss: 2.5862
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 49s 2s/step - accuracy: 0.9832 - loss: 0.0491 - val_accuracy: 0.6150 - val_loss: 2.7456
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.9890 - loss: 0.0416 - val_accuracy: 0.6350 - val_loss: 2.6034
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 45s 2s/step - accuracy: 0.9840 - loss: 0.0574 - val_accuracy: 0.6200 - val_loss: 2.5495
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 36s 1s/step - accuracy: 0.9752 - loss: 0.0676 - val_accuracy: 0.6400 - val_loss: 2.4306
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 31s 1s/step - accuracy: 0.9842 - loss: 0.0456 - val_accuracy: 0.5650 - val_loss: 3.2392
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 44s 2s/step - accuracy: 0.9629 - loss: 0.1236 - val_accuracy: 0.6050 - val_loss: 2.5910
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Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 39s 2s/step - accuracy: 0.9845 - loss: 0.0498 - val_accuracy: 0.5600 - val_loss: 3.4614
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 2s/step - accuracy: 0.9775 - loss: 0.0778 - val_accuracy: 0.5850 - val_loss: 3.4735
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 39s 2s/step - accuracy: 0.9761 - loss: 0.1006 - val_accuracy: 0.6250 - val_loss: 2.8417
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 36s 1s/step - accuracy: 0.9890 - loss: 0.0297 - val_accuracy: 0.6100 - val_loss: 3.5556
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 2s/step - accuracy: 0.9769 - loss: 0.0796 - val_accuracy: 0.6250 - val_loss: 2.8833
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 76s 2s/step - accuracy: 0.9927 - loss: 0.0417 - val_accuracy: 0.5800 - val_loss: 3.4683
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 38s 2s/step - accuracy: 0.9753 - loss: 0.1325 - val_accuracy: 0.5600 - val_loss: 3.0028
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 2s/step - accuracy: 0.9977 - loss: 0.0172 - val_accuracy: 0.5900 - val_loss: 3.1076
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 36s 1s/step - accuracy: 0.9821 - loss: 0.0533 - val_accuracy: 0.6150 - val_loss: 2.7431
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 32s 1s/step - accuracy: 0.9824 - loss: 0.0689 - val_accuracy: 0.6100 - val_loss: 2.9436
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 45s 1s/step - accuracy: 0.9848 - loss: 0.0335 - val_accuracy: 0.6350 - val_loss: 3.0803
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 2s/step - accuracy: 0.9724 - loss: 0.0594 - val_accuracy: 0.6200 - val_loss: 2.8165
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 38s 2s/step - accuracy: 0.9929 - loss: 0.0385 - val_accuracy: 0.5950 - val_loss: 2.7957
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 39s 1s/step - accuracy: 0.9721 - loss: 0.0697 - val_accuracy: 0.5900 - val_loss: 3.0092
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 37s 1s/step - accuracy: 0.9793 - loss: 0.0498 - val_accuracy: 0.6150 - val_loss: 3.1001
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 40s 1s/step - accuracy: 0.9918 - loss: 0.0250 - val_accuracy: 0.6150 - val_loss: 3.1547
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 46s 2s/step - accuracy: 0.9845 - loss: 0.0484 - val_accuracy: 0.6300 - val_loss: 3.0083
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 2s/step - accuracy: 0.9851 - loss: 0.0400 - val_accuracy: 0.6050 - val_loss: 3.2633
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 41s 2s/step - accuracy: 0.9809 - loss: 0.0622 - val_accuracy: 0.5850 - val_loss: 2.9806
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 78s 2s/step - accuracy: 0.9896 - loss: 0.0433 - val_accuracy: 0.5200 - val_loss: 4.4966
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 36s 1s/step - accuracy: 0.9712 - loss: 0.0948 - val_accuracy: 0.6250 - val_loss: 3.3453
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 48s 2s/step - accuracy: 0.9821 - loss: 0.0439 - val_accuracy: 0.6100 - val_loss: 3.2421
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 43s 2s/step - accuracy: 0.9888 - loss: 0.0370 - val_accuracy: 0.6150 - val_loss: 3.3000
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 52s 534ms/step - accuracy: 0.9968 - loss: 0.0204 - val_accuracy: 0.6100 - val_loss: 3.2120
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 568ms/step - accuracy: 0.9670 - loss: 0.1086 - val_accuracy: 0.6300 - val_loss: 2.9584
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 542ms/step - accuracy: 0.9895 - loss: 0.0179 - val_accuracy: 0.6400 - val_loss: 3.2522
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 539ms/step - accuracy: 0.9852 - loss: 0.0418 - val_accuracy: 0.6300 - val_loss: 2.9038
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 522ms/step - accuracy: 0.9963 - loss: 0.0141 - val_accuracy: 0.6100 - val_loss: 3.7893
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 549ms/step - accuracy: 0.9896 - loss: 0.0594 - val_accuracy: 0.6050 - val_loss: 3.6565
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 531ms/step - accuracy: 0.9762 - loss: 0.0803 - val_accuracy: 0.6000 - val_loss: 3.0845
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 553ms/step - accuracy: 0.9910 - loss: 0.0324 - val_accuracy: 0.5900 - val_loss: 3.1809
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 531ms/step - accuracy: 0.9763 - loss: 0.0641 - val_accuracy: 0.6000 - val_loss: 3.3820
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 490ms/step - accuracy: 0.9811 - loss: 0.0780 - val_accuracy: 0.6200 - val_loss: 3.3695
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 39s 2s/step - accuracy: 0.9879 - loss: 0.0313 - val_accuracy: 0.6050 - val_loss: 3.4536
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 37s 1s/step - accuracy: 0.9894 - loss: 0.0385 - val_accuracy: 0.6350 - val_loss: 3.3571
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 42s 2s/step - accuracy: 0.9831 - loss: 0.0570 - val_accuracy: 0.6000 - val_loss: 3.3900
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 6102.52 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 2 worker

In [2]:
```
# Set the number of threads
number_of_worker = 2
os.environ['OMP_NUM_THREADS'] = '2'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '2'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '2'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 675ms/step - accuracy: 0.0658 - loss: 2.3332 - val_accuracy: 0.1000 - val_loss: 2.3021
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 693ms/step - accuracy: 0.0986 - loss: 2.3021 - val_accuracy: 0.1000 - val_loss: 2.2934
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 16s 658ms/step - accuracy: 0.1090 - loss: 2.2960 - val_accuracy: 0.2100 - val_loss: 2.2949
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 16s 652ms/step - accuracy: 0.1633 - loss: 2.2699 - val_accuracy: 0.1900 - val_loss: 2.1670
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 15s 607ms/step - accuracy: 0.2279 - loss: 2.1263 - val_accuracy: 0.2100 - val_loss: 2.0336
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 15s 598ms/step - accuracy: 0.2639 - loss: 2.0327 - val_accuracy: 0.2800 - val_loss: 2.0367
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 15s 595ms/step - accuracy: 0.2955 - loss: 1.9982 - val_accuracy: 0.3250 - val_loss: 1.9601
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 15s 594ms/step - accuracy: 0.2485 - loss: 2.0284 - val_accuracy: 0.2950 - val_loss: 1.9328
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 15s 589ms/step - accuracy: 0.2926 - loss: 1.9276 - val_accuracy: 0.3500 - val_loss: 1.9102
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 15s 602ms/step - accuracy: 0.2897 - loss: 1.9524 - val_accuracy: 0.3400 - val_loss: 1.8158
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 16s 650ms/step - accuracy: 0.3268 - loss: 1.8249 - val_accuracy: 0.3350 - val_loss: 1.7215
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 687ms/step - accuracy: 0.3834 - loss: 1.7091 - val_accuracy: 0.3750 - val_loss: 1.6773
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 700ms/step - accuracy: 0.3712 - loss: 1.7670 - val_accuracy: 0.2500 - val_loss: 2.0661
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 699ms/step - accuracy: 0.3958 - loss: 1.7096 - val_accuracy: 0.3350 - val_loss: 1.6078
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.4427 - loss: 1.5865 - val_accuracy: 0.3950 - val_loss: 1.5535
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 733ms/step - accuracy: 0.4159 - loss: 1.5572 - val_accuracy: 0.3500 - val_loss: 1.8125
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 19s 741ms/step - accuracy: 0.4032 - loss: 1.6410 - val_accuracy: 0.4050 - val_loss: 1.5667
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 733ms/step - accuracy: 0.4755 - loss: 1.4892 - val_accuracy: 0.4050 - val_loss: 1.5534
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.4703 - loss: 1.4501 - val_accuracy: 0.4250 - val_loss: 1.5390
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.4298 - loss: 1.5520 - val_accuracy: 0.3700 - val_loss: 1.6879
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 727ms/step - accuracy: 0.4590 - loss: 1.4803 - val_accuracy: 0.4050 - val_loss: 1.5830
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.4832 - loss: 1.4678 - val_accuracy: 0.4850 - val_loss: 1.3881
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.5379 - loss: 1.2982 - val_accuracy: 0.4600 - val_loss: 1.4611
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 734ms/step - accuracy: 0.5154 - loss: 1.3152 - val_accuracy: 0.4250 - val_loss: 1.4089
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 724ms/step - accuracy: 0.5432 - loss: 1.2727 - val_accuracy: 0.5100 - val_loss: 1.3474
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 719ms/step - accuracy: 0.5513 - loss: 1.2137 - val_accuracy: 0.5150 - val_loss: 1.3525
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.5891 - loss: 1.1408 - val_accuracy: 0.5200 - val_loss: 1.3607
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.5416 - loss: 1.1971 - val_accuracy: 0.4800 - val_loss: 1.4404
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 738ms/step - accuracy: 0.5836 - loss: 1.1399 - val_accuracy: 0.5000 - val_loss: 1.3671
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 735ms/step - accuracy: 0.5671 - loss: 1.1366 - val_accuracy: 0.5200 - val_loss: 1.3093
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 19s 751ms/step - accuracy: 0.6065 - loss: 1.0926 - val_accuracy: 0.5100 - val_loss: 1.2397
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 737ms/step - accuracy: 0.5776 - loss: 1.0719 - val_accuracy: 0.5250 - val_loss: 1.3024
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 707ms/step - accuracy: 0.6042 - loss: 1.0833 - val_accuracy: 0.5250 - val_loss: 1.3458
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 690ms/step - accuracy: 0.5982 - loss: 1.1189 - val_accuracy: 0.5650 - val_loss: 1.2984
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.6693 - loss: 0.9085 - val_accuracy: 0.5400 - val_loss: 1.2657
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 735ms/step - accuracy: 0.6650 - loss: 0.9373 - val_accuracy: 0.5600 - val_loss: 1.1906
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 730ms/step - accuracy: 0.6666 - loss: 0.9179 - val_accuracy: 0.5850 - val_loss: 1.1938
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 735ms/step - accuracy: 0.6960 - loss: 0.8488 - val_accuracy: 0.6050 - val_loss: 1.1426
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.6970 - loss: 0.8214 - val_accuracy: 0.5650 - val_loss: 1.2680
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 712ms/step - accuracy: 0.6785 - loss: 0.8729 - val_accuracy: 0.5750 - val_loss: 1.1458
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 717ms/step - accuracy: 0.6635 - loss: 0.9008 - val_accuracy: 0.6000 - val_loss: 1.1763
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Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 707ms/step - accuracy: 0.6824 - loss: 0.8254 - val_accuracy: 0.5600 - val_loss: 1.1993
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 734ms/step - accuracy: 0.7287 - loss: 0.8137 - val_accuracy: 0.6000 - val_loss: 1.1503
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 725ms/step - accuracy: 0.7484 - loss: 0.6776 - val_accuracy: 0.5950 - val_loss: 1.1720
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 730ms/step - accuracy: 0.7591 - loss: 0.7487 - val_accuracy: 0.5900 - val_loss: 1.2234
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.7634 - loss: 0.6756 - val_accuracy: 0.5950 - val_loss: 1.1382
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.7567 - loss: 0.6095 - val_accuracy: 0.6150 - val_loss: 1.2420
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.7541 - loss: 0.6675 - val_accuracy: 0.6150 - val_loss: 1.2987
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 735ms/step - accuracy: 0.7979 - loss: 0.5888 - val_accuracy: 0.6400 - val_loss: 1.2228
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 731ms/step - accuracy: 0.7945 - loss: 0.5587 - val_accuracy: 0.5650 - val_loss: 1.4477
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.8001 - loss: 0.5551 - val_accuracy: 0.6050 - val_loss: 1.4301
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.7869 - loss: 0.6716 - val_accuracy: 0.5750 - val_loss: 1.3105
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.7919 - loss: 0.5782 - val_accuracy: 0.6300 - val_loss: 1.2621
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 719ms/step - accuracy: 0.8451 - loss: 0.4805 - val_accuracy: 0.6350 - val_loss: 1.2906
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 720ms/step - accuracy: 0.8179 - loss: 0.4926 - val_accuracy: 0.6200 - val_loss: 1.4216
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 725ms/step - accuracy: 0.8320 - loss: 0.4691 - val_accuracy: 0.6300 - val_loss: 1.4858
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 718ms/step - accuracy: 0.8099 - loss: 0.4724 - val_accuracy: 0.6100 - val_loss: 1.5430
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.8482 - loss: 0.4111 - val_accuracy: 0.5950 - val_loss: 1.5319
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.8596 - loss: 0.3476 - val_accuracy: 0.6100 - val_loss: 1.6917
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 709ms/step - accuracy: 0.8134 - loss: 0.4908 - val_accuracy: 0.6200 - val_loss: 1.5236
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.8909 - loss: 0.3588 - val_accuracy: 0.6200 - val_loss: 1.4370
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.8414 - loss: 0.4690 - val_accuracy: 0.6300 - val_loss: 1.7034
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 21s 716ms/step - accuracy: 0.8408 - loss: 0.5160 - val_accuracy: 0.5900 - val_loss: 1.6704
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.8854 - loss: 0.3459 - val_accuracy: 0.6050 - val_loss: 1.6405
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 723ms/step - accuracy: 0.9229 - loss: 0.2495 - val_accuracy: 0.6100 - val_loss: 1.6316
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 720ms/step - accuracy: 0.8997 - loss: 0.2830 - val_accuracy: 0.6150 - val_loss: 1.5437
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.9092 - loss: 0.2726 - val_accuracy: 0.6000 - val_loss: 1.7793
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.9390 - loss: 0.1926 - val_accuracy: 0.5800 - val_loss: 2.0801
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 723ms/step - accuracy: 0.9058 - loss: 0.3264 - val_accuracy: 0.6200 - val_loss: 1.8446
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 733ms/step - accuracy: 0.8686 - loss: 0.4121 - val_accuracy: 0.6000 - val_loss: 1.9129
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 730ms/step - accuracy: 0.8806 - loss: 0.3671 - val_accuracy: 0.6050 - val_loss: 1.6417
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 705ms/step - accuracy: 0.9386 - loss: 0.1723 - val_accuracy: 0.5900 - val_loss: 1.7384
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.9273 - loss: 0.2003 - val_accuracy: 0.5850 - val_loss: 2.1487
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9156 - loss: 0.2440 - val_accuracy: 0.6000 - val_loss: 1.9785
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 21s 729ms/step - accuracy: 0.9193 - loss: 0.2718 - val_accuracy: 0.5850 - val_loss: 2.0705
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 724ms/step - accuracy: 0.9459 - loss: 0.1662 - val_accuracy: 0.6100 - val_loss: 2.0769
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 726ms/step - accuracy: 0.9097 - loss: 0.2411 - val_accuracy: 0.6250 - val_loss: 2.1611
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 733ms/step - accuracy: 0.9575 - loss: 0.1431 - val_accuracy: 0.5850 - val_loss: 2.3373
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.9352 - loss: 0.2195 - val_accuracy: 0.6050 - val_loss: 2.0010
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 707ms/step - accuracy: 0.9505 - loss: 0.1423 - val_accuracy: 0.5950 - val_loss: 1.8676
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.9476 - loss: 0.1579 - val_accuracy: 0.5950 - val_loss: 2.0369
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 723ms/step - accuracy: 0.9688 - loss: 0.1092 - val_accuracy: 0.6150 - val_loss: 1.9845
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 731ms/step - accuracy: 0.9479 - loss: 0.1606 - val_accuracy: 0.5800 - val_loss: 2.6820
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 726ms/step - accuracy: 0.9545 - loss: 0.1623 - val_accuracy: 0.6100 - val_loss: 1.9176
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 706ms/step - accuracy: 0.9567 - loss: 0.1448 - val_accuracy: 0.6100 - val_loss: 2.0825
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.9462 - loss: 0.1407 - val_accuracy: 0.6050 - val_loss: 2.2098
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.9378 - loss: 0.1713 - val_accuracy: 0.5900 - val_loss: 2.2017
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 716ms/step - accuracy: 0.9610 - loss: 0.1053 - val_accuracy: 0.6200 - val_loss: 2.2934
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.9620 - loss: 0.1244 - val_accuracy: 0.6000 - val_loss: 2.2978
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9526 - loss: 0.1334 - val_accuracy: 0.5850 - val_loss: 2.2852
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 730ms/step - accuracy: 0.9629 - loss: 0.1154 - val_accuracy: 0.6000 - val_loss: 2.0158
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.9730 - loss: 0.0986 - val_accuracy: 0.6100 - val_loss: 2.1760
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 716ms/step - accuracy: 0.9814 - loss: 0.0740 - val_accuracy: 0.5800 - val_loss: 2.4375
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 703ms/step - accuracy: 0.9482 - loss: 0.1256 - val_accuracy: 0.6200 - val_loss: 2.1586
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.9786 - loss: 0.0733 - val_accuracy: 0.6100 - val_loss: 2.1589
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 731ms/step - accuracy: 0.9680 - loss: 0.0907 - val_accuracy: 0.5900 - val_loss: 2.4064
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 19s 754ms/step - accuracy: 0.9696 - loss: 0.0912 - val_accuracy: 0.5600 - val_loss: 2.4183
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 733ms/step - accuracy: 0.9788 - loss: 0.0655 - val_accuracy: 0.6050 - val_loss: 2.2126
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 722ms/step - accuracy: 0.9470 - loss: 0.1776 - val_accuracy: 0.6300 - val_loss: 2.1396
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 709ms/step - accuracy: 0.9711 - loss: 0.0763 - val_accuracy: 0.6050 - val_loss: 2.0356
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 724ms/step - accuracy: 0.9650 - loss: 0.1307 - val_accuracy: 0.6050 - val_loss: 2.1148
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 724ms/step - accuracy: 0.9790 - loss: 0.0682 - val_accuracy: 0.6000 - val_loss: 2.6045
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9743 - loss: 0.0784 - val_accuracy: 0.5750 - val_loss: 2.6396
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 711ms/step - accuracy: 0.9579 - loss: 0.1212 - val_accuracy: 0.5750 - val_loss: 2.9462
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 719ms/step - accuracy: 0.9851 - loss: 0.0671 - val_accuracy: 0.6000 - val_loss: 2.5684
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 726ms/step - accuracy: 0.9438 - loss: 0.2108 - val_accuracy: 0.5700 - val_loss: 2.1696
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 720ms/step - accuracy: 0.9562 - loss: 0.1139 - val_accuracy: 0.5850 - val_loss: 2.4554
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 724ms/step - accuracy: 0.9572 - loss: 0.1481 - val_accuracy: 0.6150 - val_loss: 2.1096
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.9787 - loss: 0.0589 - val_accuracy: 0.5750 - val_loss: 3.2846
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9564 - loss: 0.1865 - val_accuracy: 0.6050 - val_loss: 2.1813
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 717ms/step - accuracy: 0.9763 - loss: 0.0739 - val_accuracy: 0.5700 - val_loss: 2.6695
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 712ms/step - accuracy: 0.9603 - loss: 0.1191 - val_accuracy: 0.6050 - val_loss: 2.3246
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.9768 - loss: 0.0602 - val_accuracy: 0.6150 - val_loss: 2.4997
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 696ms/step - accuracy: 0.9840 - loss: 0.0772 - val_accuracy: 0.6000 - val_loss: 2.7861
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 716ms/step - accuracy: 0.9773 - loss: 0.1082 - val_accuracy: 0.6150 - val_loss: 2.3787
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 720ms/step - accuracy: 0.9836 - loss: 0.0524 - val_accuracy: 0.6000 - val_loss: 2.9112
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.9603 - loss: 0.1101 - val_accuracy: 0.5900 - val_loss: 2.7486
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.9809 - loss: 0.0785 - val_accuracy: 0.5950 - val_loss: 2.8456
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 702ms/step - accuracy: 0.9673 - loss: 0.1098 - val_accuracy: 0.5950 - val_loss: 2.6416
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 701ms/step - accuracy: 0.9882 - loss: 0.0370 - val_accuracy: 0.6100 - val_loss: 2.6769
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 712ms/step - accuracy: 0.9638 - loss: 0.1044 - val_accuracy: 0.6200 - val_loss: 2.9083
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 725ms/step - accuracy: 0.9782 - loss: 0.0979 - val_accuracy: 0.6200 - val_loss: 2.5686
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 729ms/step - accuracy: 0.9812 - loss: 0.0578 - val_accuracy: 0.6250 - val_loss: 2.3114
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 716ms/step - accuracy: 0.9868 - loss: 0.0367 - val_accuracy: 0.5950 - val_loss: 2.8347
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 702ms/step - accuracy: 0.9719 - loss: 0.0724 - val_accuracy: 0.6250 - val_loss: 2.6391
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9764 - loss: 0.0920 - val_accuracy: 0.5950 - val_loss: 2.5164
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 709ms/step - accuracy: 0.9781 - loss: 0.0665 - val_accuracy: 0.6250 - val_loss: 2.5423
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 705ms/step - accuracy: 0.9931 - loss: 0.0285 - val_accuracy: 0.5950 - val_loss: 2.9967
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9756 - loss: 0.0772 - val_accuracy: 0.5450 - val_loss: 3.1431
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 738ms/step - accuracy: 0.9635 - loss: 0.0942 - val_accuracy: 0.6100 - val_loss: 2.8132
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 711ms/step - accuracy: 0.9839 - loss: 0.0396 - val_accuracy: 0.5900 - val_loss: 2.7533
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 720ms/step - accuracy: 0.9689 - loss: 0.1105 - val_accuracy: 0.6100 - val_loss: 2.5281
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.9722 - loss: 0.0740 - val_accuracy: 0.5850 - val_loss: 3.1726
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9883 - loss: 0.0474 - val_accuracy: 0.6200 - val_loss: 2.6395
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 707ms/step - accuracy: 0.9730 - loss: 0.0793 - val_accuracy: 0.5900 - val_loss: 2.8316
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.9670 - loss: 0.0725 - val_accuracy: 0.6050 - val_loss: 2.2946
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 715ms/step - accuracy: 0.9915 - loss: 0.0330 - val_accuracy: 0.6050 - val_loss: 2.6592
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 717ms/step - accuracy: 0.9781 - loss: 0.0669 - val_accuracy: 0.6100 - val_loss: 2.7602
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.9688 - loss: 0.1116 - val_accuracy: 0.6100 - val_loss: 3.3575
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 691ms/step - accuracy: 0.9746 - loss: 0.1208 - val_accuracy: 0.6200 - val_loss: 2.8369
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 702ms/step - accuracy: 0.9881 - loss: 0.0348 - val_accuracy: 0.6050 - val_loss: 2.4070
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 716ms/step - accuracy: 0.9784 - loss: 0.0589 - val_accuracy: 0.5900 - val_loss: 2.8224
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9804 - loss: 0.0618 - val_accuracy: 0.6000 - val_loss: 2.9480
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 727ms/step - accuracy: 0.9570 - loss: 0.1407 - val_accuracy: 0.6050 - val_loss: 3.0398
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.9857 - loss: 0.0526 - val_accuracy: 0.6100 - val_loss: 2.8026
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 704ms/step - accuracy: 0.9799 - loss: 0.0990 - val_accuracy: 0.5900 - val_loss: 2.9637
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 711ms/step - accuracy: 0.9758 - loss: 0.0744 - val_accuracy: 0.6050 - val_loss: 2.6072
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9780 - loss: 0.0572 - val_accuracy: 0.5950 - val_loss: 2.8387
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 729ms/step - accuracy: 0.9769 - loss: 0.0605 - val_accuracy: 0.5850 - val_loss: 2.7072
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.9864 - loss: 0.0305 - val_accuracy: 0.6000 - val_loss: 3.7635
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 726ms/step - accuracy: 0.9730 - loss: 0.1296 - val_accuracy: 0.5750 - val_loss: 2.9057
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.9956 - loss: 0.0176 - val_accuracy: 0.6300 - val_loss: 2.9177
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.9782 - loss: 0.0799 - val_accuracy: 0.5900 - val_loss: 2.9872
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.9934 - loss: 0.0160 - val_accuracy: 0.5900 - val_loss: 3.0310
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 19s 762ms/step - accuracy: 0.9743 - loss: 0.0986 - val_accuracy: 0.5950 - val_loss: 2.8097
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 684ms/step - accuracy: 0.9687 - loss: 0.1124 - val_accuracy: 0.6150 - val_loss: 2.6391
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.9891 - loss: 0.0306 - val_accuracy: 0.6150 - val_loss: 2.9222
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 685ms/step - accuracy: 0.9726 - loss: 0.0740 - val_accuracy: 0.6000 - val_loss: 2.8231
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 706ms/step - accuracy: 0.9903 - loss: 0.0341 - val_accuracy: 0.5800 - val_loss: 3.2725
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 729ms/step - accuracy: 0.9856 - loss: 0.0550 - val_accuracy: 0.6050 - val_loss: 3.0906
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.9797 - loss: 0.0624 - val_accuracy: 0.5900 - val_loss: 2.7295
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 731ms/step - accuracy: 0.9947 - loss: 0.0261 - val_accuracy: 0.6050 - val_loss: 2.9180
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 736ms/step - accuracy: 0.9889 - loss: 0.0323 - val_accuracy: 0.6050 - val_loss: 2.9152
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 19s 741ms/step - accuracy: 0.9805 - loss: 0.0453 - val_accuracy: 0.6100 - val_loss: 2.8851
```

```
Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 726ms/step - accuracy: 0.9907 - loss: 0.0331 - val_accuracy: 0.6150 - val_loss: 3.0317
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 688ms/step - accuracy: 0.9721 - loss: 0.0709 - val_accuracy: 0.6100 - val_loss: 3.0954
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 713ms/step - accuracy: 0.9757 - loss: 0.0530 - val_accuracy: 0.6050 - val_loss: 3.2853
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 706ms/step - accuracy: 0.9767 - loss: 0.0868 - val_accuracy: 0.6100 - val_loss: 2.8212
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 721ms/step - accuracy: 0.9894 - loss: 0.0469 - val_accuracy: 0.6000 - val_loss: 3.0674
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9883 - loss: 0.0524 - val_accuracy: 0.5900 - val_loss: 2.7765
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9719 - loss: 0.0858 - val_accuracy: 0.5950 - val_loss: 2.9619
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 723ms/step - accuracy: 0.9967 - loss: 0.0159 - val_accuracy: 0.5950 - val_loss: 3.2934
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 702ms/step - accuracy: 0.9748 - loss: 0.0891 - val_accuracy: 0.5900 - val_loss: 2.9908
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 694ms/step - accuracy: 0.9945 - loss: 0.0353 - val_accuracy: 0.6050 - val_loss: 3.2003
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.9945 - loss: 0.0238 - val_accuracy: 0.5550 - val_loss: 5.2057
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 728ms/step - accuracy: 0.9718 - loss: 0.1247 - val_accuracy: 0.5800 - val_loss: 3.1216
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9788 - loss: 0.0614 - val_accuracy: 0.6100 - val_loss: 3.3939
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 729ms/step - accuracy: 0.9917 - loss: 0.0176 - val_accuracy: 0.5800 - val_loss: 3.5900
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 720ms/step - accuracy: 0.9924 - loss: 0.0369 - val_accuracy: 0.6100 - val_loss: 3.5684
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 716ms/step - accuracy: 0.9919 - loss: 0.0242 - val_accuracy: 0.6100 - val_loss: 3.8176
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 703ms/step - accuracy: 0.9974 - loss: 0.0112 - val_accuracy: 0.6200 - val_loss: 3.5469
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 722ms/step - accuracy: 0.9864 - loss: 0.0510 - val_accuracy: 0.6000 - val_loss: 3.8091
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 723ms/step - accuracy: 0.9632 - loss: 0.1131 - val_accuracy: 0.5950 - val_loss: 3.4164
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 732ms/step - accuracy: 0.9814 - loss: 0.1048 - val_accuracy: 0.5850 - val_loss: 2.7835
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9960 - loss: 0.0176 - val_accuracy: 0.5900 - val_loss: 3.4109
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.9937 - loss: 0.0333 - val_accuracy: 0.5950 - val_loss: 3.6571
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 681ms/step - accuracy: 0.9916 - loss: 0.0364 - val_accuracy: 0.6050 - val_loss: 3.6589
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 714ms/step - accuracy: 0.9962 - loss: 0.0138 - val_accuracy: 0.6000 - val_loss: 3.2003
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 723ms/step - accuracy: 0.9920 - loss: 0.0247 - val_accuracy: 0.5800 - val_loss: 3.8158
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 718ms/step - accuracy: 0.9831 - loss: 0.0737 - val_accuracy: 0.6250 - val_loss: 3.4735
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 719ms/step - accuracy: 0.9852 - loss: 0.0763 - val_accuracy: 0.6000 - val_loss: 3.5289
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 706ms/step - accuracy: 0.9861 - loss: 0.0350 - val_accuracy: 0.6000 - val_loss: 3.7007
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 697ms/step - accuracy: 0.9921 - loss: 0.0248 - val_accuracy: 0.6050 - val_loss: 3.6667
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 708ms/step - accuracy: 0.9772 - loss: 0.0782 - val_accuracy: 0.6200 - val_loss: 4.1763
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 703ms/step - accuracy: 0.9855 - loss: 0.0633 - val_accuracy: 0.6000 - val_loss: 3.3390
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 710ms/step - accuracy: 0.9920 - loss: 0.0385 - val_accuracy: 0.5800 - val_loss: 5.2956
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 703ms/step - accuracy: 0.9785 - loss: 0.0978 - val_accuracy: 0.5950 - val_loss: 4.0987
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 729ms/step - accuracy: 0.9750 - loss: 0.0530 - val_accuracy: 0.6100 - val_loss: 4.0447
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 18s 705ms/step - accuracy: 0.9891 - loss: 0.0457 - val_accuracy: 0.5850 - val_loss: 3.7655
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 695ms/step - accuracy: 0.9887 - loss: 0.0432 - val_accuracy: 0.5750 - val_loss: 4.1484
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 3590.61 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 3 worker

In [2]:
```
# Set the number of threads
number_of_worker = 3
os.environ['OMP_NUM_THREADS'] = '3'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '3'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '3'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 17s 524ms/step - accuracy: 0.1172 - loss: 2.3200 - val_accuracy: 0.1000 - val_loss: 2.2990
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 532ms/step - accuracy: 0.1234 - loss: 2.2973 - val_accuracy: 0.2100 - val_loss: 2.1400
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 446ms/step - accuracy: 0.1766 - loss: 2.2264 - val_accuracy: 0.1950 - val_loss: 2.1511
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 450ms/step - accuracy: 0.2260 - loss: 2.0911 - val_accuracy: 0.2800 - val_loss: 1.9925
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 451ms/step - accuracy: 0.2132 - loss: 2.0567 - val_accuracy: 0.3100 - val_loss: 1.9550
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 498ms/step - accuracy: 0.2552 - loss: 1.9979 - val_accuracy: 0.2850 - val_loss: 1.9534
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 501ms/step - accuracy: 0.2653 - loss: 2.0255 - val_accuracy: 0.2500 - val_loss: 1.9111
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 482ms/step - accuracy: 0.2902 - loss: 1.9696 - val_accuracy: 0.3850 - val_loss: 1.8503
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 477ms/step - accuracy: 0.3088 - loss: 1.9267 - val_accuracy: 0.3300 - val_loss: 1.8287
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 508ms/step - accuracy: 0.3537 - loss: 1.8062 - val_accuracy: 0.3650 - val_loss: 1.8139
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 14s 565ms/step - accuracy: 0.3134 - loss: 1.8423 - val_accuracy: 0.3800 - val_loss: 1.7176
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 460ms/step - accuracy: 0.3454 - loss: 1.7533 - val_accuracy: 0.3850 - val_loss: 1.6785
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 460ms/step - accuracy: 0.4122 - loss: 1.7147 - val_accuracy: 0.3450 - val_loss: 1.7537
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 472ms/step - accuracy: 0.3678 - loss: 1.6829 - val_accuracy: 0.3700 - val_loss: 1.7117
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 495ms/step - accuracy: 0.4258 - loss: 1.6375 - val_accuracy: 0.4200 - val_loss: 1.5848
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 464ms/step - accuracy: 0.4147 - loss: 1.6018 - val_accuracy: 0.3400 - val_loss: 1.8386
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 474ms/step - accuracy: 0.4380 - loss: 1.5571 - val_accuracy: 0.4600 - val_loss: 1.4757
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 469ms/step - accuracy: 0.4516 - loss: 1.4895 - val_accuracy: 0.3950 - val_loss: 1.6467
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 451ms/step - accuracy: 0.4831 - loss: 1.3935 - val_accuracy: 0.3550 - val_loss: 1.6572
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 450ms/step - accuracy: 0.4701 - loss: 1.4577 - val_accuracy: 0.4850 - val_loss: 1.4225
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.5340 - loss: 1.3667 - val_accuracy: 0.4450 - val_loss: 1.4603
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.5101 - loss: 1.3524 - val_accuracy: 0.4900 - val_loss: 1.3790
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 476ms/step - accuracy: 0.5124 - loss: 1.3269 - val_accuracy: 0.4250 - val_loss: 1.4842
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 454ms/step - accuracy: 0.5223 - loss: 1.3252 - val_accuracy: 0.4550 - val_loss: 1.4401
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 430ms/step - accuracy: 0.5324 - loss: 1.3002 - val_accuracy: 0.4650 - val_loss: 1.3797
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 480ms/step - accuracy: 0.5712 - loss: 1.1731 - val_accuracy: 0.4650 - val_loss: 1.4238
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 442ms/step - accuracy: 0.5879 - loss: 1.2535 - val_accuracy: 0.5150 - val_loss: 1.4551
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 471ms/step - accuracy: 0.5800 - loss: 1.1953 - val_accuracy: 0.4650 - val_loss: 1.4764
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 439ms/step - accuracy: 0.6032 - loss: 1.0950 - val_accuracy: 0.4900 - val_loss: 1.3933
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 432ms/step - accuracy: 0.6123 - loss: 1.0926 - val_accuracy: 0.5650 - val_loss: 1.3480
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 463ms/step - accuracy: 0.6430 - loss: 0.9993 - val_accuracy: 0.5500 - val_loss: 1.2991
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 433ms/step - accuracy: 0.6167 - loss: 1.0415 - val_accuracy: 0.5100 - val_loss: 1.4623
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 447ms/step - accuracy: 0.5989 - loss: 1.0725 - val_accuracy: 0.5750 - val_loss: 1.2746
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 435ms/step - accuracy: 0.6767 - loss: 0.9582 - val_accuracy: 0.5500 - val_loss: 1.2775
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 452ms/step - accuracy: 0.6763 - loss: 0.9264 - val_accuracy: 0.5600 - val_loss: 1.3444
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 438ms/step - accuracy: 0.6904 - loss: 0.8116 - val_accuracy: 0.4150 - val_loss: 1.8726
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 449ms/step - accuracy: 0.6764 - loss: 0.9323 - val_accuracy: 0.5450 - val_loss: 1.4784
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 447ms/step - accuracy: 0.7223 - loss: 0.8499 - val_accuracy: 0.5700 - val_loss: 1.3681
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 450ms/step - accuracy: 0.7044 - loss: 0.8255 - val_accuracy: 0.4900 - val_loss: 1.5316
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 442ms/step - accuracy: 0.7209 - loss: 0.7767 - val_accuracy: 0.5100 - val_loss: 1.3763
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 456ms/step - accuracy: 0.7288 - loss: 0.8238 - val_accuracy: 0.5850 - val_loss: 1.2973
```

```
Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 438ms/step - accuracy: 0.7672 - loss: 0.7296 - val_accuracy: 0.4550 - val_loss: 1.7125
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 445ms/step - accuracy: 0.7301 - loss: 0.7281 - val_accuracy: 0.4950 - val_loss: 1.5391
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 458ms/step - accuracy: 0.7694 - loss: 0.6188 - val_accuracy: 0.5400 - val_loss: 1.4922
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 451ms/step - accuracy: 0.7854 - loss: 0.6459 - val_accuracy: 0.5050 - val_loss: 1.6969
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 502ms/step - accuracy: 0.7587 - loss: 0.7253 - val_accuracy: 0.5800 - val_loss: 1.4690
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 486ms/step - accuracy: 0.8226 - loss: 0.5347 - val_accuracy: 0.5500 - val_loss: 1.4696
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 494ms/step - accuracy: 0.8037 - loss: 0.5382 - val_accuracy: 0.5500 - val_loss: 1.4454
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 464ms/step - accuracy: 0.8286 - loss: 0.4913 - val_accuracy: 0.5650 - val_loss: 1.3963
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 10s 408ms/step - accuracy: 0.8572 - loss: 0.4218 - val_accuracy: 0.5700 - val_loss: 1.5492
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 439ms/step - accuracy: 0.8326 - loss: 0.4634 - val_accuracy: 0.5250 - val_loss: 1.8723
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 462ms/step - accuracy: 0.8203 - loss: 0.5689 - val_accuracy: 0.5500 - val_loss: 1.6347
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 499ms/step - accuracy: 0.8558 - loss: 0.4413 - val_accuracy: 0.5250 - val_loss: 1.7110
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 517ms/step - accuracy: 0.8577 - loss: 0.4649 - val_accuracy: 0.5750 - val_loss: 1.5534
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 510ms/step - accuracy: 0.8622 - loss: 0.3862 - val_accuracy: 0.5800 - val_loss: 1.4429
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 500ms/step - accuracy: 0.8415 - loss: 0.4130 - val_accuracy: 0.5600 - val_loss: 1.6298
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 473ms/step - accuracy: 0.8331 - loss: 0.4591 - val_accuracy: 0.5550 - val_loss: 1.7618
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 512ms/step - accuracy: 0.8447 - loss: 0.4063 - val_accuracy: 0.5600 - val_loss: 1.7022
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 497ms/step - accuracy: 0.8745 - loss: 0.3720 - val_accuracy: 0.5500 - val_loss: 1.7594
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 484ms/step - accuracy: 0.8637 - loss: 0.3368 - val_accuracy: 0.5600 - val_loss: 1.4790
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 458ms/step - accuracy: 0.9153 - loss: 0.2569 - val_accuracy: 0.5450 - val_loss: 1.6113
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 471ms/step - accuracy: 0.9336 - loss: 0.2270 - val_accuracy: 0.5000 - val_loss: 2.4138
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 418ms/step - accuracy: 0.9275 - loss: 0.2432 - val_accuracy: 0.5550 - val_loss: 2.1046
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 426ms/step - accuracy: 0.9020 - loss: 0.2548 - val_accuracy: 0.5650 - val_loss: 1.9601
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 445ms/step - accuracy: 0.9056 - loss: 0.2923 - val_accuracy: 0.6000 - val_loss: 1.7826
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 419ms/step - accuracy: 0.9148 - loss: 0.2506 - val_accuracy: 0.5550 - val_loss: 1.8186
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 441ms/step - accuracy: 0.9171 - loss: 0.2525 - val_accuracy: 0.5900 - val_loss: 1.8137
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 447ms/step - accuracy: 0.9299 - loss: 0.2053 - val_accuracy: 0.5550 - val_loss: 2.3692
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 448ms/step - accuracy: 0.9197 - loss: 0.2721 - val_accuracy: 0.5500 - val_loss: 2.1923
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 459ms/step - accuracy: 0.9512 - loss: 0.1595 - val_accuracy: 0.5800 - val_loss: 2.3808
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 480ms/step - accuracy: 0.9184 - loss: 0.2301 - val_accuracy: 0.5500 - val_loss: 2.0233
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 522ms/step - accuracy: 0.9068 - loss: 0.2479 - val_accuracy: 0.5700 - val_loss: 2.1736
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 479ms/step - accuracy: 0.9345 - loss: 0.1671 - val_accuracy: 0.5800 - val_loss: 1.8012
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9508 - loss: 0.1823 - val_accuracy: 0.5800 - val_loss: 1.9842
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 450ms/step - accuracy: 0.9300 - loss: 0.2190 - val_accuracy: 0.5750 - val_loss: 2.5367
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 464ms/step - accuracy: 0.9385 - loss: 0.1612 - val_accuracy: 0.5600 - val_loss: 2.3644
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 486ms/step - accuracy: 0.9416 - loss: 0.1744 - val_accuracy: 0.6050 - val_loss: 2.2238
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9580 - loss: 0.1393 - val_accuracy: 0.5850 - val_loss: 2.2327
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9435 - loss: 0.1561 - val_accuracy: 0.6100 - val_loss: 2.2643
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.9536 - loss: 0.1949 - val_accuracy: 0.5950 - val_loss: 2.2301
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9532 - loss: 0.1703 - val_accuracy: 0.5700 - val_loss: 2.2645
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 459ms/step - accuracy: 0.9617 - loss: 0.0973 - val_accuracy: 0.5700 - val_loss: 2.4140
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 450ms/step - accuracy: 0.9347 - loss: 0.1793 - val_accuracy: 0.5800 - val_loss: 2.2786
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 449ms/step - accuracy: 0.9474 - loss: 0.1033 - val_accuracy: 0.5750 - val_loss: 2.3670
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 453ms/step - accuracy: 0.9548 - loss: 0.1371 - val_accuracy: 0.5600 - val_loss: 2.4043
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 455ms/step - accuracy: 0.9691 - loss: 0.0769 - val_accuracy: 0.5900 - val_loss: 2.4306
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 509ms/step - accuracy: 0.9638 - loss: 0.1350 - val_accuracy: 0.5850 - val_loss: 2.1009
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 520ms/step - accuracy: 0.9666 - loss: 0.0947 - val_accuracy: 0.5700 - val_loss: 2.6385
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 463ms/step - accuracy: 0.9648 - loss: 0.1116 - val_accuracy: 0.5850 - val_loss: 2.4659
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 472ms/step - accuracy: 0.9513 - loss: 0.1856 - val_accuracy: 0.6000 - val_loss: 2.4104
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 478ms/step - accuracy: 0.9636 - loss: 0.1290 - val_accuracy: 0.6000 - val_loss: 2.7544
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9492 - loss: 0.1673 - val_accuracy: 0.5850 - val_loss: 2.5110
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 458ms/step - accuracy: 0.9847 - loss: 0.0773 - val_accuracy: 0.5650 - val_loss: 2.4438
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 446ms/step - accuracy: 0.9749 - loss: 0.0914 - val_accuracy: 0.5900 - val_loss: 2.8167
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 463ms/step - accuracy: 0.9696 - loss: 0.0948 - val_accuracy: 0.5450 - val_loss: 2.9110
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 485ms/step - accuracy: 0.9595 - loss: 0.1383 - val_accuracy: 0.5800 - val_loss: 2.2549
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 463ms/step - accuracy: 0.9758 - loss: 0.0668 - val_accuracy: 0.5550 - val_loss: 2.1897
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 458ms/step - accuracy: 0.9547 - loss: 0.1388 - val_accuracy: 0.5750 - val_loss: 2.3984
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 452ms/step - accuracy: 0.9875 - loss: 0.0453 - val_accuracy: 0.5850 - val_loss: 2.7185
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 470ms/step - accuracy: 0.9522 - loss: 0.1185 - val_accuracy: 0.5650 - val_loss: 2.8550
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9707 - loss: 0.0789 - val_accuracy: 0.5600 - val_loss: 2.9188
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 453ms/step - accuracy: 0.9429 - loss: 0.1708 - val_accuracy: 0.5800 - val_loss: 2.5333
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 460ms/step - accuracy: 0.9541 - loss: 0.1467 - val_accuracy: 0.5650 - val_loss: 2.8877
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9750 - loss: 0.0700 - val_accuracy: 0.5700 - val_loss: 2.9475
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 453ms/step - accuracy: 0.9723 - loss: 0.0933 - val_accuracy: 0.5550 - val_loss: 2.5764
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 451ms/step - accuracy: 0.9811 - loss: 0.0727 - val_accuracy: 0.5650 - val_loss: 2.3499
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9667 - loss: 0.0938 - val_accuracy: 0.5650 - val_loss: 3.0872
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 436ms/step - accuracy: 0.9589 - loss: 0.1414 - val_accuracy: 0.5950 - val_loss: 3.2135
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 445ms/step - accuracy: 0.9679 - loss: 0.1062 - val_accuracy: 0.5700 - val_loss: 2.9951
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 451ms/step - accuracy: 0.9856 - loss: 0.0488 - val_accuracy: 0.5850 - val_loss: 3.3977
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 436ms/step - accuracy: 0.9446 - loss: 0.1606 - val_accuracy: 0.5650 - val_loss: 3.1326
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 476ms/step - accuracy: 0.9832 - loss: 0.0424 - val_accuracy: 0.5650 - val_loss: 2.7708
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 451ms/step - accuracy: 0.9500 - loss: 0.1129 - val_accuracy: 0.5750 - val_loss: 2.9067
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.9897 - loss: 0.0355 - val_accuracy: 0.5950 - val_loss: 2.9419
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 446ms/step - accuracy: 0.9769 - loss: 0.0644 - val_accuracy: 0.5600 - val_loss: 3.7960
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 456ms/step - accuracy: 0.9770 - loss: 0.0871 - val_accuracy: 0.5700 - val_loss: 3.1759
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 459ms/step - accuracy: 0.9854 - loss: 0.0627 - val_accuracy: 0.5700 - val_loss: 3.0052
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 459ms/step - accuracy: 0.9806 - loss: 0.0613 - val_accuracy: 0.5750 - val_loss: 3.2695
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 446ms/step - accuracy: 0.9679 - loss: 0.1012 - val_accuracy: 0.5650 - val_loss: 2.8748
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 441ms/step - accuracy: 0.9692 - loss: 0.0690 - val_accuracy: 0.6050 - val_loss: 2.5103
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 440ms/step - accuracy: 0.9825 - loss: 0.0566 - val_accuracy: 0.6000 - val_loss: 2.9525
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 21s 467ms/step - accuracy: 0.9866 - loss: 0.0416 - val_accuracy: 0.5750 - val_loss: 3.5913
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 506ms/step - accuracy: 0.9780 - loss: 0.1305 - val_accuracy: 0.5700 - val_loss: 2.7642
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 500ms/step - accuracy: 0.9718 - loss: 0.0886 - val_accuracy: 0.5750 - val_loss: 3.1585
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 458ms/step - accuracy: 0.9804 - loss: 0.0619 - val_accuracy: 0.5650 - val_loss: 2.9625
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 461ms/step - accuracy: 0.9762 - loss: 0.0649 - val_accuracy: 0.5750 - val_loss: 3.0198
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 448ms/step - accuracy: 0.9707 - loss: 0.1140 - val_accuracy: 0.5750 - val_loss: 2.7649
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 425ms/step - accuracy: 0.9731 - loss: 0.0610 - val_accuracy: 0.6200 - val_loss: 2.5508
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 441ms/step - accuracy: 0.9855 - loss: 0.0462 - val_accuracy: 0.5600 - val_loss: 3.7263
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 431ms/step - accuracy: 0.9819 - loss: 0.0629 - val_accuracy: 0.5700 - val_loss: 3.2173
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 431ms/step - accuracy: 0.9690 - loss: 0.0907 - val_accuracy: 0.5850 - val_loss: 3.3084
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 444ms/step - accuracy: 0.9616 - loss: 0.0969 - val_accuracy: 0.5950 - val_loss: 2.6866
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 462ms/step - accuracy: 0.9888 - loss: 0.0369 - val_accuracy: 0.5950 - val_loss: 2.8829
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 447ms/step - accuracy: 0.9853 - loss: 0.0488 - val_accuracy: 0.5750 - val_loss: 2.7760
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 469ms/step - accuracy: 0.9835 - loss: 0.0482 - val_accuracy: 0.5650 - val_loss: 3.7458
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 472ms/step - accuracy: 0.9735 - loss: 0.0852 - val_accuracy: 0.5800 - val_loss: 2.7073
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 484ms/step - accuracy: 0.9857 - loss: 0.0469 - val_accuracy: 0.5500 - val_loss: 3.1712
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 481ms/step - accuracy: 0.9869 - loss: 0.0471 - val_accuracy: 0.5950 - val_loss: 2.9931
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 495ms/step - accuracy: 0.9815 - loss: 0.0554 - val_accuracy: 0.5850 - val_loss: 2.8937
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 484ms/step - accuracy: 0.9905 - loss: 0.0404 - val_accuracy: 0.5650 - val_loss: 3.5348
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 474ms/step - accuracy: 0.9711 - loss: 0.1107 - val_accuracy: 0.5450 - val_loss: 2.9330
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 456ms/step - accuracy: 0.9827 - loss: 0.0638 - val_accuracy: 0.5800 - val_loss: 2.7175
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 453ms/step - accuracy: 0.9693 - loss: 0.1044 - val_accuracy: 0.5900 - val_loss: 2.5806
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 462ms/step - accuracy: 0.9912 - loss: 0.0224 - val_accuracy: 0.5650 - val_loss: 3.2506
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 459ms/step - accuracy: 0.9614 - loss: 0.1111 - val_accuracy: 0.5550 - val_loss: 3.4666
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 456ms/step - accuracy: 0.9848 - loss: 0.0526 - val_accuracy: 0.5650 - val_loss: 3.5513
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 474ms/step - accuracy: 0.9844 - loss: 0.0788 - val_accuracy: 0.5750 - val_loss: 2.8310
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 441ms/step - accuracy: 0.9880 - loss: 0.0294 - val_accuracy: 0.6150 - val_loss: 3.0327
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 463ms/step - accuracy: 0.9798 - loss: 0.0653 - val_accuracy: 0.6100 - val_loss: 2.5929
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 465ms/step - accuracy: 0.9912 - loss: 0.0427 - val_accuracy: 0.5750 - val_loss: 3.6527
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 464ms/step - accuracy: 0.9785 - loss: 0.1017 - val_accuracy: 0.5600 - val_loss: 3.2230
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9716 - loss: 0.0848 - val_accuracy: 0.5850 - val_loss: 3.4565
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 452ms/step - accuracy: 0.9892 - loss: 0.0360 - val_accuracy: 0.5800 - val_loss: 3.7426
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 486ms/step - accuracy: 0.9900 - loss: 0.0370 - val_accuracy: 0.5850 - val_loss: 3.6133
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.9752 - loss: 0.0612 - val_accuracy: 0.5850 - val_loss: 3.4285
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 476ms/step - accuracy: 0.9927 - loss: 0.0228 - val_accuracy: 0.5850 - val_loss: 3.9586
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 487ms/step - accuracy: 0.9683 - loss: 0.1098 - val_accuracy: 0.5600 - val_loss: 3.3739
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 453ms/step - accuracy: 0.9795 - loss: 0.0823 - val_accuracy: 0.5700 - val_loss: 3.5236
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 470ms/step - accuracy: 0.9853 - loss: 0.0560 - val_accuracy: 0.5550 - val_loss: 3.9693
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 507ms/step - accuracy: 0.9642 - loss: 0.1503 - val_accuracy: 0.5900 - val_loss: 3.8540
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 473ms/step - accuracy: 0.9885 - loss: 0.0555 - val_accuracy: 0.5750 - val_loss: 3.8009
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 477ms/step - accuracy: 0.9780 - loss: 0.0851 - val_accuracy: 0.6000 - val_loss: 3.0384
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 491ms/step - accuracy: 0.9875 - loss: 0.0423 - val_accuracy: 0.6050 - val_loss: 3.1324
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 472ms/step - accuracy: 0.9842 - loss: 0.0422 - val_accuracy: 0.5850 - val_loss: 3.5753
```

```
Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 509ms/step - accuracy: 0.9946 - loss: 0.0276 - val_accuracy: 0.5800 - val_loss: 4.1496
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.9832 - loss: 0.0464 - val_accuracy: 0.5450 - val_loss: 3.8821
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 500ms/step - accuracy: 0.9846 - loss: 0.0371 - val_accuracy: 0.5700 - val_loss: 4.1487
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 498ms/step - accuracy: 0.9689 - loss: 0.1025 - val_accuracy: 0.5750 - val_loss: 3.4159
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 481ms/step - accuracy: 0.9792 - loss: 0.0696 - val_accuracy: 0.5800 - val_loss: 3.8318
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 474ms/step - accuracy: 0.9868 - loss: 0.0269 - val_accuracy: 0.5700 - val_loss: 3.6744
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 456ms/step - accuracy: 0.9849 - loss: 0.0440 - val_accuracy: 0.5550 - val_loss: 3.8352
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 463ms/step - accuracy: 0.9948 - loss: 0.0249 - val_accuracy: 0.5500 - val_loss: 4.1566
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 13s 528ms/step - accuracy: 0.9784 - loss: 0.0598 - val_accuracy: 0.5800 - val_loss: 4.4257
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 20s 489ms/step - accuracy: 0.9742 - loss: 0.0952 - val_accuracy: 0.5450 - val_loss: 4.0259
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 472ms/step - accuracy: 0.9933 - loss: 0.0179 - val_accuracy: 0.5750 - val_loss: 3.7908
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.9774 - loss: 0.1114 - val_accuracy: 0.5750 - val_loss: 3.6599
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 466ms/step - accuracy: 0.9853 - loss: 0.0346 - val_accuracy: 0.5600 - val_loss: 4.2077
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 475ms/step - accuracy: 0.9845 - loss: 0.0378 - val_accuracy: 0.5700 - val_loss: 4.1975
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 477ms/step - accuracy: 0.9792 - loss: 0.0861 - val_accuracy: 0.5750 - val_loss: 4.6767
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 481ms/step - accuracy: 0.9858 - loss: 0.0325 - val_accuracy: 0.5700 - val_loss: 4.3123
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 484ms/step - accuracy: 0.9795 - loss: 0.0905 - val_accuracy: 0.5850 - val_loss: 4.3368
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 446ms/step - accuracy: 0.9910 - loss: 0.0388 - val_accuracy: 0.6150 - val_loss: 4.0462
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 452ms/step - accuracy: 0.9808 - loss: 0.0731 - val_accuracy: 0.6000 - val_loss: 3.6067
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 465ms/step - accuracy: 0.9906 - loss: 0.0207 - val_accuracy: 0.5900 - val_loss: 4.4340
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 453ms/step - accuracy: 0.9866 - loss: 0.0524 - val_accuracy: 0.5950 - val_loss: 4.0456
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 435ms/step - accuracy: 0.9843 - loss: 0.0646 - val_accuracy: 0.6100 - val_loss: 3.4074
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 434ms/step - accuracy: 0.9754 - loss: 0.0781 - val_accuracy: 0.5750 - val_loss: 3.6424
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 435ms/step - accuracy: 0.9921 - loss: 0.0286 - val_accuracy: 0.5900 - val_loss: 3.4255
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 458ms/step - accuracy: 0.9945 - loss: 0.0156 - val_accuracy: 0.6150 - val_loss: 3.5043
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 457ms/step - accuracy: 0.9765 - loss: 0.0669 - val_accuracy: 0.5900 - val_loss: 3.0471
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 441ms/step - accuracy: 0.9822 - loss: 0.0497 - val_accuracy: 0.5900 - val_loss: 3.5785
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 432ms/step - accuracy: 0.9866 - loss: 0.0376 - val_accuracy: 0.6000 - val_loss: 3.5430
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 447ms/step - accuracy: 0.9905 - loss: 0.0331 - val_accuracy: 0.5700 - val_loss: 3.9939
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 21s 459ms/step - accuracy: 0.9802 - loss: 0.0612 - val_accuracy: 0.5750 - val_loss: 4.2690
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 458ms/step - accuracy: 0.9828 - loss: 0.0629 - val_accuracy: 0.5700 - val_loss: 3.7037
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 457ms/step - accuracy: 0.9917 - loss: 0.0292 - val_accuracy: 0.6000 - val_loss: 3.6349
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 11s 457ms/step - accuracy: 0.9881 - loss: 0.0378 - val_accuracy: 0.5800 - val_loss: 3.7407
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 460ms/step - accuracy: 0.9869 - loss: 0.0346 - val_accuracy: 0.5800 - val_loss: 3.9399
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 461ms/step - accuracy: 0.9959 - loss: 0.0230 - val_accuracy: 0.5700 - val_loss: 4.6127
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 12s 467ms/step - accuracy: 0.9954 - loss: 0.0106 - val_accuracy: 0.5800 - val_loss: 4.2340
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 2385.14 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 4 worker

In [2]:
```
# Set the number of threads
number_of_worker = 4
os.environ['OMP_NUM_THREADS'] = '4'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '4'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '4'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 173ms/step - accuracy: 0.0870 - loss: 2.3293 - val_accuracy: 0.1100 - val_loss: 2.3020
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 216ms/step - accuracy: 0.0947 - loss: 2.2986 - val_accuracy: 0.1950 - val_loss: 2.2405
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 6s 225ms/step - accuracy: 0.1855 - loss: 2.2011 - val_accuracy: 0.2150 - val_loss: 2.0685
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.2282 - loss: 2.0942 - val_accuracy: 0.2550 - val_loss: 2.0424
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.2203 - loss: 2.0702 - val_accuracy: 0.2550 - val_loss: 2.0806
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 217ms/step - accuracy: 0.2572 - loss: 1.9645 - val_accuracy: 0.2900 - val_loss: 1.9782
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.3156 - loss: 1.9579 - val_accuracy: 0.3250 - val_loss: 1.8348
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.3074 - loss: 1.8452 - val_accuracy: 0.3250 - val_loss: 1.8351
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 6s 226ms/step - accuracy: 0.3443 - loss: 1.8782 - val_accuracy: 0.2900 - val_loss: 1.8884
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.3463 - loss: 1.8369 - val_accuracy: 0.3250 - val_loss: 1.8362
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 217ms/step - accuracy: 0.3712 - loss: 1.7110 - val_accuracy: 0.3650 - val_loss: 1.7915
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 220ms/step - accuracy: 0.3908 - loss: 1.6327 - val_accuracy: 0.3700 - val_loss: 1.6816
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.4393 - loss: 1.5735 - val_accuracy: 0.3700 - val_loss: 1.5917
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.4326 - loss: 1.5463 - val_accuracy: 0.4000 - val_loss: 1.5241
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 217ms/step - accuracy: 0.4399 - loss: 1.5921 - val_accuracy: 0.4650 - val_loss: 1.4620
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 220ms/step - accuracy: 0.4507 - loss: 1.4386 - val_accuracy: 0.4450 - val_loss: 1.4631
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.4912 - loss: 1.3967 - val_accuracy: 0.4400 - val_loss: 1.4481
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 217ms/step - accuracy: 0.5001 - loss: 1.3790 - val_accuracy: 0.3750 - val_loss: 2.0581
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.5079 - loss: 1.4559 - val_accuracy: 0.5000 - val_loss: 1.3329
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.5149 - loss: 1.3141 - val_accuracy: 0.5050 - val_loss: 1.3870
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.5731 - loss: 1.1841 - val_accuracy: 0.4200 - val_loss: 1.6203
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.5305 - loss: 1.2805 - val_accuracy: 0.4950 - val_loss: 1.3256
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.5929 - loss: 1.1132 - val_accuracy: 0.5200 - val_loss: 1.3397
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.5806 - loss: 1.2093 - val_accuracy: 0.4350 - val_loss: 1.6354
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.5817 - loss: 1.1601 - val_accuracy: 0.4750 - val_loss: 1.3573
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.5897 - loss: 1.1286 - val_accuracy: 0.5000 - val_loss: 1.2507
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.6270 - loss: 1.0092 - val_accuracy: 0.4900 - val_loss: 1.2686
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.6185 - loss: 1.0675 - val_accuracy: 0.4900 - val_loss: 1.2638
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.6287 - loss: 1.0181 - val_accuracy: 0.5050 - val_loss: 1.2547
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.6260 - loss: 0.9962 - val_accuracy: 0.5350 - val_loss: 1.1956
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.6691 - loss: 0.9625 - val_accuracy: 0.5700 - val_loss: 1.2107
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.6510 - loss: 0.9998 - val_accuracy: 0.5350 - val_loss: 1.2706
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.6723 - loss: 0.9011 - val_accuracy: 0.5750 - val_loss: 1.2675
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.6595 - loss: 0.9651 - val_accuracy: 0.5950 - val_loss: 1.1681
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.6944 - loss: 0.9113 - val_accuracy: 0.5800 - val_loss: 1.2224
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.7236 - loss: 0.7811 - val_accuracy: 0.5850 - val_loss: 1.2078
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.7506 - loss: 0.7508 - val_accuracy: 0.5300 - val_loss: 1.3483
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.6970 - loss: 0.7597 - val_accuracy: 0.5600 - val_loss: 1.2773
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.7253 - loss: 0.7940 - val_accuracy: 0.5750 - val_loss: 1.3194
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.7113 - loss: 0.7393 - val_accuracy: 0.6100 - val_loss: 1.2596
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.7447 - loss: 0.7134 - val_accuracy: 0.5700 - val_loss: 1.3982
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Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.7806 - loss: 0.6490 - val_accuracy: 0.5650 - val_loss: 1.2638
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 6s 223ms/step - accuracy: 0.7568 - loss: 0.6466 - val_accuracy: 0.5850 - val_loss: 1.2449
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.7851 - loss: 0.5774 - val_accuracy: 0.5750 - val_loss: 1.3505
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.7652 - loss: 0.6773 - val_accuracy: 0.6100 - val_loss: 1.4523
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.7777 - loss: 0.5810 - val_accuracy: 0.5950 - val_loss: 1.4568
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.7944 - loss: 0.5911 - val_accuracy: 0.6000 - val_loss: 1.4199
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.8184 - loss: 0.5705 - val_accuracy: 0.5950 - val_loss: 1.4033
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.8032 - loss: 0.4969 - val_accuracy: 0.5350 - val_loss: 1.5725
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.8524 - loss: 0.4568 - val_accuracy: 0.5650 - val_loss: 1.5162
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.8675 - loss: 0.4323 - val_accuracy: 0.5550 - val_loss: 1.6451
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.8801 - loss: 0.3655 - val_accuracy: 0.6250 - val_loss: 1.4862
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.8359 - loss: 0.4234 - val_accuracy: 0.6050 - val_loss: 1.5294
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.8761 - loss: 0.3410 - val_accuracy: 0.5500 - val_loss: 1.8546
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.8498 - loss: 0.4090 - val_accuracy: 0.6050 - val_loss: 1.5737
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 216ms/step - accuracy: 0.8667 - loss: 0.3876 - val_accuracy: 0.5550 - val_loss: 2.0229
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.8925 - loss: 0.3106 - val_accuracy: 0.6200 - val_loss: 1.6577
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.8861 - loss: 0.3055 - val_accuracy: 0.6050 - val_loss: 1.7928
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9239 - loss: 0.2821 - val_accuracy: 0.6300 - val_loss: 1.6734
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9099 - loss: 0.2721 - val_accuracy: 0.6400 - val_loss: 1.8624
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.8851 - loss: 0.2915 - val_accuracy: 0.6300 - val_loss: 1.7194
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.9221 - loss: 0.2401 - val_accuracy: 0.5750 - val_loss: 2.4121
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.8771 - loss: 0.4255 - val_accuracy: 0.6400 - val_loss: 1.6150
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9291 - loss: 0.2064 - val_accuracy: 0.6100 - val_loss: 2.1086
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.8845 - loss: 0.2733 - val_accuracy: 0.5550 - val_loss: 1.9794
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9221 - loss: 0.2269 - val_accuracy: 0.6400 - val_loss: 1.6637
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9380 - loss: 0.2449 - val_accuracy: 0.5950 - val_loss: 1.9453
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9244 - loss: 0.1791 - val_accuracy: 0.6150 - val_loss: 1.8998
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 218ms/step - accuracy: 0.9393 - loss: 0.1946 - val_accuracy: 0.6400 - val_loss: 2.0027
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9358 - loss: 0.1815 - val_accuracy: 0.6250 - val_loss: 2.1165
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.8922 - loss: 0.2702 - val_accuracy: 0.6250 - val_loss: 1.6935
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9485 - loss: 0.1672 - val_accuracy: 0.6050 - val_loss: 1.8513
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9588 - loss: 0.1375 - val_accuracy: 0.6150 - val_loss: 2.1926
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9385 - loss: 0.1757 - val_accuracy: 0.6100 - val_loss: 2.0779
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9415 - loss: 0.1850 - val_accuracy: 0.6000 - val_loss: 2.5533
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9361 - loss: 0.1930 - val_accuracy: 0.6200 - val_loss: 2.0268
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9443 - loss: 0.1485 - val_accuracy: 0.6150 - val_loss: 1.9755
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9376 - loss: 0.1604 - val_accuracy: 0.6000 - val_loss: 2.1409
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9639 - loss: 0.1241 - val_accuracy: 0.6350 - val_loss: 1.8937
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9295 - loss: 0.1915 - val_accuracy: 0.6250 - val_loss: 2.3712
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.9673 - loss: 0.1002 - val_accuracy: 0.6200 - val_loss: 2.1481
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.9725 - loss: 0.1002 - val_accuracy: 0.6100 - val_loss: 2.2447
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.9341 - loss: 0.1945 - val_accuracy: 0.6350 - val_loss: 2.1486
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9491 - loss: 0.1159 - val_accuracy: 0.6250 - val_loss: 2.4833
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9479 - loss: 0.1705 - val_accuracy: 0.6550 - val_loss: 2.0087
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9279 - loss: 0.2786 - val_accuracy: 0.6250 - val_loss: 1.9962
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9769 - loss: 0.0652 - val_accuracy: 0.6300 - val_loss: 2.4628
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9497 - loss: 0.1454 - val_accuracy: 0.6500 - val_loss: 2.3110
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9618 - loss: 0.1068 - val_accuracy: 0.6050 - val_loss: 2.2710
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.9721 - loss: 0.0832 - val_accuracy: 0.5950 - val_loss: 2.7386
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9349 - loss: 0.1676 - val_accuracy: 0.6250 - val_loss: 2.4609
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.9738 - loss: 0.0941 - val_accuracy: 0.6350 - val_loss: 2.3282
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9720 - loss: 0.0798 - val_accuracy: 0.6100 - val_loss: 2.5202
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9720 - loss: 0.0775 - val_accuracy: 0.6000 - val_loss: 2.6692
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9602 - loss: 0.1247 - val_accuracy: 0.6050 - val_loss: 2.3386
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9693 - loss: 0.1137 - val_accuracy: 0.5850 - val_loss: 2.4407
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9746 - loss: 0.0910 - val_accuracy: 0.6400 - val_loss: 2.2343
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9675 - loss: 0.0999 - val_accuracy: 0.6050 - val_loss: 2.4878
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.9729 - loss: 0.1077 - val_accuracy: 0.6300 - val_loss: 2.3810
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9738 - loss: 0.0803 - val_accuracy: 0.6200 - val_loss: 2.4213
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9728 - loss: 0.0843 - val_accuracy: 0.6150 - val_loss: 2.6465
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9731 - loss: 0.0868 - val_accuracy: 0.6150 - val_loss: 2.2760
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9727 - loss: 0.0999 - val_accuracy: 0.6450 - val_loss: 2.4515
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9519 - loss: 0.1494 - val_accuracy: 0.6300 - val_loss: 2.3754
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.9746 - loss: 0.0898 - val_accuracy: 0.6300 - val_loss: 2.7129
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9821 - loss: 0.0691 - val_accuracy: 0.6300 - val_loss: 2.8243
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9801 - loss: 0.0752 - val_accuracy: 0.6200 - val_loss: 2.7709
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 216ms/step - accuracy: 0.9664 - loss: 0.1235 - val_accuracy: 0.6100 - val_loss: 2.7197
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9812 - loss: 0.0641 - val_accuracy: 0.6400 - val_loss: 2.7450
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9763 - loss: 0.0770 - val_accuracy: 0.6200 - val_loss: 2.6184
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9752 - loss: 0.0604 - val_accuracy: 0.6100 - val_loss: 2.6203
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9920 - loss: 0.0344 - val_accuracy: 0.6200 - val_loss: 2.7276
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9461 - loss: 0.1494 - val_accuracy: 0.6650 - val_loss: 2.4975
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9848 - loss: 0.0547 - val_accuracy: 0.6350 - val_loss: 2.7020
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9735 - loss: 0.0877 - val_accuracy: 0.6250 - val_loss: 2.7517
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9790 - loss: 0.0701 - val_accuracy: 0.6350 - val_loss: 2.5372
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9793 - loss: 0.0651 - val_accuracy: 0.6350 - val_loss: 3.0050
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9703 - loss: 0.0804 - val_accuracy: 0.6500 - val_loss: 2.2230
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9836 - loss: 0.0570 - val_accuracy: 0.6300 - val_loss: 2.7662
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 216ms/step - accuracy: 0.9821 - loss: 0.0468 - val_accuracy: 0.6450 - val_loss: 2.6975
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9702 - loss: 0.0829 - val_accuracy: 0.6350 - val_loss: 2.5993
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9644 - loss: 0.1291 - val_accuracy: 0.6450 - val_loss: 2.7768
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9766 - loss: 0.0689 - val_accuracy: 0.6200 - val_loss: 2.8439
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9886 - loss: 0.0279 - val_accuracy: 0.6100 - val_loss: 3.0244
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9813 - loss: 0.0663 - val_accuracy: 0.6500 - val_loss: 3.1208
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.9855 - loss: 0.0411 - val_accuracy: 0.6500 - val_loss: 2.7819
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9888 - loss: 0.0385 - val_accuracy: 0.6600 - val_loss: 3.1580
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9817 - loss: 0.0764 - val_accuracy: 0.6650 - val_loss: 2.7910
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9767 - loss: 0.0670 - val_accuracy: 0.6450 - val_loss: 3.1073
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9796 - loss: 0.0653 - val_accuracy: 0.6350 - val_loss: 2.9026
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9897 - loss: 0.0606 - val_accuracy: 0.5650 - val_loss: 4.0656
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9431 - loss: 0.2323 - val_accuracy: 0.6550 - val_loss: 2.6973
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 6s 220ms/step - accuracy: 0.9872 - loss: 0.0522 - val_accuracy: 0.6400 - val_loss: 2.6923
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9980 - loss: 0.0147 - val_accuracy: 0.6550 - val_loss: 2.8682
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9789 - loss: 0.0659 - val_accuracy: 0.6550 - val_loss: 2.9029
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9781 - loss: 0.0519 - val_accuracy: 0.6450 - val_loss: 3.3952
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9841 - loss: 0.0550 - val_accuracy: 0.6950 - val_loss: 2.4342
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9835 - loss: 0.0416 - val_accuracy: 0.5950 - val_loss: 3.0843
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9796 - loss: 0.0624 - val_accuracy: 0.6200 - val_loss: 3.3547
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9814 - loss: 0.0590 - val_accuracy: 0.6500 - val_loss: 2.9060
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9790 - loss: 0.0728 - val_accuracy: 0.6400 - val_loss: 3.7736
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 218ms/step - accuracy: 0.9811 - loss: 0.0637 - val_accuracy: 0.6450 - val_loss: 3.2781
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9746 - loss: 0.0844 - val_accuracy: 0.6050 - val_loss: 3.2517
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9946 - loss: 0.0231 - val_accuracy: 0.6300 - val_loss: 3.2410
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9646 - loss: 0.1369 - val_accuracy: 0.6450 - val_loss: 3.3306
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9848 - loss: 0.0446 - val_accuracy: 0.6400 - val_loss: 2.9006
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9890 - loss: 0.0328 - val_accuracy: 0.6350 - val_loss: 3.0408
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9745 - loss: 0.0681 - val_accuracy: 0.6250 - val_loss: 2.8711
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9827 - loss: 0.0773 - val_accuracy: 0.6700 - val_loss: 3.0453
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9862 - loss: 0.0550 - val_accuracy: 0.6600 - val_loss: 2.8548
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9790 - loss: 0.0703 - val_accuracy: 0.6650 - val_loss: 2.9448
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9811 - loss: 0.0715 - val_accuracy: 0.6550 - val_loss: 3.0744
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9831 - loss: 0.0430 - val_accuracy: 0.6500 - val_loss: 3.1276
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9720 - loss: 0.0975 - val_accuracy: 0.6400 - val_loss: 2.9376
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9923 - loss: 0.0249 - val_accuracy: 0.6200 - val_loss: 3.2989
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9571 - loss: 0.0950 - val_accuracy: 0.6300 - val_loss: 3.2689
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9922 - loss: 0.0247 - val_accuracy: 0.6300 - val_loss: 3.2124
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9918 - loss: 0.0198 - val_accuracy: 0.6200 - val_loss: 3.5101
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9756 - loss: 0.0976 - val_accuracy: 0.6450 - val_loss: 3.0890
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9899 - loss: 0.0320 - val_accuracy: 0.5250 - val_loss: 4.3071
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9500 - loss: 0.1923 - val_accuracy: 0.6150 - val_loss: 2.8679
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9766 - loss: 0.0628 - val_accuracy: 0.6350 - val_loss: 2.5324
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.9859 - loss: 0.0392 - val_accuracy: 0.6400 - val_loss: 2.7800
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.9729 - loss: 0.0914 - val_accuracy: 0.6250 - val_loss: 3.1907
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Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9707 - loss: 0.0861 - val_accuracy: 0.6700 - val_loss: 3.0659
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9804 - loss: 0.0650 - val_accuracy: 0.6550 - val_loss: 2.8892
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9777 - loss: 0.0900 - val_accuracy: 0.6450 - val_loss: 3.1240
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9789 - loss: 0.0641 - val_accuracy: 0.6600 - val_loss: 2.8889
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9611 - loss: 0.1326 - val_accuracy: 0.6800 - val_loss: 2.6419
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9922 - loss: 0.0444 - val_accuracy: 0.6250 - val_loss: 3.5239
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 6s 224ms/step - accuracy: 0.9777 - loss: 0.0627 - val_accuracy: 0.6350 - val_loss: 3.0843
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.9845 - loss: 0.0833 - val_accuracy: 0.6400 - val_loss: 3.2503
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9847 - loss: 0.0406 - val_accuracy: 0.6300 - val_loss: 3.2927
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 205ms/step - accuracy: 0.9957 - loss: 0.0156 - val_accuracy: 0.6350 - val_loss: 3.5053
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9836 - loss: 0.0420 - val_accuracy: 0.5950 - val_loss: 3.7164
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9834 - loss: 0.0705 - val_accuracy: 0.6450 - val_loss: 3.0541
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9733 - loss: 0.0997 - val_accuracy: 0.6600 - val_loss: 3.0176
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9859 - loss: 0.0259 - val_accuracy: 0.6150 - val_loss: 3.4758
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9645 - loss: 0.1496 - val_accuracy: 0.6200 - val_loss: 3.6725
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 203ms/step - accuracy: 0.9876 - loss: 0.0493 - val_accuracy: 0.6200 - val_loss: 3.2856
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9886 - loss: 0.0565 - val_accuracy: 0.6250 - val_loss: 3.9449
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9770 - loss: 0.0616 - val_accuracy: 0.6200 - val_loss: 3.2310
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 213ms/step - accuracy: 0.9864 - loss: 0.0475 - val_accuracy: 0.6450 - val_loss: 3.0371
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 6s 228ms/step - accuracy: 0.9862 - loss: 0.0486 - val_accuracy: 0.6350 - val_loss: 3.6485
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9795 - loss: 0.0680 - val_accuracy: 0.6100 - val_loss: 3.3821
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.9834 - loss: 0.0764 - val_accuracy: 0.6450 - val_loss: 3.2714
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9888 - loss: 0.0797 - val_accuracy: 0.6800 - val_loss: 3.0651
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 198ms/step - accuracy: 0.9895 - loss: 0.0452 - val_accuracy: 0.6000 - val_loss: 3.8176
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9764 - loss: 0.0732 - val_accuracy: 0.6300 - val_loss: 3.2673
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 208ms/step - accuracy: 0.9867 - loss: 0.0555 - val_accuracy: 0.6400 - val_loss: 3.1765
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9903 - loss: 0.0231 - val_accuracy: 0.6750 - val_loss: 3.3168
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.9844 - loss: 0.0556 - val_accuracy: 0.6400 - val_loss: 2.8865
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9779 - loss: 0.0447 - val_accuracy: 0.6750 - val_loss: 3.1290
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 210ms/step - accuracy: 0.9906 - loss: 0.0313 - val_accuracy: 0.5900 - val_loss: 3.4275
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 206ms/step - accuracy: 0.9902 - loss: 0.0367 - val_accuracy: 0.6250 - val_loss: 3.2306
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 215ms/step - accuracy: 0.9877 - loss: 0.0718 - val_accuracy: 0.5900 - val_loss: 3.6389
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 211ms/step - accuracy: 0.9846 - loss: 0.0554 - val_accuracy: 0.6650 - val_loss: 3.2400
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 209ms/step - accuracy: 0.9880 - loss: 0.0415 - val_accuracy: 0.6450 - val_loss: 3.2804
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.9821 - loss: 0.0445 - val_accuracy: 0.6550 - val_loss: 3.3964
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 212ms/step - accuracy: 0.9776 - loss: 0.0669 - val_accuracy: 0.6150 - val_loss: 3.7908
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 1036.82 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 5 worker

In [2]:
```
# Set the number of threads
number_of_worker = 5
os.environ['OMP_NUM_THREADS'] = '5'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '5'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '5'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 153ms/step - accuracy: 0.0947 - loss: 2.3395 - val_accuracy: 0.1800 - val_loss: 2.2968
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.1267 - loss: 2.2874 - val_accuracy: 0.2250 - val_loss: 2.2684
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.1525 - loss: 2.2579 - val_accuracy: 0.1450 - val_loss: 2.2890
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.1746 - loss: 2.2096 - val_accuracy: 0.1300 - val_loss: 2.3036
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.2015 - loss: 2.1897 - val_accuracy: 0.2700 - val_loss: 1.9919
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.2600 - loss: 2.0449 - val_accuracy: 0.3150 - val_loss: 1.9102
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.2192 - loss: 2.1385 - val_accuracy: 0.3200 - val_loss: 1.9702
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.2778 - loss: 1.9687 - val_accuracy: 0.2950 - val_loss: 2.0048
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.2959 - loss: 1.9138 - val_accuracy: 0.3400 - val_loss: 1.8138
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.3270 - loss: 1.8565 - val_accuracy: 0.3700 - val_loss: 1.8105
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.3472 - loss: 1.7873 - val_accuracy: 0.2900 - val_loss: 1.9588
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.3980 - loss: 1.6698 - val_accuracy: 0.4450 - val_loss: 1.6245
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.4249 - loss: 1.6145 - val_accuracy: 0.4050 - val_loss: 1.6579
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.3869 - loss: 1.6297 - val_accuracy: 0.4300 - val_loss: 1.5762
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.3926 - loss: 1.6391 - val_accuracy: 0.4050 - val_loss: 1.6126
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.4444 - loss: 1.5492 - val_accuracy: 0.4450 - val_loss: 1.4956
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.3875 - loss: 1.6314 - val_accuracy: 0.4400 - val_loss: 1.5098
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.4552 - loss: 1.4967 - val_accuracy: 0.4350 - val_loss: 1.5309
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.4820 - loss: 1.3829 - val_accuracy: 0.4600 - val_loss: 1.4706
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.4636 - loss: 1.4114 - val_accuracy: 0.4750 - val_loss: 1.4325
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.5140 - loss: 1.3883 - val_accuracy: 0.4900 - val_loss: 1.4102
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 185ms/step - accuracy: 0.5524 - loss: 1.2626 - val_accuracy: 0.4800 - val_loss: 1.4580
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.5119 - loss: 1.3195 - val_accuracy: 0.5000 - val_loss: 1.3673
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.5571 - loss: 1.2439 - val_accuracy: 0.4900 - val_loss: 1.3707
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.5772 - loss: 1.1844 - val_accuracy: 0.5100 - val_loss: 1.3961
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.5738 - loss: 1.1956 - val_accuracy: 0.5150 - val_loss: 1.3461
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.5962 - loss: 1.1263 - val_accuracy: 0.5350 - val_loss: 1.3342
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.5756 - loss: 1.1709 - val_accuracy: 0.5850 - val_loss: 1.2785
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.6157 - loss: 1.0428 - val_accuracy: 0.5050 - val_loss: 1.3166
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.5870 - loss: 1.1603 - val_accuracy: 0.5200 - val_loss: 1.3354
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.5897 - loss: 1.0747 - val_accuracy: 0.5750 - val_loss: 1.3224
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.6535 - loss: 0.9584 - val_accuracy: 0.5150 - val_loss: 1.3154
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.6701 - loss: 0.9027 - val_accuracy: 0.5900 - val_loss: 1.2023
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.6354 - loss: 0.9593 - val_accuracy: 0.6050 - val_loss: 1.1918
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.6474 - loss: 0.9642 - val_accuracy: 0.5800 - val_loss: 1.2895
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.7099 - loss: 0.7981 - val_accuracy: 0.5900 - val_loss: 1.2998
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 182ms/step - accuracy: 0.6821 - loss: 0.8373 - val_accuracy: 0.5450 - val_loss: 1.3157
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 198ms/step - accuracy: 0.7395 - loss: 0.7698 - val_accuracy: 0.5550 - val_loss: 1.3241
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.7437 - loss: 0.7579 - val_accuracy: 0.5700 - val_loss: 1.3051
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.7123 - loss: 0.7496 - val_accuracy: 0.6300 - val_loss: 1.2596
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.7576 - loss: 0.6787 - val_accuracy: 0.5650 - val_loss: 1.4545
```

```
Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 204ms/step - accuracy: 0.7592 - loss: 0.7017 - val_accuracy: 0.5650 - val_loss: 1.4580
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.7450 - loss: 0.6825 - val_accuracy: 0.5950 - val_loss: 1.3154
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.8020 - loss: 0.5688 - val_accuracy: 0.5600 - val_loss: 1.3848
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.8079 - loss: 0.5317 - val_accuracy: 0.5700 - val_loss: 1.4590
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.7713 - loss: 0.6108 - val_accuracy: 0.5650 - val_loss: 1.3786
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.7668 - loss: 0.6010 - val_accuracy: 0.5900 - val_loss: 1.4130
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.8221 - loss: 0.4975 - val_accuracy: 0.5700 - val_loss: 1.4629
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.7979 - loss: 0.5379 - val_accuracy: 0.5650 - val_loss: 1.4927
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.8335 - loss: 0.4722 - val_accuracy: 0.6000 - val_loss: 1.5870
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.8321 - loss: 0.4891 - val_accuracy: 0.5650 - val_loss: 1.8292
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.8426 - loss: 0.4643 - val_accuracy: 0.6250 - val_loss: 1.5597
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.8810 - loss: 0.3997 - val_accuracy: 0.5900 - val_loss: 1.5873
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.8325 - loss: 0.4602 - val_accuracy: 0.6000 - val_loss: 1.7301
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.8486 - loss: 0.4165 - val_accuracy: 0.5950 - val_loss: 1.6603
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.8677 - loss: 0.3930 - val_accuracy: 0.6050 - val_loss: 1.5699
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.8873 - loss: 0.3440 - val_accuracy: 0.6050 - val_loss: 1.5525
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.8883 - loss: 0.3339 - val_accuracy: 0.5850 - val_loss: 1.8909
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 185ms/step - accuracy: 0.8920 - loss: 0.2942 - val_accuracy: 0.5700 - val_loss: 1.7802
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9011 - loss: 0.3193 - val_accuracy: 0.5950 - val_loss: 2.0626
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.8948 - loss: 0.3518 - val_accuracy: 0.6150 - val_loss: 1.9260
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.8986 - loss: 0.2625 - val_accuracy: 0.5950 - val_loss: 1.8665
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9059 - loss: 0.2910 - val_accuracy: 0.6100 - val_loss: 1.7793
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9151 - loss: 0.2510 - val_accuracy: 0.6300 - val_loss: 1.8918
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.9331 - loss: 0.2084 - val_accuracy: 0.5800 - val_loss: 1.9621
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9136 - loss: 0.2767 - val_accuracy: 0.6150 - val_loss: 1.8002
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9290 - loss: 0.2592 - val_accuracy: 0.6050 - val_loss: 2.0399
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.8988 - loss: 0.2698 - val_accuracy: 0.5950 - val_loss: 2.1498
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9527 - loss: 0.1518 - val_accuracy: 0.6100 - val_loss: 2.1151
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9299 - loss: 0.1859 - val_accuracy: 0.6050 - val_loss: 2.1399
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.9354 - loss: 0.1745 - val_accuracy: 0.5850 - val_loss: 2.1911
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9467 - loss: 0.1526 - val_accuracy: 0.5800 - val_loss: 2.0856
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9430 - loss: 0.1523 - val_accuracy: 0.5550 - val_loss: 2.4861
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9512 - loss: 0.1692 - val_accuracy: 0.5850 - val_loss: 2.1487
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9661 - loss: 0.1040 - val_accuracy: 0.6400 - val_loss: 2.2880
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9370 - loss: 0.1945 - val_accuracy: 0.6150 - val_loss: 2.5149
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9633 - loss: 0.2527 - val_accuracy: 0.6050 - val_loss: 2.1542
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9281 - loss: 0.2165 - val_accuracy: 0.5850 - val_loss: 2.1198
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9671 - loss: 0.1049 - val_accuracy: 0.5950 - val_loss: 2.1969
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9430 - loss: 0.1505 - val_accuracy: 0.5700 - val_loss: 2.4307
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 185ms/step - accuracy: 0.9560 - loss: 0.1293 - val_accuracy: 0.5650 - val_loss: 2.3232
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.9472 - loss: 0.1393 - val_accuracy: 0.5800 - val_loss: 2.6178
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9441 - loss: 0.1490 - val_accuracy: 0.5950 - val_loss: 2.2539
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9621 - loss: 0.1124 - val_accuracy: 0.5850 - val_loss: 2.4427
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9460 - loss: 0.1516 - val_accuracy: 0.6250 - val_loss: 2.1418
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9625 - loss: 0.1522 - val_accuracy: 0.6050 - val_loss: 2.3322
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9580 - loss: 0.1109 - val_accuracy: 0.6100 - val_loss: 2.1526
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9683 - loss: 0.1126 - val_accuracy: 0.6200 - val_loss: 2.5570
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9610 - loss: 0.1214 - val_accuracy: 0.5750 - val_loss: 2.4782
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9599 - loss: 0.1022 - val_accuracy: 0.5550 - val_loss: 2.3816
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9712 - loss: 0.1005 - val_accuracy: 0.5700 - val_loss: 2.6433
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.9472 - loss: 0.1302 - val_accuracy: 0.5750 - val_loss: 3.0499
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9653 - loss: 0.1075 - val_accuracy: 0.5850 - val_loss: 2.9033
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9574 - loss: 0.1204 - val_accuracy: 0.5850 - val_loss: 2.7043
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9684 - loss: 0.1105 - val_accuracy: 0.6000 - val_loss: 2.6137
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 185ms/step - accuracy: 0.9573 - loss: 0.1077 - val_accuracy: 0.6000 - val_loss: 2.3739
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9490 - loss: 0.1130 - val_accuracy: 0.6100 - val_loss: 2.3640
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9790 - loss: 0.0706 - val_accuracy: 0.5750 - val_loss: 3.0800
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9857 - loss: 0.0605 - val_accuracy: 0.6050 - val_loss: 2.4089
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9794 - loss: 0.0811 - val_accuracy: 0.5750 - val_loss: 2.9083
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9759 - loss: 0.0625 - val_accuracy: 0.6000 - val_loss: 3.0784
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9781 - loss: 0.0984 - val_accuracy: 0.6300 - val_loss: 2.7971
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9554 - loss: 0.1220 - val_accuracy: 0.6150 - val_loss: 2.3903
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.9743 - loss: 0.0762 - val_accuracy: 0.5700 - val_loss: 2.5217
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9893 - loss: 0.0418 - val_accuracy: 0.5900 - val_loss: 2.6067
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9804 - loss: 0.0651 - val_accuracy: 0.6000 - val_loss: 2.2410
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.9545 - loss: 0.0943 - val_accuracy: 0.5700 - val_loss: 2.6078
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9713 - loss: 0.0938 - val_accuracy: 0.5700 - val_loss: 2.6523
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9663 - loss: 0.1164 - val_accuracy: 0.6000 - val_loss: 2.6464
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9702 - loss: 0.0860 - val_accuracy: 0.5700 - val_loss: 2.7814
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9639 - loss: 0.1292 - val_accuracy: 0.6100 - val_loss: 2.4844
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9848 - loss: 0.0520 - val_accuracy: 0.6100 - val_loss: 3.0841
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9740 - loss: 0.0715 - val_accuracy: 0.5800 - val_loss: 2.8770
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9860 - loss: 0.0509 - val_accuracy: 0.6000 - val_loss: 3.2372
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9700 - loss: 0.0779 - val_accuracy: 0.5750 - val_loss: 3.0240
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9712 - loss: 0.1071 - val_accuracy: 0.5850 - val_loss: 2.9968
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9741 - loss: 0.0612 - val_accuracy: 0.6000 - val_loss: 3.3724
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9812 - loss: 0.0701 - val_accuracy: 0.6150 - val_loss: 2.8990
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9770 - loss: 0.0852 - val_accuracy: 0.5900 - val_loss: 2.3540
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9712 - loss: 0.0952 - val_accuracy: 0.6200 - val_loss: 2.4252
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9906 - loss: 0.0291 - val_accuracy: 0.5500 - val_loss: 3.8702
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9757 - loss: 0.0829 - val_accuracy: 0.6100 - val_loss: 3.0957
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9720 - loss: 0.0825 - val_accuracy: 0.5850 - val_loss: 3.0245
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.9676 - loss: 0.1079 - val_accuracy: 0.5900 - val_loss: 3.5802
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9640 - loss: 0.1216 - val_accuracy: 0.5550 - val_loss: 2.6271
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9681 - loss: 0.1053 - val_accuracy: 0.5950 - val_loss: 3.2023
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9804 - loss: 0.0468 - val_accuracy: 0.5600 - val_loss: 2.7726
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9893 - loss: 0.0385 - val_accuracy: 0.5950 - val_loss: 3.2134
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9809 - loss: 0.0590 - val_accuracy: 0.5950 - val_loss: 2.9174
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9780 - loss: 0.0603 - val_accuracy: 0.5900 - val_loss: 2.7604
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9894 - loss: 0.0479 - val_accuracy: 0.5800 - val_loss: 3.1874
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9859 - loss: 0.0606 - val_accuracy: 0.5750 - val_loss: 3.1136
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9753 - loss: 0.0876 - val_accuracy: 0.6050 - val_loss: 2.9528
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9896 - loss: 0.0464 - val_accuracy: 0.5900 - val_loss: 3.2710
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9720 - loss: 0.1045 - val_accuracy: 0.5950 - val_loss: 2.7128
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9933 - loss: 0.0282 - val_accuracy: 0.6050 - val_loss: 3.0566
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9833 - loss: 0.0745 - val_accuracy: 0.5650 - val_loss: 3.8128
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9689 - loss: 0.0789 - val_accuracy: 0.6200 - val_loss: 2.9367
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9794 - loss: 0.0616 - val_accuracy: 0.5650 - val_loss: 2.7952
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 201ms/step - accuracy: 0.9961 - loss: 0.0180 - val_accuracy: 0.5850 - val_loss: 3.2651
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9910 - loss: 0.0361 - val_accuracy: 0.5300 - val_loss: 3.2572
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9853 - loss: 0.0725 - val_accuracy: 0.5800 - val_loss: 2.8074
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9817 - loss: 0.0475 - val_accuracy: 0.5700 - val_loss: 3.0449
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9891 - loss: 0.0474 - val_accuracy: 0.5900 - val_loss: 3.5814
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.9811 - loss: 0.0532 - val_accuracy: 0.5900 - val_loss: 3.5755
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.9628 - loss: 0.1155 - val_accuracy: 0.5650 - val_loss: 3.1388
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 198ms/step - accuracy: 0.9839 - loss: 0.0366 - val_accuracy: 0.6000 - val_loss: 3.2828
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.9905 - loss: 0.0346 - val_accuracy: 0.5800 - val_loss: 2.7950
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9843 - loss: 0.0378 - val_accuracy: 0.5900 - val_loss: 3.3712
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9826 - loss: 0.0814 - val_accuracy: 0.5600 - val_loss: 3.1906
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9868 - loss: 0.0411 - val_accuracy: 0.6100 - val_loss: 3.3522
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9826 - loss: 0.0764 - val_accuracy: 0.5850 - val_loss: 3.1451
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9711 - loss: 0.0864 - val_accuracy: 0.5700 - val_loss: 3.3927
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9854 - loss: 0.0434 - val_accuracy: 0.5650 - val_loss: 3.5499
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9890 - loss: 0.0358 - val_accuracy: 0.5900 - val_loss: 3.3332
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.9874 - loss: 0.0431 - val_accuracy: 0.5850 - val_loss: 3.6944
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9905 - loss: 0.0310 - val_accuracy: 0.5700 - val_loss: 3.6082
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9814 - loss: 0.0555 - val_accuracy: 0.5950 - val_loss: 3.4962
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9585 - loss: 0.0979 - val_accuracy: 0.6000 - val_loss: 3.2705
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9963 - loss: 0.0190 - val_accuracy: 0.5800 - val_loss: 3.3270
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9895 - loss: 0.0377 - val_accuracy: 0.5650 - val_loss: 2.9575
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9772 - loss: 0.0976 - val_accuracy: 0.5950 - val_loss: 3.2801
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9748 - loss: 0.0613 - val_accuracy: 0.5600 - val_loss: 2.9793
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9830 - loss: 0.0523 - val_accuracy: 0.6050 - val_loss: 3.0790
```

```
Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9915 - loss: 0.0286 - val_accuracy: 0.6050 - val_loss: 3.7859
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 186ms/step - accuracy: 0.9891 - loss: 0.0436 - val_accuracy: 0.5500 - val_loss: 3.0983
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 207ms/step - accuracy: 0.9789 - loss: 0.0917 - val_accuracy: 0.5500 - val_loss: 3.3727
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 197ms/step - accuracy: 0.9814 - loss: 0.0524 - val_accuracy: 0.5650 - val_loss: 3.5163
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 191ms/step - accuracy: 0.9922 - loss: 0.0449 - val_accuracy: 0.5700 - val_loss: 3.3930
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9858 - loss: 0.0606 - val_accuracy: 0.5400 - val_loss: 3.3500
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 187ms/step - accuracy: 0.9942 - loss: 0.0179 - val_accuracy: 0.5700 - val_loss: 3.6854
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 202ms/step - accuracy: 0.9836 - loss: 0.0725 - val_accuracy: 0.6050 - val_loss: 3.5931
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9918 - loss: 0.0542 - val_accuracy: 0.5700 - val_loss: 3.5743
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9908 - loss: 0.0405 - val_accuracy: 0.5850 - val_loss: 3.6747
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9892 - loss: 0.0261 - val_accuracy: 0.6050 - val_loss: 3.7958
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9804 - loss: 0.0539 - val_accuracy: 0.5300 - val_loss: 3.9636
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9904 - loss: 0.0310 - val_accuracy: 0.6100 - val_loss: 3.5858
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9821 - loss: 0.0586 - val_accuracy: 0.6000 - val_loss: 3.3208
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9860 - loss: 0.0452 - val_accuracy: 0.5850 - val_loss: 3.4362
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9893 - loss: 0.0315 - val_accuracy: 0.6050 - val_loss: 3.4990
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9871 - loss: 0.0347 - val_accuracy: 0.5950 - val_loss: 3.3163
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 188ms/step - accuracy: 0.9882 - loss: 0.0513 - val_accuracy: 0.5800 - val_loss: 3.4056
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 185ms/step - accuracy: 0.9828 - loss: 0.0370 - val_accuracy: 0.5450 - val_loss: 3.7495
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9824 - loss: 0.0682 - val_accuracy: 0.6000 - val_loss: 3.6786
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9805 - loss: 0.0477 - val_accuracy: 0.5550 - val_loss: 3.7180
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 199ms/step - accuracy: 0.9865 - loss: 0.0487 - val_accuracy: 0.5350 - val_loss: 3.4560
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 200ms/step - accuracy: 0.9870 - loss: 0.0400 - val_accuracy: 0.5700 - val_loss: 3.4295
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9863 - loss: 0.0447 - val_accuracy: 0.5650 - val_loss: 3.5240
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 195ms/step - accuracy: 0.9796 - loss: 0.0755 - val_accuracy: 0.5950 - val_loss: 3.6435
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9626 - loss: 0.1290 - val_accuracy: 0.5600 - val_loss: 3.2255
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9832 - loss: 0.0353 - val_accuracy: 0.5250 - val_loss: 3.6364
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9832 - loss: 0.0420 - val_accuracy: 0.5600 - val_loss: 3.4615
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9907 - loss: 0.0301 - val_accuracy: 0.5600 - val_loss: 4.0156
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 194ms/step - accuracy: 0.9744 - loss: 0.0831 - val_accuracy: 0.5800 - val_loss: 3.4824
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9933 - loss: 0.0319 - val_accuracy: 0.5500 - val_loss: 4.6713
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 196ms/step - accuracy: 0.9767 - loss: 0.1003 - val_accuracy: 0.5400 - val_loss: 5.9740
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 193ms/step - accuracy: 0.9628 - loss: 0.2369 - val_accuracy: 0.5600 - val_loss: 3.9092
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 192ms/step - accuracy: 0.9807 - loss: 0.0682 - val_accuracy: 0.5750 - val_loss: 4.1215
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 190ms/step - accuracy: 0.9963 - loss: 0.0230 - val_accuracy: 0.5950 - val_loss: 3.8465
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 189ms/step - accuracy: 0.9853 - loss: 0.0466 - val_accuracy: 0.5800 - val_loss: 3.8862
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 967.01 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 6 worker

In [2]:
```
# Set the number of threads
number_of_worker = 6
os.environ['OMP_NUM_THREADS'] = '6'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '6'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '6'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 157ms/step - accuracy: 0.0890 - loss: 2.3322 - val_accuracy: 0.1000 - val_loss: 2.3011
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.1340 - loss: 2.3001 - val_accuracy: 0.1550 - val_loss: 2.2372
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.1880 - loss: 2.2027 - val_accuracy: 0.2400 - val_loss: 2.0769
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 160ms/step - accuracy: 0.2299 - loss: 2.1084 - val_accuracy: 0.2600 - val_loss: 2.0161
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.2161 - loss: 2.0444 - val_accuracy: 0.2450 - val_loss: 1.9046
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 160ms/step - accuracy: 0.2236 - loss: 2.0755 - val_accuracy: 0.2700 - val_loss: 1.9300
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.2998 - loss: 1.9565 - val_accuracy: 0.2900 - val_loss: 1.9200
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 163ms/step - accuracy: 0.2854 - loss: 1.9678 - val_accuracy: 0.2200 - val_loss: 2.0452
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 161ms/step - accuracy: 0.3138 - loss: 1.9735 - val_accuracy: 0.3500 - val_loss: 1.8268
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.3174 - loss: 1.8635 - val_accuracy: 0.3950 - val_loss: 1.7900
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.3454 - loss: 1.8097 - val_accuracy: 0.4200 - val_loss: 1.6308
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.3527 - loss: 1.7176 - val_accuracy: 0.4450 - val_loss: 1.5843
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 164ms/step - accuracy: 0.3828 - loss: 1.6564 - val_accuracy: 0.4500 - val_loss: 1.5476
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.3882 - loss: 1.6838 - val_accuracy: 0.4000 - val_loss: 1.6897
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.3887 - loss: 1.6812 - val_accuracy: 0.4350 - val_loss: 1.5513
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.4168 - loss: 1.6188 - val_accuracy: 0.3950 - val_loss: 1.5964
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 164ms/step - accuracy: 0.3895 - loss: 1.6571 - val_accuracy: 0.4650 - val_loss: 1.5162
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.4429 - loss: 1.5384 - val_accuracy: 0.5150 - val_loss: 1.4634
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.4582 - loss: 1.4640 - val_accuracy: 0.4400 - val_loss: 1.4517
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.4804 - loss: 1.4429 - val_accuracy: 0.4650 - val_loss: 1.4854
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.4517 - loss: 1.4612 - val_accuracy: 0.5150 - val_loss: 1.4165
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.4987 - loss: 1.3627 - val_accuracy: 0.4500 - val_loss: 1.4091
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.4607 - loss: 1.4274 - val_accuracy: 0.5600 - val_loss: 1.2584
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 163ms/step - accuracy: 0.5193 - loss: 1.3213 - val_accuracy: 0.5650 - val_loss: 1.2483
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 163ms/step - accuracy: 0.4835 - loss: 1.3475 - val_accuracy: 0.5500 - val_loss: 1.2676
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.5028 - loss: 1.3596 - val_accuracy: 0.5300 - val_loss: 1.2933
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.5224 - loss: 1.3174 - val_accuracy: 0.5300 - val_loss: 1.2774
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.5612 - loss: 1.2203 - val_accuracy: 0.5550 - val_loss: 1.2307
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.5548 - loss: 1.1674 - val_accuracy: 0.5950 - val_loss: 1.2334
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.5841 - loss: 1.1709 - val_accuracy: 0.5500 - val_loss: 1.1717
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.6043 - loss: 1.0935 - val_accuracy: 0.5400 - val_loss: 1.2270
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.5900 - loss: 1.1565 - val_accuracy: 0.6050 - val_loss: 1.1707
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.6057 - loss: 1.0924 - val_accuracy: 0.5700 - val_loss: 1.1845
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.6117 - loss: 1.0508 - val_accuracy: 0.5650 - val_loss: 1.2611
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.6288 - loss: 1.0134 - val_accuracy: 0.6050 - val_loss: 1.1702
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.6574 - loss: 1.0158 - val_accuracy: 0.5050 - val_loss: 1.3790
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.6466 - loss: 0.9846 - val_accuracy: 0.4950 - val_loss: 1.3185
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.6530 - loss: 0.9448 - val_accuracy: 0.6300 - val_loss: 1.1059
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.6636 - loss: 0.9406 - val_accuracy: 0.5450 - val_loss: 1.3051
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.7135 - loss: 0.7819 - val_accuracy: 0.5100 - val_loss: 1.4909
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.6594 - loss: 0.9155 - val_accuracy: 0.6400 - val_loss: 1.0680
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Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.7064 - loss: 0.8548 - val_accuracy: 0.6250 - val_loss: 1.1288
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.7434 - loss: 0.7080 - val_accuracy: 0.6400 - val_loss: 1.0650
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.7365 - loss: 0.7392 - val_accuracy: 0.6400 - val_loss: 1.2224
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.7206 - loss: 0.7465 - val_accuracy: 0.6050 - val_loss: 1.1413
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.7372 - loss: 0.7719 - val_accuracy: 0.6600 - val_loss: 1.0741
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.7668 - loss: 0.6776 - val_accuracy: 0.6050 - val_loss: 1.2668
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.7406 - loss: 0.6342 - val_accuracy: 0.6450 - val_loss: 1.0855
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.7495 - loss: 0.6687 - val_accuracy: 0.6200 - val_loss: 1.1426
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.7787 - loss: 0.5902 - val_accuracy: 0.5900 - val_loss: 1.3110
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.7930 - loss: 0.6049 - val_accuracy: 0.6400 - val_loss: 1.2216
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.8118 - loss: 0.5545 - val_accuracy: 0.6900 - val_loss: 1.1773
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.7822 - loss: 0.5856 - val_accuracy: 0.6450 - val_loss: 1.1829
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.7902 - loss: 0.5876 - val_accuracy: 0.6500 - val_loss: 1.1793
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.7871 - loss: 0.5644 - val_accuracy: 0.5750 - val_loss: 1.3634
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.8249 - loss: 0.4743 - val_accuracy: 0.6400 - val_loss: 1.3440
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.7946 - loss: 0.5888 - val_accuracy: 0.6550 - val_loss: 1.2579
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.8377 - loss: 0.4342 - val_accuracy: 0.6600 - val_loss: 1.2937
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.8479 - loss: 0.4293 - val_accuracy: 0.6600 - val_loss: 1.2260
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.8441 - loss: 0.4288 - val_accuracy: 0.6800 - val_loss: 1.1514
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.8759 - loss: 0.3626 - val_accuracy: 0.6300 - val_loss: 1.5372
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.8100 - loss: 0.5374 - val_accuracy: 0.6400 - val_loss: 1.2935
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.8421 - loss: 0.4204 - val_accuracy: 0.6200 - val_loss: 1.5336
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.8930 - loss: 0.2955 - val_accuracy: 0.6700 - val_loss: 1.3578
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.8889 - loss: 0.3113 - val_accuracy: 0.6150 - val_loss: 1.3991
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.8777 - loss: 0.3702 - val_accuracy: 0.6750 - val_loss: 1.3092
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.8840 - loss: 0.3203 - val_accuracy: 0.6650 - val_loss: 1.3457
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.8963 - loss: 0.2672 - val_accuracy: 0.6700 - val_loss: 1.3466
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.8528 - loss: 0.4241 - val_accuracy: 0.6050 - val_loss: 1.6286
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9103 - loss: 0.2695 - val_accuracy: 0.6650 - val_loss: 1.4309
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9254 - loss: 0.2268 - val_accuracy: 0.6350 - val_loss: 1.4934
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9097 - loss: 0.2662 - val_accuracy: 0.6550 - val_loss: 1.5303
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.8869 - loss: 0.2817 - val_accuracy: 0.6650 - val_loss: 1.4049
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9100 - loss: 0.2291 - val_accuracy: 0.6550 - val_loss: 1.3215
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9192 - loss: 0.2422 - val_accuracy: 0.6750 - val_loss: 1.2551
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.9105 - loss: 0.2636 - val_accuracy: 0.6300 - val_loss: 1.5186
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.9350 - loss: 0.1721 - val_accuracy: 0.5850 - val_loss: 1.7975
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9183 - loss: 0.2491 - val_accuracy: 0.6500 - val_loss: 1.4510
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 159ms/step - accuracy: 0.9141 - loss: 0.2119 - val_accuracy: 0.6500 - val_loss: 1.5305
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9163 - loss: 0.2393 - val_accuracy: 0.6850 - val_loss: 1.3357
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 159ms/step - accuracy: 0.9439 - loss: 0.1721 - val_accuracy: 0.6800 - val_loss: 1.5198
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.9051 - loss: 0.2558 - val_accuracy: 0.6450 - val_loss: 1.4418
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9331 - loss: 0.1749 - val_accuracy: 0.6750 - val_loss: 1.4238
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9438 - loss: 0.1506 - val_accuracy: 0.6850 - val_loss: 1.3142
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9479 - loss: 0.1356 - val_accuracy: 0.6800 - val_loss: 1.5173
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9248 - loss: 0.2362 - val_accuracy: 0.6600 - val_loss: 1.7096
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9312 - loss: 0.1948 - val_accuracy: 0.6550 - val_loss: 1.7363
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9397 - loss: 0.1930 - val_accuracy: 0.6350 - val_loss: 1.7357
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9558 - loss: 0.1363 - val_accuracy: 0.6750 - val_loss: 1.4225
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9226 - loss: 0.2255 - val_accuracy: 0.6750 - val_loss: 1.5259
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9393 - loss: 0.1695 - val_accuracy: 0.6550 - val_loss: 1.8268
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 161ms/step - accuracy: 0.9457 - loss: 0.1703 - val_accuracy: 0.6550 - val_loss: 1.9608
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.9414 - loss: 0.1481 - val_accuracy: 0.6550 - val_loss: 1.5784
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9607 - loss: 0.1032 - val_accuracy: 0.6550 - val_loss: 1.7475
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.9778 - loss: 0.1090 - val_accuracy: 0.6700 - val_loss: 1.4802
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9754 - loss: 0.1131 - val_accuracy: 0.6850 - val_loss: 1.4780
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9543 - loss: 0.1551 - val_accuracy: 0.4850 - val_loss: 3.1356
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 163ms/step - accuracy: 0.9005 - loss: 0.3302 - val_accuracy: 0.6600 - val_loss: 1.5196
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 164ms/step - accuracy: 0.9756 - loss: 0.0736 - val_accuracy: 0.6750 - val_loss: 1.6067
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9593 - loss: 0.1224 - val_accuracy: 0.6150 - val_loss: 2.1983
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9357 - loss: 0.2089 - val_accuracy: 0.6800 - val_loss: 1.7204
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9600 - loss: 0.1106 - val_accuracy: 0.6600 - val_loss: 2.1862
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9742 - loss: 0.1175 - val_accuracy: 0.6700 - val_loss: 1.7248
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9673 - loss: 0.1144 - val_accuracy: 0.6800 - val_loss: 1.7310
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9703 - loss: 0.0887 - val_accuracy: 0.6900 - val_loss: 1.7657
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9544 - loss: 0.1503 - val_accuracy: 0.6500 - val_loss: 1.8447
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9348 - loss: 0.1630 - val_accuracy: 0.6800 - val_loss: 1.7305
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 178ms/step - accuracy: 0.9695 - loss: 0.1021 - val_accuracy: 0.6550 - val_loss: 2.1379
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 161ms/step - accuracy: 0.9433 - loss: 0.1890 - val_accuracy: 0.6500 - val_loss: 1.6394
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.9777 - loss: 0.1011 - val_accuracy: 0.6550 - val_loss: 1.5713
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9575 - loss: 0.1313 - val_accuracy: 0.6700 - val_loss: 1.6176
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9760 - loss: 0.0796 - val_accuracy: 0.6400 - val_loss: 2.2218
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9694 - loss: 0.0870 - val_accuracy: 0.6450 - val_loss: 2.2486
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 160ms/step - accuracy: 0.9743 - loss: 0.0628 - val_accuracy: 0.5700 - val_loss: 3.4683
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9345 - loss: 0.2422 - val_accuracy: 0.6000 - val_loss: 2.5655
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9648 - loss: 0.1994 - val_accuracy: 0.6300 - val_loss: 2.0663
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9458 - loss: 0.1140 - val_accuracy: 0.6750 - val_loss: 1.9091
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9762 - loss: 0.0969 - val_accuracy: 0.7050 - val_loss: 1.7098
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9849 - loss: 0.0512 - val_accuracy: 0.6600 - val_loss: 2.0054
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9551 - loss: 0.1360 - val_accuracy: 0.6650 - val_loss: 1.9079
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9772 - loss: 0.0688 - val_accuracy: 0.6650 - val_loss: 1.8168
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9620 - loss: 0.1115 - val_accuracy: 0.6750 - val_loss: 1.8947
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 179ms/step - accuracy: 0.9783 - loss: 0.0906 - val_accuracy: 0.6550 - val_loss: 1.8924
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 163ms/step - accuracy: 0.9669 - loss: 0.1133 - val_accuracy: 0.6750 - val_loss: 1.7190
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 180ms/step - accuracy: 0.9892 - loss: 0.0311 - val_accuracy: 0.6550 - val_loss: 2.1296
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9659 - loss: 0.0754 - val_accuracy: 0.6700 - val_loss: 1.9735
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 177ms/step - accuracy: 0.9602 - loss: 0.1226 - val_accuracy: 0.6650 - val_loss: 2.0814
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9858 - loss: 0.0539 - val_accuracy: 0.6800 - val_loss: 2.1406
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9681 - loss: 0.1102 - val_accuracy: 0.6750 - val_loss: 1.9733
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9774 - loss: 0.0680 - val_accuracy: 0.6700 - val_loss: 1.7611
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9811 - loss: 0.0621 - val_accuracy: 0.6500 - val_loss: 1.8567
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9886 - loss: 0.0347 - val_accuracy: 0.6050 - val_loss: 2.9189
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9355 - loss: 0.3112 - val_accuracy: 0.6600 - val_loss: 1.9797
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9788 - loss: 0.0517 - val_accuracy: 0.6500 - val_loss: 2.3874
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9656 - loss: 0.0846 - val_accuracy: 0.6650 - val_loss: 2.0185
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9800 - loss: 0.0580 - val_accuracy: 0.6900 - val_loss: 1.9009
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 159ms/step - accuracy: 0.9758 - loss: 0.0743 - val_accuracy: 0.6350 - val_loss: 2.5351
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 161ms/step - accuracy: 0.9412 - loss: 0.1937 - val_accuracy: 0.6750 - val_loss: 2.3021
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9578 - loss: 0.0986 - val_accuracy: 0.6600 - val_loss: 2.4281
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9918 - loss: 0.0322 - val_accuracy: 0.6400 - val_loss: 2.8026
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.9650 - loss: 0.0813 - val_accuracy: 0.6900 - val_loss: 2.1600
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9815 - loss: 0.0500 - val_accuracy: 0.6800 - val_loss: 2.1603
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9883 - loss: 0.0346 - val_accuracy: 0.6850 - val_loss: 2.0507
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9832 - loss: 0.0488 - val_accuracy: 0.6600 - val_loss: 2.2622
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9690 - loss: 0.1287 - val_accuracy: 0.6600 - val_loss: 2.0851
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9703 - loss: 0.0971 - val_accuracy: 0.6600 - val_loss: 2.2161
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9647 - loss: 0.1197 - val_accuracy: 0.6900 - val_loss: 1.9852
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9848 - loss: 0.0470 - val_accuracy: 0.6800 - val_loss: 2.1950
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9646 - loss: 0.1005 - val_accuracy: 0.6750 - val_loss: 2.2800
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9792 - loss: 0.0724 - val_accuracy: 0.6750 - val_loss: 2.0512
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9825 - loss: 0.0804 - val_accuracy: 0.6900 - val_loss: 2.4662
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9782 - loss: 0.0690 - val_accuracy: 0.6450 - val_loss: 2.5868
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9741 - loss: 0.0586 - val_accuracy: 0.6700 - val_loss: 2.2021
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9772 - loss: 0.0831 - val_accuracy: 0.6850 - val_loss: 2.1732
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9813 - loss: 0.0443 - val_accuracy: 0.6250 - val_loss: 2.8519
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9704 - loss: 0.0755 - val_accuracy: 0.6450 - val_loss: 2.3332
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9592 - loss: 0.1600 - val_accuracy: 0.6850 - val_loss: 2.0250
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9815 - loss: 0.0503 - val_accuracy: 0.6800 - val_loss: 2.1698
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9784 - loss: 0.0438 - val_accuracy: 0.7050 - val_loss: 2.1671
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9854 - loss: 0.0685 - val_accuracy: 0.6750 - val_loss: 2.2213
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 175ms/step - accuracy: 0.9817 - loss: 0.0532 - val_accuracy: 0.6800 - val_loss: 2.1180
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 5s 179ms/step - accuracy: 0.9793 - loss: 0.0800 - val_accuracy: 0.6650 - val_loss: 2.0562
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9934 - loss: 0.0224 - val_accuracy: 0.6800 - val_loss: 2.3128
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9781 - loss: 0.0955 - val_accuracy: 0.6850 - val_loss: 2.1782
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Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 161ms/step - accuracy: 0.9667 - loss: 0.1743 - val_accuracy: 0.6650 - val_loss: 2.3627
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9924 - loss: 0.0248 - val_accuracy: 0.6650 - val_loss: 2.4867
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9799 - loss: 0.0824 - val_accuracy: 0.6800 - val_loss: 2.2316
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9718 - loss: 0.0875 - val_accuracy: 0.6750 - val_loss: 2.1804
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9887 - loss: 0.0427 - val_accuracy: 0.6750 - val_loss: 2.0417
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.9892 - loss: 0.0395 - val_accuracy: 0.6750 - val_loss: 2.4242
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9685 - loss: 0.1369 - val_accuracy: 0.6550 - val_loss: 2.5412
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 175ms/step - accuracy: 0.9850 - loss: 0.0492 - val_accuracy: 0.7000 - val_loss: 1.9487
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9841 - loss: 0.0448 - val_accuracy: 0.6200 - val_loss: 2.5740
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 177ms/step - accuracy: 0.9827 - loss: 0.0601 - val_accuracy: 0.6850 - val_loss: 1.9880
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9967 - loss: 0.0140 - val_accuracy: 0.6900 - val_loss: 2.1357
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9829 - loss: 0.0802 - val_accuracy: 0.6800 - val_loss: 2.0864
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.9862 - loss: 0.0423 - val_accuracy: 0.6900 - val_loss: 2.1834
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9574 - loss: 0.1224 - val_accuracy: 0.6650 - val_loss: 2.3492
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9945 - loss: 0.0241 - val_accuracy: 0.6250 - val_loss: 3.3972
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9831 - loss: 0.0915 - val_accuracy: 0.6700 - val_loss: 3.0905
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 162ms/step - accuracy: 0.9797 - loss: 0.0585 - val_accuracy: 0.6150 - val_loss: 3.0855
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 166ms/step - accuracy: 0.9878 - loss: 0.0432 - val_accuracy: 0.6750 - val_loss: 2.1840
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 173ms/step - accuracy: 0.9706 - loss: 0.1064 - val_accuracy: 0.6550 - val_loss: 2.7121
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9745 - loss: 0.0734 - val_accuracy: 0.6900 - val_loss: 2.2102
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9871 - loss: 0.0432 - val_accuracy: 0.6950 - val_loss: 2.0016
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 165ms/step - accuracy: 0.9841 - loss: 0.0458 - val_accuracy: 0.6650 - val_loss: 2.3818
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9763 - loss: 0.0931 - val_accuracy: 0.6950 - val_loss: 2.1277
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 168ms/step - accuracy: 0.9905 - loss: 0.0339 - val_accuracy: 0.6950 - val_loss: 2.1814
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 172ms/step - accuracy: 0.9924 - loss: 0.0474 - val_accuracy: 0.6600 - val_loss: 2.8345
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 169ms/step - accuracy: 0.9727 - loss: 0.0834 - val_accuracy: 0.6600 - val_loss: 2.1733
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9894 - loss: 0.0371 - val_accuracy: 0.6700 - val_loss: 2.3174
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9936 - loss: 0.0223 - val_accuracy: 0.6850 - val_loss: 2.5772
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 160ms/step - accuracy: 0.9917 - loss: 0.0226 - val_accuracy: 0.6650 - val_loss: 2.3985
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.9880 - loss: 0.0382 - val_accuracy: 0.6750 - val_loss: 2.5574
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9776 - loss: 0.1042 - val_accuracy: 0.6600 - val_loss: 2.7016
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 175ms/step - accuracy: 0.9847 - loss: 0.0479 - val_accuracy: 0.6950 - val_loss: 2.6320
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 170ms/step - accuracy: 0.9786 - loss: 0.0357 - val_accuracy: 0.6550 - val_loss: 2.3906
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 174ms/step - accuracy: 0.9901 - loss: 0.0448 - val_accuracy: 0.6600 - val_loss: 2.7241
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 167ms/step - accuracy: 0.9870 - loss: 0.0350 - val_accuracy: 0.6250 - val_loss: 2.9793
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 171ms/step - accuracy: 0.9906 - loss: 0.0226 - val_accuracy: 0.6500 - val_loss: 2.4609
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 850.77 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv

from matplotlib import figure
```

Define 7 worker

In [2]:
```
# Set the number of threads
number_of_worker = 7
os.environ['OMP_NUM_THREADS'] = '7'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '7'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '7'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 123ms/step - accuracy: 0.0818 - loss: 2.3262 - val_accuracy: 0.1050 - val_loss: 2.2680
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.1573 - loss: 2.2889 - val_accuracy: 0.2100 - val_loss: 2.0738
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 149ms/step - accuracy: 0.1911 - loss: 2.1370 - val_accuracy: 0.2250 - val_loss: 2.1721
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 145ms/step - accuracy: 0.2274 - loss: 2.1387 - val_accuracy: 0.2350 - val_loss: 2.0582
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 149ms/step - accuracy: 0.2377 - loss: 2.0395 - val_accuracy: 0.3100 - val_loss: 1.9587
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.2534 - loss: 1.9749 - val_accuracy: 0.3600 - val_loss: 2.0144
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.2613 - loss: 1.9955 - val_accuracy: 0.3100 - val_loss: 1.8442
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 149ms/step - accuracy: 0.2949 - loss: 1.8974 - val_accuracy: 0.3950 - val_loss: 1.8752
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.3669 - loss: 1.8716 - val_accuracy: 0.4100 - val_loss: 1.8567
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.3370 - loss: 1.8430 - val_accuracy: 0.4150 - val_loss: 1.7267
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.3315 - loss: 1.8672 - val_accuracy: 0.3900 - val_loss: 1.6877
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.4074 - loss: 1.7262 - val_accuracy: 0.4200 - val_loss: 1.7082
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.3605 - loss: 1.7425 - val_accuracy: 0.4300 - val_loss: 1.6156
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.3964 - loss: 1.6583 - val_accuracy: 0.4500 - val_loss: 1.5646
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.3550 - loss: 1.7073 - val_accuracy: 0.4550 - val_loss: 1.5227
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.4600 - loss: 1.5362 - val_accuracy: 0.4300 - val_loss: 1.5923
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.4731 - loss: 1.5131 - val_accuracy: 0.4800 - val_loss: 1.4602
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.4707 - loss: 1.4784 - val_accuracy: 0.4700 - val_loss: 1.4989
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 147ms/step - accuracy: 0.5048 - loss: 1.4154 - val_accuracy: 0.4900 - val_loss: 1.4474
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.5050 - loss: 1.4192 - val_accuracy: 0.4300 - val_loss: 1.5239
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.4976 - loss: 1.4264 - val_accuracy: 0.5150 - val_loss: 1.3873
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.5021 - loss: 1.3814 - val_accuracy: 0.5700 - val_loss: 1.3150
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.5420 - loss: 1.3249 - val_accuracy: 0.5050 - val_loss: 1.3644
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.5389 - loss: 1.2833 - val_accuracy: 0.5650 - val_loss: 1.2784
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.5266 - loss: 1.2446 - val_accuracy: 0.5300 - val_loss: 1.3330
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.5608 - loss: 1.2418 - val_accuracy: 0.5250 - val_loss: 1.3601
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.6144 - loss: 1.1044 - val_accuracy: 0.5150 - val_loss: 1.3303
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.5713 - loss: 1.1832 - val_accuracy: 0.5700 - val_loss: 1.2238
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.5994 - loss: 1.0920 - val_accuracy: 0.5350 - val_loss: 1.3166
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.6277 - loss: 1.0387 - val_accuracy: 0.5650 - val_loss: 1.3302
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.6816 - loss: 0.9319 - val_accuracy: 0.5200 - val_loss: 1.3509
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.6372 - loss: 1.0041 - val_accuracy: 0.5250 - val_loss: 1.3733
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.6570 - loss: 0.9495 - val_accuracy: 0.6100 - val_loss: 1.1951
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.7004 - loss: 0.8949 - val_accuracy: 0.5900 - val_loss: 1.2032
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.7214 - loss: 0.7897 - val_accuracy: 0.5300 - val_loss: 1.3989
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.6723 - loss: 0.9051 - val_accuracy: 0.5700 - val_loss: 1.3947
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.7025 - loss: 0.8452 - val_accuracy: 0.5950 - val_loss: 1.4084
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.7058 - loss: 0.8214 - val_accuracy: 0.6000 - val_loss: 1.3120
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.7523 - loss: 0.7262 - val_accuracy: 0.6000 - val_loss: 1.3909
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.7442 - loss: 0.6782 - val_accuracy: 0.6300 - val_loss: 1.2302
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.7542 - loss: 0.6868 - val_accuracy: 0.5750 - val_loss: 1.3111
```

```
Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.7372 - loss: 0.7429 - val_accuracy: 0.6000 - val_loss: 1.3485
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.7675 - loss: 0.6476 - val_accuracy: 0.5900 - val_loss: 1.5109
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.7961 - loss: 0.6001 - val_accuracy: 0.6050 - val_loss: 1.4317
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.8014 - loss: 0.5804 - val_accuracy: 0.6100 - val_loss: 1.2404
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.7928 - loss: 0.5734 - val_accuracy: 0.6250 - val_loss: 1.4807
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.8146 - loss: 0.5881 - val_accuracy: 0.6300 - val_loss: 1.3544
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.8335 - loss: 0.4861 - val_accuracy: 0.6150 - val_loss: 1.5126
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.8099 - loss: 0.5352 - val_accuracy: 0.5750 - val_loss: 1.4304
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.8612 - loss: 0.4229 - val_accuracy: 0.5750 - val_loss: 1.5456
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.8352 - loss: 0.5294 - val_accuracy: 0.5600 - val_loss: 1.8977
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.8287 - loss: 0.4984 - val_accuracy: 0.6050 - val_loss: 1.4981
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.8452 - loss: 0.4254 - val_accuracy: 0.6400 - val_loss: 1.5920
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.8350 - loss: 0.4264 - val_accuracy: 0.6150 - val_loss: 1.4441
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.9038 - loss: 0.3091 - val_accuracy: 0.6400 - val_loss: 1.4488
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.8716 - loss: 0.3435 - val_accuracy: 0.6200 - val_loss: 1.4544
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.8840 - loss: 0.3251 - val_accuracy: 0.6000 - val_loss: 1.4671
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.8853 - loss: 0.3201 - val_accuracy: 0.6200 - val_loss: 1.4904
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.8687 - loss: 0.3920 - val_accuracy: 0.5850 - val_loss: 1.6867
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.8751 - loss: 0.3240 - val_accuracy: 0.6350 - val_loss: 1.5783
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.8843 - loss: 0.3223 - val_accuracy: 0.6150 - val_loss: 1.7564
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.8901 - loss: 0.3179 - val_accuracy: 0.6050 - val_loss: 1.6935
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9084 - loss: 0.2651 - val_accuracy: 0.6450 - val_loss: 1.5367
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 159ms/step - accuracy: 0.9011 - loss: 0.2681 - val_accuracy: 0.6550 - val_loss: 1.5078
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9111 - loss: 0.2012 - val_accuracy: 0.6550 - val_loss: 1.7399
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9056 - loss: 0.2551 - val_accuracy: 0.6450 - val_loss: 1.7057
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9123 - loss: 0.2318 - val_accuracy: 0.6200 - val_loss: 1.7583
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9229 - loss: 0.2184 - val_accuracy: 0.6200 - val_loss: 1.7297
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9322 - loss: 0.1998 - val_accuracy: 0.6450 - val_loss: 1.6918
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9346 - loss: 0.1579 - val_accuracy: 0.6300 - val_loss: 1.9413
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 149ms/step - accuracy: 0.9307 - loss: 0.1901 - val_accuracy: 0.6100 - val_loss: 1.6549
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.8986 - loss: 0.2894 - val_accuracy: 0.6350 - val_loss: 1.7343
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9419 - loss: 0.1680 - val_accuracy: 0.6350 - val_loss: 1.8229
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9522 - loss: 0.1810 - val_accuracy: 0.6350 - val_loss: 1.8504
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9320 - loss: 0.2007 - val_accuracy: 0.5950 - val_loss: 1.8805
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9319 - loss: 0.1726 - val_accuracy: 0.6050 - val_loss: 2.3080
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9378 - loss: 0.1729 - val_accuracy: 0.5850 - val_loss: 2.5177
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9300 - loss: 0.2347 - val_accuracy: 0.6300 - val_loss: 1.8858
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.9570 - loss: 0.1181 - val_accuracy: 0.6500 - val_loss: 1.7856
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9564 - loss: 0.1307 - val_accuracy: 0.6600 - val_loss: 1.9016
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9573 - loss: 0.1220 - val_accuracy: 0.6350 - val_loss: 2.2473
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 147ms/step - accuracy: 0.9390 - loss: 0.1833 - val_accuracy: 0.6300 - val_loss: 1.9236
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9190 - loss: 0.2433 - val_accuracy: 0.6200 - val_loss: 1.9956
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9646 - loss: 0.0943 - val_accuracy: 0.6400 - val_loss: 1.9079
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9253 - loss: 0.2035 - val_accuracy: 0.6650 - val_loss: 1.9023
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9570 - loss: 0.1210 - val_accuracy: 0.6300 - val_loss: 2.2414
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9634 - loss: 0.1130 - val_accuracy: 0.6800 - val_loss: 1.7807
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9449 - loss: 0.1721 - val_accuracy: 0.5950 - val_loss: 2.3276
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 158ms/step - accuracy: 0.9632 - loss: 0.1476 - val_accuracy: 0.6400 - val_loss: 1.9755
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 146ms/step - accuracy: 0.9655 - loss: 0.1029 - val_accuracy: 0.6450 - val_loss: 2.1367
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 147ms/step - accuracy: 0.9527 - loss: 0.1291 - val_accuracy: 0.6400 - val_loss: 2.1940
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9660 - loss: 0.0966 - val_accuracy: 0.6100 - val_loss: 2.1825
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9590 - loss: 0.1117 - val_accuracy: 0.6500 - val_loss: 2.4047
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9492 - loss: 0.1480 - val_accuracy: 0.6200 - val_loss: 2.1937
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9725 - loss: 0.0931 - val_accuracy: 0.5950 - val_loss: 2.4867
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9345 - loss: 0.1980 - val_accuracy: 0.5950 - val_loss: 2.5017
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9536 - loss: 0.1214 - val_accuracy: 0.6600 - val_loss: 2.3244
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9634 - loss: 0.1116 - val_accuracy: 0.6050 - val_loss: 2.7636
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9595 - loss: 0.1351 - val_accuracy: 0.6100 - val_loss: 2.1780
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9683 - loss: 0.0903 - val_accuracy: 0.6450 - val_loss: 2.2073
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.9749 - loss: 0.0874 - val_accuracy: 0.6300 - val_loss: 2.6755
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.9796 - loss: 0.0895 - val_accuracy: 0.6300 - val_loss: 2.2189
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 149ms/step - accuracy: 0.9510 - loss: 0.1476 - val_accuracy: 0.5800 - val_loss: 2.4473
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.9651 - loss: 0.1142 - val_accuracy: 0.6400 - val_loss: 2.1473
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9715 - loss: 0.1023 - val_accuracy: 0.5900 - val_loss: 2.3329
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9530 - loss: 0.1820 - val_accuracy: 0.6000 - val_loss: 2.7490
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9564 - loss: 0.1376 - val_accuracy: 0.6500 - val_loss: 2.3251
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9596 - loss: 0.1519 - val_accuracy: 0.6550 - val_loss: 2.4093
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9653 - loss: 0.0969 - val_accuracy: 0.5850 - val_loss: 2.8712
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.9487 - loss: 0.1415 - val_accuracy: 0.6350 - val_loss: 2.0791
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9632 - loss: 0.1062 - val_accuracy: 0.6350 - val_loss: 2.1070
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9727 - loss: 0.0791 - val_accuracy: 0.6250 - val_loss: 2.1753
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.9769 - loss: 0.0716 - val_accuracy: 0.6500 - val_loss: 2.0458
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9788 - loss: 0.0582 - val_accuracy: 0.6400 - val_loss: 2.2886
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9330 - loss: 0.2581 - val_accuracy: 0.6450 - val_loss: 2.3485
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9665 - loss: 0.1004 - val_accuracy: 0.6450 - val_loss: 2.5679
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.9841 - loss: 0.0572 - val_accuracy: 0.6350 - val_loss: 2.4322
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9653 - loss: 0.0872 - val_accuracy: 0.6350 - val_loss: 2.3860
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9739 - loss: 0.0839 - val_accuracy: 0.6250 - val_loss: 2.6356
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 147ms/step - accuracy: 0.9751 - loss: 0.0728 - val_accuracy: 0.6400 - val_loss: 2.5431
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.9766 - loss: 0.0772 - val_accuracy: 0.6450 - val_loss: 2.2422
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9807 - loss: 0.0660 - val_accuracy: 0.6250 - val_loss: 2.4464
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9760 - loss: 0.0668 - val_accuracy: 0.6100 - val_loss: 2.8307
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9725 - loss: 0.0801 - val_accuracy: 0.6250 - val_loss: 2.3358
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9702 - loss: 0.1228 - val_accuracy: 0.6500 - val_loss: 2.3098
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9603 - loss: 0.1196 - val_accuracy: 0.6550 - val_loss: 2.4535
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9828 - loss: 0.0520 - val_accuracy: 0.6400 - val_loss: 2.5397
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9824 - loss: 0.0516 - val_accuracy: 0.6250 - val_loss: 2.7237
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9866 - loss: 0.0471 - val_accuracy: 0.6250 - val_loss: 2.4941
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9766 - loss: 0.0721 - val_accuracy: 0.6350 - val_loss: 2.6602
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9856 - loss: 0.0327 - val_accuracy: 0.6400 - val_loss: 3.0325
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9794 - loss: 0.0530 - val_accuracy: 0.6200 - val_loss: 2.9336
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9736 - loss: 0.0823 - val_accuracy: 0.6100 - val_loss: 2.8365
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9675 - loss: 0.1192 - val_accuracy: 0.6150 - val_loss: 2.5089
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9666 - loss: 0.1056 - val_accuracy: 0.6550 - val_loss: 2.5584
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9863 - loss: 0.0400 - val_accuracy: 0.6100 - val_loss: 2.6453
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.9780 - loss: 0.0677 - val_accuracy: 0.6500 - val_loss: 2.3392
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9820 - loss: 0.0461 - val_accuracy: 0.6400 - val_loss: 2.6747
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9669 - loss: 0.1188 - val_accuracy: 0.6150 - val_loss: 2.7924
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9767 - loss: 0.0923 - val_accuracy: 0.6300 - val_loss: 2.4425
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9895 - loss: 0.0273 - val_accuracy: 0.6000 - val_loss: 2.8783
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 159ms/step - accuracy: 0.9818 - loss: 0.0588 - val_accuracy: 0.6200 - val_loss: 3.2892
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9920 - loss: 0.0224 - val_accuracy: 0.6350 - val_loss: 2.8748
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9902 - loss: 0.0372 - val_accuracy: 0.6450 - val_loss: 2.9861
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 149ms/step - accuracy: 0.9819 - loss: 0.0749 - val_accuracy: 0.6250 - val_loss: 2.6517
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9738 - loss: 0.0858 - val_accuracy: 0.6450 - val_loss: 2.7020
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9814 - loss: 0.0641 - val_accuracy: 0.6250 - val_loss: 2.7762
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9870 - loss: 0.0443 - val_accuracy: 0.5850 - val_loss: 3.0334
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9825 - loss: 0.0449 - val_accuracy: 0.6450 - val_loss: 2.9334
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9744 - loss: 0.1010 - val_accuracy: 0.6250 - val_loss: 2.8921
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9817 - loss: 0.0701 - val_accuracy: 0.6300 - val_loss: 2.8880
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9804 - loss: 0.0619 - val_accuracy: 0.6450 - val_loss: 2.9605
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9932 - loss: 0.0343 - val_accuracy: 0.6550 - val_loss: 2.7758
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9638 - loss: 0.1059 - val_accuracy: 0.6250 - val_loss: 3.0840
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9836 - loss: 0.0825 - val_accuracy: 0.5850 - val_loss: 3.1181
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9827 - loss: 0.1365 - val_accuracy: 0.6250 - val_loss: 2.3661
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9843 - loss: 0.0540 - val_accuracy: 0.6200 - val_loss: 3.2481
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 157ms/step - accuracy: 0.9880 - loss: 0.0368 - val_accuracy: 0.6100 - val_loss: 2.9156
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9795 - loss: 0.0625 - val_accuracy: 0.6350 - val_loss: 2.9362
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9871 - loss: 0.0501 - val_accuracy: 0.6100 - val_loss: 2.6436
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9893 - loss: 0.0645 - val_accuracy: 0.6000 - val_loss: 3.0421
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9654 - loss: 0.0766 - val_accuracy: 0.6750 - val_loss: 2.8712
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 161ms/step - accuracy: 0.9946 - loss: 0.0277 - val_accuracy: 0.6450 - val_loss: 3.0525
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9867 - loss: 0.0390 - val_accuracy: 0.6050 - val_loss: 3.7059
```

```
Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9782 - loss: 0.0850 - val_accuracy: 0.6400 - val_loss: 3.2004
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 150ms/step - accuracy: 0.9659 - loss: 0.1274 - val_accuracy: 0.6400 - val_loss: 2.7282
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9869 - loss: 0.0290 - val_accuracy: 0.6350 - val_loss: 2.9333
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9765 - loss: 0.0736 - val_accuracy: 0.6200 - val_loss: 3.0869
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9709 - loss: 0.0626 - val_accuracy: 0.6200 - val_loss: 3.1077
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9798 - loss: 0.0398 - val_accuracy: 0.6150 - val_loss: 3.1138
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9849 - loss: 0.0470 - val_accuracy: 0.6300 - val_loss: 3.1697
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9905 - loss: 0.0274 - val_accuracy: 0.6200 - val_loss: 2.9240
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9799 - loss: 0.0688 - val_accuracy: 0.6250 - val_loss: 3.0502
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9785 - loss: 0.0580 - val_accuracy: 0.5950 - val_loss: 3.1900
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9910 - loss: 0.0383 - val_accuracy: 0.6300 - val_loss: 3.1558
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9687 - loss: 0.0718 - val_accuracy: 0.6350 - val_loss: 3.1910
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9696 - loss: 0.0787 - val_accuracy: 0.6450 - val_loss: 2.9201
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9831 - loss: 0.0540 - val_accuracy: 0.6400 - val_loss: 2.9415
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9862 - loss: 0.0781 - val_accuracy: 0.6650 - val_loss: 3.0149
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9834 - loss: 0.0509 - val_accuracy: 0.6450 - val_loss: 2.8482
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9862 - loss: 0.0647 - val_accuracy: 0.6500 - val_loss: 3.4474
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9794 - loss: 0.1101 - val_accuracy: 0.6500 - val_loss: 2.7705
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9850 - loss: 0.0286 - val_accuracy: 0.6600 - val_loss: 3.5766
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9922 - loss: 0.0405 - val_accuracy: 0.6650 - val_loss: 2.8988
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9823 - loss: 0.0602 - val_accuracy: 0.6500 - val_loss: 2.8050
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9909 - loss: 0.0293 - val_accuracy: 0.6450 - val_loss: 2.7298
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9860 - loss: 0.0411 - val_accuracy: 0.6450 - val_loss: 3.0310
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9940 - loss: 0.0242 - val_accuracy: 0.6600 - val_loss: 3.1644
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9837 - loss: 0.0473 - val_accuracy: 0.6550 - val_loss: 2.8926
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 156ms/step - accuracy: 0.9790 - loss: 0.1066 - val_accuracy: 0.6300 - val_loss: 2.9581
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9876 - loss: 0.0275 - val_accuracy: 0.6350 - val_loss: 3.0488
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9851 - loss: 0.0696 - val_accuracy: 0.6200 - val_loss: 3.1620
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 154ms/step - accuracy: 0.9921 - loss: 0.0154 - val_accuracy: 0.6500 - val_loss: 3.8708
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 153ms/step - accuracy: 0.9761 - loss: 0.1093 - val_accuracy: 0.6750 - val_loss: 2.9113
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 151ms/step - accuracy: 0.9773 - loss: 0.0973 - val_accuracy: 0.6550 - val_loss: 3.0089
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 158ms/step - accuracy: 0.9829 - loss: 0.0561 - val_accuracy: 0.6550 - val_loss: 2.9303
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 152ms/step - accuracy: 0.9827 - loss: 0.0508 - val_accuracy: 0.6300 - val_loss: 3.1155
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9807 - loss: 0.0829 - val_accuracy: 0.6350 - val_loss: 2.8135
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 155ms/step - accuracy: 0.9841 - loss: 0.0454 - val_accuracy: 0.6450 - val_loss: 3.5844
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 148ms/step - accuracy: 0.9732 - loss: 0.0892 - val_accuracy: 0.6450 - val_loss: 2.8868
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 770.62 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```

Import Req Lib

In [1]:
```
%matplotlib inline


import shutil
import random
import numpy as np
from warnings import filterwarnings
filterwarnings('ignore')

from tensorflow.keras import layers,regularizers, optimizers
from tensorflow.keras import models
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import LeakyReLU,Dense, Activation, Flatten, Dropout, BatchNormalization,Conv2D, MaxPooling2D
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import tensorflow as tf

import os
import time
import csv


from matplotlib import figure
```

Define 8 worker

In [2]:
```
# Set the number of threads
number_of_worker = 8
os.environ['OMP_NUM_THREADS'] = '8'  # OpenMP threads for parallelism
os.environ['TF_NUM_INTEROP_THREADS'] = '8'  # Threads for inter-operation parallelism
os.environ['TF_NUM_INTRAOP_THREADS'] = '8'  # Threads for intra-operation parallelism

# Confirm TensorFlow is using the specified number of threads
tf.config.threading.set_inter_op_parallelism_threads(number_of_worker)
tf.config.threading.set_intra_op_parallelism_threads(number_of_worker)
```

Train Val data Split

In [3]:
```
source_dir = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DATA\Convert_Audio_File_to_jpg_file"
target_dir = r'genres_train_val_split_data'
split_ratio = 0.8

def Train_Test_Split(source_dir,target_dir,split_ratio):
    # Define source and target directories
    train_dir = os.path.join(target_dir, 'train')
    val_dir = os.path.join(target_dir, 'val')

    # Create target directories if they don't exist
    os.makedirs(train_dir, exist_ok=True)
    os.makedirs(val_dir, exist_ok=True)

    # Get the list of class directories
    classes = [d for d in os.listdir(source_dir) if os.path.isdir(os.path.join(source_dir, d))]

    for class_name in classes:
        # Create class directories in train and val folders
        os.makedirs(os.path.join(train_dir, class_name), exist_ok=True)
        os.makedirs(os.path.join(val_dir, class_name), exist_ok=True)

        # Get list of images in the class directory
        class_dir = os.path.join(source_dir, class_name)
        images = [f for f in os.listdir(class_dir) if os.path.isfile(os.path.join(class_dir, f))]

        # Shuffle the images
        random.shuffle(images)

        # Compute the split point
        split_point = int(len(images) * split_ratio)

        # Split the images into training and validation sets
        train_images = images[:split_point]
        val_images = images[split_point:]
```

```
        # Move the images to the respective directories
        for img in train_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(train_dir, class_name, img))

        for img in val_images:
            shutil.copy(os.path.join(class_dir, img), os.path.join(val_dir, class_name, img))

    print("Data split completed successfully!")
```

In [4]:
```
Train_Test_Split(source_dir,target_dir,split_ratio)
```

```
Data split completed successfully!
```

Load the Data

In [5]:
```
WIDTH = 64
HEIGHT = 64
BATCH_SIZE = 32
TRAIN_DIR=r'genres_train_val_split_data/train'
val_dir = r'genres_train_val_split_data/val'

# data prep
train_datagen = ImageDataGenerator(
    rescale=1./255.,validation_split=0.25)


train_generator = train_datagen.flow_from_directory(
    TRAIN_DIR,
    target_size=(HEIGHT, WIDTH),
        batch_size=BATCH_SIZE,
        class_mode='categorical')

validation_gen = train_datagen.flow_from_directory(
    val_dir,target_size = (HEIGHT,WIDTH),
    batch_size = BATCH_SIZE,
    class_mode = 'categorical'
 )
```

```
Found 800 images belonging to 10 classes.
Found 200 images belonging to 10 classes.
```

Model Architecture

In [6]:
```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding='same',
                 input_shape=(64,64,3)))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Conv2D(64, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Conv2D(128, (3, 3), padding='same'))
model.add(Activation('relu'))
model.add(Conv2D(128, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.5))
model.add(Flatten())
model.add(Dense(512))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))
model.compile(optimizers.RMSprop(learning_rate=0.0005, decay=1e-6),loss="categorical_crossentropy",metrics=["accuracy"])
model.summary()
```

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 64, 64, 32)	896
activation (Activation)	(None, 64, 64, 32)	0
conv2d_1 (Conv2D)	(None, 62, 62, 64)	18,496
activation_1 (Activation)	(None, 62, 62, 64)	0
max_pooling2d (MaxPooling2D)	(None, 31, 31, 64)	0
dropout (Dropout)	(None, 31, 31, 64)	0
conv2d_2 (Conv2D)	(None, 31, 31, 64)	36,928
activation_2 (Activation)	(None, 31, 31, 64)	0
conv2d_3 (Conv2D)	(None, 29, 29, 64)	36,928
activation_3 (Activation)	(None, 29, 29, 64)	0
max_pooling2d_1 (MaxPooling2D)	(None, 14, 14, 64)	0
dropout_1 (Dropout)	(None, 14, 14, 64)	0
conv2d_4 (Conv2D)	(None, 14, 14, 128)	73,856
activation_4 (Activation)	(None, 14, 14, 128)	0
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147,584
activation_5 (Activation)	(None, 12, 12, 128)	0
max_pooling2d_2 (MaxPooling2D)	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dense (Dense)	(None, 512)	2,359,808
activation_6 (Activation)	(None, 512)	0
dropout_3 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 10)	5,130

Total params: 2,679,626 (10.22 MB)

Trainable params: 2,679,626 (10.22 MB)

Non-trainable params: 0 (0.00 B)

In [7]:
```
STEP_SIZE_TRAIN=train_generator.n//train_generator.batch_size
# Measure the execution time
start_time = time.time()

model.fit(train_generator,validation_data=validation_gen,epochs=200)

end_time = time.time()
elapsed_time = end_time - start_time
```

```
Epoch 1/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 126ms/step - accuracy: 0.0908 - loss: 2.3262 - val_accuracy: 0.1000 - val_loss: 2.3015
Epoch 2/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 135ms/step - accuracy: 0.1362 - loss: 2.2996 - val_accuracy: 0.1950 - val_loss: 2.2538
Epoch 3/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 136ms/step - accuracy: 0.1901 - loss: 2.2619 - val_accuracy: 0.1550 - val_loss: 2.1788
Epoch 4/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 136ms/step - accuracy: 0.2647 - loss: 2.0942 - val_accuracy: 0.1650 - val_loss: 2.1146
Epoch 5/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 135ms/step - accuracy: 0.2221 - loss: 2.0821 - val_accuracy: 0.2550 - val_loss: 2.0688
Epoch 6/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.2638 - loss: 1.9729 - val_accuracy: 0.1850 - val_loss: 2.1266
Epoch 7/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.2670 - loss: 2.0135 - val_accuracy: 0.3050 - val_loss: 1.9701
Epoch 8/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.3221 - loss: 1.8983 - val_accuracy: 0.3200 - val_loss: 1.9209
Epoch 9/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.3465 - loss: 1.8112 - val_accuracy: 0.3850 - val_loss: 1.7874
Epoch 10/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 134ms/step - accuracy: 0.3333 - loss: 1.7993 - val_accuracy: 0.3800 - val_loss: 1.7778
Epoch 11/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.3197 - loss: 1.7694 - val_accuracy: 0.3800 - val_loss: 1.8889
Epoch 12/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.4073 - loss: 1.7037 - val_accuracy: 0.3950 - val_loss: 1.7497
Epoch 13/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.4157 - loss: 1.6517 - val_accuracy: 0.4050 - val_loss: 1.6553
Epoch 14/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.4353 - loss: 1.5729 - val_accuracy: 0.4100 - val_loss: 1.5987
Epoch 15/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.4026 - loss: 1.6035 - val_accuracy: 0.4650 - val_loss: 1.5758
Epoch 16/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.4446 - loss: 1.5463 - val_accuracy: 0.4250 - val_loss: 1.5314
Epoch 17/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.4380 - loss: 1.5158 - val_accuracy: 0.3150 - val_loss: 1.9509
Epoch 18/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.4421 - loss: 1.5638 - val_accuracy: 0.5050 - val_loss: 1.5129
Epoch 19/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.4866 - loss: 1.4481 - val_accuracy: 0.4600 - val_loss: 1.4984
Epoch 20/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.5063 - loss: 1.3240 - val_accuracy: 0.5150 - val_loss: 1.4143
Epoch 21/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.4910 - loss: 1.3623 - val_accuracy: 0.5200 - val_loss: 1.4117
Epoch 22/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.5047 - loss: 1.3392 - val_accuracy: 0.4800 - val_loss: 1.5531
Epoch 23/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.5424 - loss: 1.2446 - val_accuracy: 0.5400 - val_loss: 1.3136
Epoch 24/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.5654 - loss: 1.2154 - val_accuracy: 0.4050 - val_loss: 1.7990
Epoch 25/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.5409 - loss: 1.2645 - val_accuracy: 0.5100 - val_loss: 1.5017
Epoch 26/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.6027 - loss: 1.1757 - val_accuracy: 0.5600 - val_loss: 1.3537
Epoch 27/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.5567 - loss: 1.1760 - val_accuracy: 0.5450 - val_loss: 1.3311
Epoch 28/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.6314 - loss: 1.0326 - val_accuracy: 0.4900 - val_loss: 1.6634
Epoch 29/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.5486 - loss: 1.2524 - val_accuracy: 0.5700 - val_loss: 1.2929
Epoch 30/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.6574 - loss: 1.0052 - val_accuracy: 0.5450 - val_loss: 1.3549
Epoch 31/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.6195 - loss: 1.0483 - val_accuracy: 0.5400 - val_loss: 1.2411
Epoch 32/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.6598 - loss: 0.9453 - val_accuracy: 0.5750 - val_loss: 1.2204
Epoch 33/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.6279 - loss: 1.0213 - val_accuracy: 0.6000 - val_loss: 1.2158
Epoch 34/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 138ms/step - accuracy: 0.6599 - loss: 0.9575 - val_accuracy: 0.6000 - val_loss: 1.2094
Epoch 35/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.6886 - loss: 0.8812 - val_accuracy: 0.5850 - val_loss: 1.1563
Epoch 36/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.6898 - loss: 0.8930 - val_accuracy: 0.5550 - val_loss: 1.2696
Epoch 37/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.6576 - loss: 0.8930 - val_accuracy: 0.5500 - val_loss: 1.2612
Epoch 38/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.6722 - loss: 0.9251 - val_accuracy: 0.5900 - val_loss: 1.2177
Epoch 39/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.6881 - loss: 0.8160 - val_accuracy: 0.6000 - val_loss: 1.1883
Epoch 40/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.7392 - loss: 0.7417 - val_accuracy: 0.5600 - val_loss: 1.1867
Epoch 41/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.6914 - loss: 0.8287 - val_accuracy: 0.5600 - val_loss: 1.3192
```

```
Epoch 42/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.7687 - loss: 0.6921 - val_accuracy: 0.5750 - val_loss: 1.3051
Epoch 43/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.7411 - loss: 0.7306 - val_accuracy: 0.5950 - val_loss: 1.1532
Epoch 44/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.7491 - loss: 0.6981 - val_accuracy: 0.5800 - val_loss: 1.4488
Epoch 45/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.7577 - loss: 0.6257 - val_accuracy: 0.5050 - val_loss: 1.5136
Epoch 46/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.7645 - loss: 0.6471 - val_accuracy: 0.5900 - val_loss: 1.2315
Epoch 47/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.7872 - loss: 0.5983 - val_accuracy: 0.6150 - val_loss: 1.2239
Epoch 48/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.7524 - loss: 0.7278 - val_accuracy: 0.6250 - val_loss: 1.1958
Epoch 49/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.7851 - loss: 0.6215 - val_accuracy: 0.6300 - val_loss: 1.2098
Epoch 50/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.8122 - loss: 0.5169 - val_accuracy: 0.6100 - val_loss: 1.3742
Epoch 51/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8208 - loss: 0.4952 - val_accuracy: 0.6300 - val_loss: 1.3932
Epoch 52/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.8011 - loss: 0.5288 - val_accuracy: 0.5900 - val_loss: 1.3119
Epoch 53/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.8117 - loss: 0.4985 - val_accuracy: 0.6000 - val_loss: 1.4959
Epoch 54/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.8080 - loss: 0.4890 - val_accuracy: 0.6050 - val_loss: 1.4572
Epoch 55/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8633 - loss: 0.3825 - val_accuracy: 0.6000 - val_loss: 1.4302
Epoch 56/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8359 - loss: 0.4682 - val_accuracy: 0.5900 - val_loss: 1.4071
Epoch 57/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.8595 - loss: 0.4078 - val_accuracy: 0.5450 - val_loss: 1.7839
Epoch 58/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.8430 - loss: 0.3921 - val_accuracy: 0.5900 - val_loss: 1.5943
Epoch 59/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.8386 - loss: 0.4653 - val_accuracy: 0.6600 - val_loss: 1.2770
Epoch 60/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8801 - loss: 0.3475 - val_accuracy: 0.5850 - val_loss: 1.5956
Epoch 61/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8934 - loss: 0.3076 - val_accuracy: 0.6100 - val_loss: 1.5560
Epoch 62/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8729 - loss: 0.2943 - val_accuracy: 0.5500 - val_loss: 2.1760
Epoch 63/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 133ms/step - accuracy: 0.8659 - loss: 0.3484 - val_accuracy: 0.6050 - val_loss: 1.3787
Epoch 64/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.8979 - loss: 0.3263 - val_accuracy: 0.6150 - val_loss: 1.2772
Epoch 65/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9240 - loss: 0.2520 - val_accuracy: 0.6150 - val_loss: 1.5082
Epoch 66/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9125 - loss: 0.2537 - val_accuracy: 0.6450 - val_loss: 1.6815
Epoch 67/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9034 - loss: 0.3102 - val_accuracy: 0.6150 - val_loss: 1.6648
Epoch 68/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.8977 - loss: 0.2868 - val_accuracy: 0.6150 - val_loss: 1.5470
Epoch 69/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.9120 - loss: 0.2509 - val_accuracy: 0.6050 - val_loss: 1.7457
Epoch 70/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.8936 - loss: 0.2831 - val_accuracy: 0.5750 - val_loss: 2.1970
Epoch 71/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.8854 - loss: 0.3099 - val_accuracy: 0.6350 - val_loss: 1.7903
Epoch 72/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9302 - loss: 0.2035 - val_accuracy: 0.6450 - val_loss: 1.5624
Epoch 73/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9376 - loss: 0.1596 - val_accuracy: 0.6400 - val_loss: 1.7233
Epoch 74/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9390 - loss: 0.1822 - val_accuracy: 0.6400 - val_loss: 1.7426
Epoch 75/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9161 - loss: 0.2388 - val_accuracy: 0.6150 - val_loss: 1.8065
Epoch 76/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9217 - loss: 0.2217 - val_accuracy: 0.5850 - val_loss: 2.0870
Epoch 77/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9474 - loss: 0.1783 - val_accuracy: 0.5600 - val_loss: 1.9619
Epoch 78/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9547 - loss: 0.1430 - val_accuracy: 0.6400 - val_loss: 1.7234
Epoch 79/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9492 - loss: 0.1798 - val_accuracy: 0.6450 - val_loss: 1.7415
Epoch 80/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9351 - loss: 0.1791 - val_accuracy: 0.6250 - val_loss: 2.0626
Epoch 81/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9433 - loss: 0.1763 - val_accuracy: 0.6250 - val_loss: 1.8965
Epoch 82/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9281 - loss: 0.2056 - val_accuracy: 0.6350 - val_loss: 1.8599
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Epoch 83/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9496 - loss: 0.1491 - val_accuracy: 0.5900 - val_loss: 2.2457
Epoch 84/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9162 - loss: 0.2485 - val_accuracy: 0.5650 - val_loss: 2.3358
Epoch 85/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.9598 - loss: 0.1338 - val_accuracy: 0.6200 - val_loss: 2.0118
Epoch 86/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9405 - loss: 0.1782 - val_accuracy: 0.6250 - val_loss: 1.8883
Epoch 87/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9804 - loss: 0.0627 - val_accuracy: 0.6350 - val_loss: 2.0973
Epoch 88/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9515 - loss: 0.1667 - val_accuracy: 0.6250 - val_loss: 2.0799
Epoch 89/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9499 - loss: 0.1645 - val_accuracy: 0.6100 - val_loss: 2.1547
Epoch 90/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9439 - loss: 0.1523 - val_accuracy: 0.6250 - val_loss: 2.1661
Epoch 91/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9245 - loss: 0.1971 - val_accuracy: 0.5800 - val_loss: 2.1904
Epoch 92/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9467 - loss: 0.1535 - val_accuracy: 0.6200 - val_loss: 2.0070
Epoch 93/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9467 - loss: 0.2095 - val_accuracy: 0.6500 - val_loss: 1.8759
Epoch 94/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 135ms/step - accuracy: 0.9725 - loss: 0.0735 - val_accuracy: 0.6050 - val_loss: 2.1894
Epoch 95/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9641 - loss: 0.1138 - val_accuracy: 0.6100 - val_loss: 2.1479
Epoch 96/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9625 - loss: 0.1299 - val_accuracy: 0.5650 - val_loss: 1.9899
Epoch 97/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9669 - loss: 0.1340 - val_accuracy: 0.6200 - val_loss: 2.0378
Epoch 98/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9557 - loss: 0.1493 - val_accuracy: 0.5800 - val_loss: 2.0380
Epoch 99/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.9268 - loss: 0.1841 - val_accuracy: 0.6200 - val_loss: 2.1253
Epoch 100/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9663 - loss: 0.1215 - val_accuracy: 0.6300 - val_loss: 2.0655
Epoch 101/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9568 - loss: 0.1693 - val_accuracy: 0.6250 - val_loss: 1.7176
Epoch 102/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9743 - loss: 0.0622 - val_accuracy: 0.5800 - val_loss: 2.7079
Epoch 103/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9500 - loss: 0.1408 - val_accuracy: 0.6400 - val_loss: 2.3660
Epoch 104/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9346 - loss: 0.1862 - val_accuracy: 0.6000 - val_loss: 2.5210
Epoch 105/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9648 - loss: 0.0955 - val_accuracy: 0.5850 - val_loss: 2.5043
Epoch 106/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9383 - loss: 0.2160 - val_accuracy: 0.6200 - val_loss: 2.3773
Epoch 107/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.9772 - loss: 0.0925 - val_accuracy: 0.6300 - val_loss: 2.3062
Epoch 108/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9854 - loss: 0.0618 - val_accuracy: 0.5800 - val_loss: 2.2823
Epoch 109/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.9648 - loss: 0.1287 - val_accuracy: 0.6500 - val_loss: 2.2313
Epoch 110/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9834 - loss: 0.0841 - val_accuracy: 0.6150 - val_loss: 2.8426
Epoch 111/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9567 - loss: 0.1696 - val_accuracy: 0.6000 - val_loss: 2.2645
Epoch 112/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9763 - loss: 0.0623 - val_accuracy: 0.5850 - val_loss: 3.1558
Epoch 113/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9779 - loss: 0.0871 - val_accuracy: 0.6000 - val_loss: 2.3316
Epoch 114/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9771 - loss: 0.0701 - val_accuracy: 0.6100 - val_loss: 2.5346
Epoch 115/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9910 - loss: 0.0450 - val_accuracy: 0.6200 - val_loss: 2.6165
Epoch 116/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 133ms/step - accuracy: 0.9698 - loss: 0.0784 - val_accuracy: 0.6100 - val_loss: 2.5954
Epoch 117/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9836 - loss: 0.0577 - val_accuracy: 0.5850 - val_loss: 2.7277
Epoch 118/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9925 - loss: 0.0346 - val_accuracy: 0.6300 - val_loss: 2.8001
Epoch 119/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9619 - loss: 0.1764 - val_accuracy: 0.6100 - val_loss: 2.6465
Epoch 120/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9778 - loss: 0.0528 - val_accuracy: 0.5600 - val_loss: 3.3701
Epoch 121/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9516 - loss: 0.1404 - val_accuracy: 0.6050 - val_loss: 2.2734
Epoch 122/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.9612 - loss: 0.1199 - val_accuracy: 0.5950 - val_loss: 3.1950
Epoch 123/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9744 - loss: 0.1086 - val_accuracy: 0.6000 - val_loss: 2.6465
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Epoch 124/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9637 - loss: 0.0909 - val_accuracy: 0.6150 - val_loss: 2.5651
Epoch 125/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9712 - loss: 0.0857 - val_accuracy: 0.6150 - val_loss: 2.9187
Epoch 126/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9763 - loss: 0.0642 - val_accuracy: 0.6500 - val_loss: 2.5741
Epoch 127/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9774 - loss: 0.0712 - val_accuracy: 0.6100 - val_loss: 2.8007
Epoch 128/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9647 - loss: 0.1249 - val_accuracy: 0.6250 - val_loss: 2.3439
Epoch 129/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9923 - loss: 0.0272 - val_accuracy: 0.6050 - val_loss: 2.8320
Epoch 130/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9654 - loss: 0.0755 - val_accuracy: 0.6050 - val_loss: 2.5047
Epoch 131/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.9896 - loss: 0.0388 - val_accuracy: 0.6000 - val_loss: 2.9230
Epoch 132/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9675 - loss: 0.1126 - val_accuracy: 0.5800 - val_loss: 2.9205
Epoch 133/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9697 - loss: 0.1045 - val_accuracy: 0.6300 - val_loss: 2.8700
Epoch 134/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9584 - loss: 0.1553 - val_accuracy: 0.6100 - val_loss: 3.2127
Epoch 135/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9559 - loss: 0.1463 - val_accuracy: 0.6400 - val_loss: 2.4648
Epoch 136/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9850 - loss: 0.0413 - val_accuracy: 0.6400 - val_loss: 2.4898
Epoch 137/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9781 - loss: 0.0685 - val_accuracy: 0.6100 - val_loss: 3.1533
Epoch 138/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9778 - loss: 0.0885 - val_accuracy: 0.6400 - val_loss: 2.9685
Epoch 139/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.9756 - loss: 0.0563 - val_accuracy: 0.5950 - val_loss: 3.0030
Epoch 140/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 140ms/step - accuracy: 0.9734 - loss: 0.1123 - val_accuracy: 0.6200 - val_loss: 2.6312
Epoch 141/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.9894 - loss: 0.0447 - val_accuracy: 0.6000 - val_loss: 2.7892
Epoch 142/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 136ms/step - accuracy: 0.9839 - loss: 0.0571 - val_accuracy: 0.6100 - val_loss: 3.5329
Epoch 143/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9584 - loss: 0.2007 - val_accuracy: 0.6000 - val_loss: 3.1208
Epoch 144/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9645 - loss: 0.0972 - val_accuracy: 0.6100 - val_loss: 3.0806
Epoch 145/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9682 - loss: 0.1397 - val_accuracy: 0.6200 - val_loss: 2.8241
Epoch 146/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9820 - loss: 0.0489 - val_accuracy: 0.6100 - val_loss: 2.8053
Epoch 147/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9878 - loss: 0.0593 - val_accuracy: 0.6150 - val_loss: 2.6795
Epoch 148/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 145ms/step - accuracy: 0.9806 - loss: 0.0387 - val_accuracy: 0.6450 - val_loss: 3.2969
Epoch 149/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9720 - loss: 0.0867 - val_accuracy: 0.5750 - val_loss: 3.8260
Epoch 150/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.9751 - loss: 0.0840 - val_accuracy: 0.6100 - val_loss: 3.1916
Epoch 151/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9577 - loss: 0.2086 - val_accuracy: 0.6250 - val_loss: 2.7172
Epoch 152/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9896 - loss: 0.0274 - val_accuracy: 0.6300 - val_loss: 2.7414
Epoch 153/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 144ms/step - accuracy: 0.9864 - loss: 0.0404 - val_accuracy: 0.6200 - val_loss: 2.8900
Epoch 154/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9674 - loss: 0.1702 - val_accuracy: 0.6150 - val_loss: 2.7966
Epoch 155/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9900 - loss: 0.0298 - val_accuracy: 0.6150 - val_loss: 3.0291
Epoch 156/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9665 - loss: 0.1125 - val_accuracy: 0.6450 - val_loss: 2.6484
Epoch 157/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 137ms/step - accuracy: 0.9833 - loss: 0.0632 - val_accuracy: 0.6200 - val_loss: 2.6650
Epoch 158/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9877 - loss: 0.0304 - val_accuracy: 0.5750 - val_loss: 3.2498
Epoch 159/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9653 - loss: 0.1523 - val_accuracy: 0.6350 - val_loss: 2.5158
Epoch 160/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9975 - loss: 0.0103 - val_accuracy: 0.6350 - val_loss: 2.9519
Epoch 161/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9862 - loss: 0.0531 - val_accuracy: 0.6300 - val_loss: 2.7204
Epoch 162/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9858 - loss: 0.0496 - val_accuracy: 0.6450 - val_loss: 3.1435
Epoch 163/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9840 - loss: 0.0454 - val_accuracy: 0.6350 - val_loss: 3.5224
Epoch 164/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9805 - loss: 0.0615 - val_accuracy: 0.6050 - val_loss: 3.2094
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Epoch 165/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9871 - loss: 0.0618 - val_accuracy: 0.6350 - val_loss: 3.2888
Epoch 166/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9696 - loss: 0.1007 - val_accuracy: 0.6400 - val_loss: 2.6891
Epoch 167/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 145ms/step - accuracy: 0.9872 - loss: 0.0435 - val_accuracy: 0.5900 - val_loss: 3.3853
Epoch 168/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9914 - loss: 0.0244 - val_accuracy: 0.6200 - val_loss: 3.1923
Epoch 169/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9791 - loss: 0.0804 - val_accuracy: 0.6300 - val_loss: 2.9425
Epoch 170/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9858 - loss: 0.0313 - val_accuracy: 0.6400 - val_loss: 3.1421
Epoch 171/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9780 - loss: 0.1068 - val_accuracy: 0.6050 - val_loss: 2.7188
Epoch 172/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 145ms/step - accuracy: 0.9848 - loss: 0.0615 - val_accuracy: 0.6200 - val_loss: 2.4824
Epoch 173/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9863 - loss: 0.0414 - val_accuracy: 0.6400 - val_loss: 2.7057
Epoch 174/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9884 - loss: 0.0382 - val_accuracy: 0.6700 - val_loss: 2.7627
Epoch 175/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9889 - loss: 0.0458 - val_accuracy: 0.6450 - val_loss: 3.2791
Epoch 176/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9926 - loss: 0.0161 - val_accuracy: 0.6350 - val_loss: 3.3782
Epoch 177/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9737 - loss: 0.0997 - val_accuracy: 0.5950 - val_loss: 2.9673
Epoch 178/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9740 - loss: 0.0582 - val_accuracy: 0.6250 - val_loss: 2.7655
Epoch 179/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9769 - loss: 0.0929 - val_accuracy: 0.6100 - val_loss: 3.2484
Epoch 180/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9844 - loss: 0.0512 - val_accuracy: 0.6450 - val_loss: 3.1637
Epoch 181/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9837 - loss: 0.0645 - val_accuracy: 0.6100 - val_loss: 3.5123
Epoch 182/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 138ms/step - accuracy: 0.9856 - loss: 0.0575 - val_accuracy: 0.6300 - val_loss: 3.5459
Epoch 183/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9792 - loss: 0.0598 - val_accuracy: 0.6250 - val_loss: 3.2964
Epoch 184/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9887 - loss: 0.0531 - val_accuracy: 0.6150 - val_loss: 3.4861
Epoch 185/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9784 - loss: 0.0492 - val_accuracy: 0.6350 - val_loss: 3.3608
Epoch 186/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9810 - loss: 0.0573 - val_accuracy: 0.6200 - val_loss: 3.4178
Epoch 187/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 139ms/step - accuracy: 0.9845 - loss: 0.0397 - val_accuracy: 0.6050 - val_loss: 3.8684
Epoch 188/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9640 - loss: 0.1283 - val_accuracy: 0.6350 - val_loss: 3.2243
Epoch 189/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9854 - loss: 0.0466 - val_accuracy: 0.6200 - val_loss: 4.0521
Epoch 190/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 136ms/step - accuracy: 0.9810 - loss: 0.0668 - val_accuracy: 0.6050 - val_loss: 3.4468
Epoch 191/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 138ms/step - accuracy: 0.9773 - loss: 0.0749 - val_accuracy: 0.6200 - val_loss: 3.5472
Epoch 192/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 145ms/step - accuracy: 0.9875 - loss: 0.0332 - val_accuracy: 0.5800 - val_loss: 4.8018
Epoch 193/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9606 - loss: 0.1226 - val_accuracy: 0.6250 - val_loss: 3.5109
Epoch 194/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 3s 139ms/step - accuracy: 0.9761 - loss: 0.0790 - val_accuracy: 0.6300 - val_loss: 4.0045
Epoch 195/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 140ms/step - accuracy: 0.9658 - loss: 0.1862 - val_accuracy: 0.6150 - val_loss: 3.4841
Epoch 196/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9821 - loss: 0.0515 - val_accuracy: 0.5900 - val_loss: 3.7746
Epoch 197/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 142ms/step - accuracy: 0.9773 - loss: 0.0986 - val_accuracy: 0.6100 - val_loss: 3.8439
Epoch 198/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9911 - loss: 0.0289 - val_accuracy: 0.6600 - val_loss: 3.3768
Epoch 199/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 141ms/step - accuracy: 0.9782 - loss: 0.0690 - val_accuracy: 0.6250 - val_loss: 3.4474
Epoch 200/200
25/25 ━━━━━━━━━━━━━━━━━━━━ 4s 143ms/step - accuracy: 0.9942 - loss: 0.0190 - val_accuracy: 0.6150 - val_loss: 4.5955
```

In [8]:
```
print(f"Execution time: {elapsed_time:.2f} seconds")
```

```
Execution time: 707.66 seconds
```

In [9]:
```
def append_core_data(score_path, num_cores, elapsed_time):
    # Check if the file already exists
    file_exists = os.path.exists(score_path)

    # Open the file in append mode
    with open(score_path, mode='a', newline='') as file:
```

```
        writer = csv.writer(file)

        # If the file is new, write the header
        if not file_exists:
            writer.writerow(["Number of Cores", "Elapsed Time"])

        # Write the new data
        writer.writerow([num_cores, elapsed_time])
```

In [10]:
```
score_path = r"C:\Users\nikhi\OneDrive\Desktop\Final Project\DEEP LEARNING WITH HPSC\core_data.txt"
append_core_data(score_path, number_of_worker, elapsed_time)
```