

MSAAI_511_GRP_5_Composer_Classification

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0.0.2 Final Team Project: Music Genre and Composure Classification

0.0.3 AAI 511 Group 5

1 Composer Classification Using Deep Learning

The music of **Bach**, **Beethoven**, **Chopin**, and **Mozart** collectively represents some of the most famous and most studied pieces of musical art in history.

In this report, we describe how our team used deep learning to accurately identify the composer of a musical piece. We leveraged **Long Short-Term Memory (LSTM)** and **Convolutional Neural Network (CNN)** architectures to achieve our project's goals.

Our system successfully classified the pieces with significant accuracy, demonstrating the potential of deep learning in **musicology**.

```
[3]: !pip install pretty_midi
```

```
Collecting pretty_midi
```

```
  Downloading pretty_midi-0.2.10.tar.gz (5.6 MB)
```

```
5.6/5.6 MB
```

```
33.1 MB/s eta 0:00:00
```

```
  Preparing metadata (setup.py) ... done
```

```
Requirement already satisfied: numpy>=1.7.0 in /usr/local/lib/python3.11/dist-packages (from pretty_midi) (2.0.2)
```

```
Collecting mido>=1.1.16 (from pretty_midi)
```

```
  Downloading mido-1.3.3-py3-none-any.whl.metadata (6.4 kB)
```

```
Requirement already satisfied: six in /usr/local/lib/python3.11/dist-packages (from pretty_midi) (1.17.0)
```

```
Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from mido>=1.1.16->pretty_midi) (25.0)
```

```
Downloading mido-1.3.3-py3-none-any.whl (54 kB)
```

```
54.6/54.6 kB
```

```
5.2 MB/s eta 0:00:00
```

```
Building wheels for collected packages: pretty_midi
```

```
  Building wheel for pretty_midi (setup.py) ... done
```

```
  Created wheel for pretty_midi: filename=pretty_midi-0.2.10-py3-none-any.whl size=5592286
```

```
sha256=7c469c28f3cd8cc4200d93aeb4e7fabfa3bdb88bf6d78b029c593b7c2d65a735
```

Stored in directory: /root/.cache/pip/wheels/e6/95/ac/15ceaeb2823b04d8e638fd1495357adb8d26c00ccac9d7782e
Successfully built pretty_midi
Installing collected packages: mido, pretty_midi
Successfully installed mido-1.3.3 pretty_midi-0.2.10

1.0.1 1. Find and count the .mid (MIDI) files in the data directories

```
[4]: import numpy as np
import pandas as pd
import pretty_midi
import warnings
warnings.filterwarnings('ignore')
```

```
[5]: import os

# Import the drive function from google.colab
# Mount Google Drive
from google.colab import drive
drive.mount('/content/drive')

# Specify the path to the data files by composer: Mozart
mozart_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/Mozart'
mozart_concertos_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Mozart/Piano Concertos'
mozart_sonatas_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Mozart/Piano Sonatas'
mozart_symphonies_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Mozart/Symphonies'
mozart_Chelsea_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Mozart/The Chelsea Notebook'

# Specify the path to the data files by composer: Chopin
chopin_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/Chopin'

# Specify the path to the data files by composer: Beethoven
beethoven_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Beethoven'
beethoven_symphonies_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Beethoven/Symphonies'
beethoven_sonatas_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Beethoven/Piano Sonatas'

# Specify the path to the data files by composer: Bach
bach_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/Bach'
bach_harp_concertos_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Harpsichord Concertos'
```

```

bach_concertos_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Concertos'
bach_artoffugue_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/TheArtOfFugue'
bach_nusicaloffering_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Bwv1079 The Musical Offering'
bach_orchestralesuites_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Bwv1066-1069 Orchestral Suites'
bach_goldbertvariations_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Bwv988 The Goldberg Variations'
bach_clavier1_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Bach/Bwv846-869 The Well Tempered Clavier Book 1'
bach_clavier2_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Bach/Bwv870-893 The Well Tempered Clavier Book 2'
bach_sinfonias_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Bwv787-801 Three Part Inventions (Sinfonias)'
bach_twopart_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Bach/Bwv772-786 Two Part Inventions'
bach_matthew_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Bach/Matthew Passion'
bach_mass_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Bach/Bwv232 Mass'
bach_400chorales_dataset_path = '/content/drive/My Drive/Colab Notebooks/
↳Musicians/Bach/Bwv001- 400 Chorales'
bach_notebook_dataset_path = '/content/drive/My Drive/Colab Notebooks/Musicians/
↳Bach/LittleNotebook'

# Create lists of the dataset paths
mozart_dataset_path_list = [
    mozart_dataset_path,
    mozart_concertos_dataset_path,
    mozart_sonatas_dataset_path,
    mozart_symphonies_dataset_path,
    mozart_Chelsea_dataset_path
]

chopin_dataset_path_list = [
    chopin_dataset_path
]

beethoven_dataset_path_list = [
    beethoven_dataset_path,
    beethoven_symphonies_dataset_path,
    beethoven_sonatas_dataset_path
]

```

```

bach_dataset_path_list = [
    bach_dataset_path,
    bach_harp_concertos_dataset_path,
    bach_concertos_dataset_path,
    bach_artoffugue_dataset_path,
    bach_nusicaloffering_dataset_path,
    bach_orchestralesuites_dataset_path,
    bach_goldbertvariations_dataset_path,
    bach_clavier1_dataset_path,
    bach_clavier2_dataset_path,
    bach_sinfonias_dataset_path,
    bach_twopart_dataset_path,
    bach_matthew_dataset_path,
    bach_mass_dataset_path,
    bach_400chorales_dataset_path,
    bach_notebook_dataset_path
]

# Initialize a variable to store the total count
mozart_total_mid_files = 0
chopin_total_mid_files = 0
beethoven_total_mid_files = 0
bach_total_mid_files = 0

# Iterate through each Mozart path and count the .mid files
print()
for path in mozart_dataset_path_list:
    mid_file_count = 0
    if os.path.isdir(path):
        for filename in os.listdir(path):
            if filename.endswith('.mid'):
                mid_file_count += 1
        print(f"Number of .mid files in '{path}': {mid_file_count}")
        mozart_total_mid_files += mid_file_count
    else:
        print(f"Path not found or is not a directory: '{path}'")

# Print the total number of .mid files for Mozart
print()
print(f"Total number of .mid files for Mozart: {mozart_total_mid_files}")
print()

## Chopin
# Iterate through each Chopin path and count the .mid files
print()

```

```

for path in chopin_dataset_path_list:
    mid_file_count = 0
    if os.path.isdir(path):
        for filename in os.listdir(path):
            if filename.endswith('.mid'):
                mid_file_count += 1
        print(f"Number of .mid files in '{path}': {mid_file_count}")
        chopin_total_mid_files += mid_file_count
    else:
        print(f"Path not found or is not a directory: '{path}'")

# Print the total number of .mid files for Chopin
print(f"Total number of .mid files for Chopin: {chopin_total_mid_files}")
print()

## Beethoven
# Iterate through each Beethoven path and count the .mid files
print()
for path in beethoven_dataset_path_list:
    mid_file_count = 0
    if os.path.isdir(path):
        for filename in os.listdir(path):
            if filename.endswith('.mid'):
                mid_file_count += 1
        print(f"Number of .mid files in '{path}': {mid_file_count}")
        beethoven_total_mid_files += mid_file_count
    else:
        print(f"Path not found or is not a directory: '{path}'")

# Print the total number of .mid files for Beethoven
print(f"Total number of .mid files for Beethoven: {beethoven_total_mid_files}")
print()

## Bach
# Iterate through each Mozart path and count the .mid files
print()
for path in bach_dataset_path_list:
    mid_file_count = 0
    if os.path.isdir(path):
        for filename in os.listdir(path):
            if filename.endswith('.mid'):
                mid_file_count += 1
        print(f"Number of .mid files in '{path}': {mid_file_count}")
        bach_total_mid_files += mid_file_count
    else:

```

```

    print(f"Path not found or is not a directory: '{path}')"

# Print the total number of .mid files for Bach
print(f"Total number of .mid files for Bach: {bach_total_mid_files}")
print()

```

Mounted at /content/drive

Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Mozart': 90
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Mozart/Piano Concertos': 36
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Mozart/Piano Sonatas': 19
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Mozart/Symphonies': 54
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Mozart/The Chelsea Notebook': 20

Total number of .mid files for Mozart: 219

Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Chopin': 136
 Total number of .mid files for Chopin: 136

Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Beethoven': 133
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Beethoven/Symphonies': 34
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Beethoven/Piano Sonatas': 45
 Total number of .mid files for Beethoven: 212

Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Bach': 130
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Bach/Harpsichord Concertos': 27
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Bach/Concertos': 25
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Bach/TheArtOfFugue': 19
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Bach/Bwv1079 The Musical Offering': 0
 Number of .mid files in '/content/drive/My Drive/Colab Notebooks/Musicians/Bach/Bwv1066-1069 Orchestral Suites': 24

```

Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv988 The Goldberg Variations': 32
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv846-869 The Well Tempered Clavier Book 1': 0
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv870-893 The Well Tempered Clavier Book 2': 28
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv787-801 Three Part Inventions (Sinfonias)': 15
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv772-786 Two Part Inventions': 15
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Matthew Passion': 10
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv232 Mass': 23
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/Bwv001- 400 Chorales': 519
Number of .mid files in '/content/drive/My Drive/Colab
Notebooks/Musicians/Bach/LittleNotebook': 17
Total number of .mid files for Bach: 884

```

1.1 Load and Clean Mozart MIDI Dataset

Load all .mid files from the various Mozart dataset paths, clean the filenames by removing spaces and punctuation (except for the .mid extension), and store the cleaned filenames and the corresponding MIDI data.

1.1.1 Define a function to clean filenames

```

[6]: import re

# The filenames have spaces and some additional punctuation that might be
↪helpful to remove

def clean_filename(filename):
    """
    Cleans a filename by removing spaces and punctuation, preserving the .mid
    ↪extension.

    Args:
        filename: The original filename string.

    Returns:
        The cleaned filename string.
    """
    # Separate the filename and extension
    name, ext = os.path.splitext(filename)

```

```

    # Remove spaces and punctuation from the name using regex
    cleaned_name = re.sub(r'[\W-]', '', name) # Keep alphanumeric characters
    ↪and hyphens

    # Recombine the cleaned name and original extension
    cleaned_filename = cleaned_name + ext

    return cleaned_filename

```

1.1.2 Iterate through directories and load the midi files

Loop through the Mozart dataset paths, read each .mid file, apply the cleaning function to the filename, and store the cleaned filename and the loaded MIDI data.

```

[7]: import pretty_midi

# Initialize a dictionary to store cleaned filenames and loaded MIDI data
mozart_midi_data = {}

# Iterate through each path in the mozart_dataset_path_list
for path in mozart_dataset_path_list:
    if os.path.isdir(path):
        # Iterate through each file in the directory
        for filename in os.listdir(path):
            # Check if the file ends with '.mid'
            if filename.endswith('.mid'):
                # Construct the full path to the MIDI file
                full_path = os.path.join(path, filename)

                try:
                    # Load the MIDI file
                    midi_data = pretty_midi.PrettyMIDI(full_path)

                    # Clean the filename
                    cleaned_filename = clean_filename(filename)

                    # Store the cleaned filename and loaded MIDI data
                    mozart_midi_data[cleaned_filename] = midi_data
                except Exception as e:
                    # Print an error message if the file could not be loaded
                    print(f"Error loading file '{full_path}': {e}")

# Display the number of loaded MIDI files
print()
print(f"Successfully loaded and processed {len(mozart_midi_data)} Mozart MIDI
    ↪files.")
print()

```


Successfully loaded and processed 219 Mozart MIDI files.

Loop through the Chopin dataset paths, read each .mid file, apply the cleaning function to the filename, and store the cleaned filename and the loaded MIDI data.

```
[8]: # Initialize a dictionary to store cleaned filenames and loaded MIDI data
chopin_midi_data = {}

# Iterate through each path in the mozart_dataset_path_list
for path in chopin_dataset_path_list:
    if os.path.isdir(path):
        # Iterate through each file in the directory
        for filename in os.listdir(path):
            # Check if the file ends with '.mid'
            if filename.endswith('.mid'):
                # Construct the full path to the MIDI file
                full_path = os.path.join(path, filename)

                try:
                    # Load the MIDI file
                    midi_data = pretty_midi.PrettyMIDI(full_path)

                    # Clean the filename
                    cleaned_filename = clean_filename(filename)

                    # Store the cleaned filename and loaded MIDI data
                    chopin_midi_data[cleaned_filename] = midi_data
                except Exception as e:
                    # Print an error message if the file could not be loaded
                    print(f"Error loading file '{full_path}': {e}")

# Display the number of loaded MIDI files
print()
print(f"Successfully loaded and processed {len(chopin_midi_data)} Chopin MIDI_
↪files.")
print()
```

Successfully loaded and processed 136 Chopin MIDI files.

Loop through the Beethoven dataset paths, read each .mid file, apply the cleaning function to the filename, and store the cleaned filename and the loaded MIDI data.

```
[9]: # Initialize a dictionary to store cleaned filenames and loaded MIDI data
beethoven_midi_data = {}
```

```

# Iterate through each path in the mozart_dataset_path_list
for path in beethoven_dataset_path_list:
    if os.path.isdir(path):
        # Iterate through each file in the directory
        for filename in os.listdir(path):
            # Check if the file ends with '.mid'
            if filename.endswith('.mid'):
                # Construct the full path to the MIDI file
                full_path = os.path.join(path, filename)

                try:
                    # Load the MIDI file
                    midi_data = pretty_midi.PrettyMIDI(full_path)

                    # Clean the filename
                    cleaned_filename = clean_filename(filename)

                    # Store the cleaned filename and loaded MIDI data
                    beethoven_midi_data[cleaned_filename] = midi_data
                except Exception as e:
                    # Print an error message if the file could not be loaded
                    print(f"Error loading file '{full_path}': {e}")

# Display the number of loaded MIDI files
print()
print(f"Successfully loaded and processed {len(beethoven_midi_data)} Beethoven_
↳ MIDI files.")
print()

```

Error loading file '/content/drive/My Drive/Colab Notebooks/Musicians/Beethoven/Anhang 14-3.mid': Could not decode key with 3 flats and mode 255

Successfully loaded and processed 211 Beethoven MIDI files.

Loop through the Bach dataset paths, read each .mid file, apply the cleaning function to the filename, and store the cleaned filename and the loaded MIDI data.

```

[10]: # Initialize a dictionary to store cleaned filenames and loaded MIDI data
bach_midi_data = {}

# Iterate through each path in the mozart_dataset_path_list
for path in bach_dataset_path_list:
    if os.path.isdir(path):
        # Iterate through each file in the directory
        for filename in os.listdir(path):
            # Check if the file ends with '.mid'

```

```

if filename.endswith('.mid'):
    # Construct the full path to the MIDI file
    full_path = os.path.join(path, filename)

    try:
        # Load the MIDI file
        midi_data = pretty_midi.PrettyMIDI(full_path)

        # Clean the filename
        cleaned_filename = clean_filename(filename)

        # Store the cleaned filename and loaded MIDI data
        bach_midi_data[cleaned_filename] = midi_data
    except Exception as e:
        # Print an error message if the file could not be loaded
        print(f"Error loading file '{full_path}': {e}")

# Display the number of loaded MIDI files
print()
print(f"Successfully loaded and processed {len(bach_midi_data)} Bach MIDI files.
↪")
print()

```

Successfully loaded and processed 884 Bach MIDI files.

```

[11]: # We now should have a dictionary for each composer, where the dictionary
↪ stores the MIDI data along with
# the (cleaned) filename for that MIDI file.

print()
print(" There are ", len(mozart_midi_data), "MIDI files for Mozart that have
↪ been loaded")
print()
print(" There are ", len(chopin_midi_data), "MIDI files for Chopin that have
↪ been loaded")
print()
print(" There are ", len(beethoven_midi_data), "MIDI files for Beethoven that
↪ have been loaded")
print()
print(" There are ", len(bach_midi_data), "MIDI files for Bach that have been
↪ loaded")

```

There are 219 MIDI files for Mozart that have been loaded

There are 136 MIDI files for Chopin that have been loaded

There are 211 MIDI files for Beethoven that have been loaded

There are 884 MIDI files for Bach that have been loaded

2 Feature Extraction for CNN

```
[12]: # Convert dict → list of dicts with filename + midi
formatted_mozart = [{"filename": fname, "midi": midi} for fname, midi in
    ↪mozart_midi_data.items()]
formatted_chopin = [{"filename": fname, "midi": midi} for fname, midi in
    ↪chopin_midi_data.items()]
formatted_beethoven = [{"filename": fname, "midi": midi} for fname, midi in
    ↪beethoven_midi_data.items()]
formatted_bach = [{"filename": fname, "midi": midi} for fname, midi in
    ↪bach_midi_data.items()]

[ ]: # Create a mapping of composers to their MIDI data and labels
# Each composer is associated with a list of MIDI objects and a label (0 for
    ↪Mozart, 1 for Chopin, etc.)
# The label is used for classification tasks, where each composer

composer_map = {
    "Mozart": (formatted_mozart, 0),
    "Chopin": (formatted_chopin, 1),
    "Beethoven": (formatted_beethoven, 2),
    "Bach": (formatted_bach, 3)
}

all_data = []
labels = []

for composer, (midi_list, label) in composer_map.items():
    for entry in midi_list:
        midi_obj = entry["midi"] # Now works perfectly
        all_data.append(midi_obj)
        labels.append(label)

[ ]: import numpy as np
# Convert a pretty_midi.PrettyMIDI object to a fixed-size piano roll.
def midi_to_fixed_roll(midi, fs=10, max_len=500):
    """
    Convert a pretty_midi.PrettyMIDI object to a fixed-size piano roll.

    Parameters:
    -----
    midi : pretty_midi.PrettyMIDI
```

```

    The parsed MIDI object.
    fs : int, optional (default=10)
        Frames per second for piano roll resolution.
    max_len : int, optional (default=500)
        The maximum number of time steps to keep.
        Rolls shorter than this will be zero-padded.

Returns:
-----
roll : np.ndarray
    A 2D array of shape (128, max_len), normalized to [0,1].
    Returns None if the MIDI file has no notes.
"""
try:
    roll = midi.get_piano_roll(fs=fs) # Shape = (128, time_steps)

    # Skip empty MIDI (no active notes)
    if roll.shape[1] == 0 or np.max(roll) == 0:
        return None

    # Crop or pad to fixed length
    roll = roll[:, :max_len]
    if roll.shape[1] < max_len:
        pad = max_len - roll.shape[1]
        roll = np.pad(roll, ((0, 0), (0, pad)), mode='constant')

    # Normalize velocities to [0,1]
    return roll / 127.0

except Exception as e:
    print(f"Error converting MIDI to piano roll: {e}")
    return None

```

```

[15]: roll = midi_to_fixed_roll(all_data[0])
if roll is not None:
    print("Piano roll shape:", roll.shape) # Should be (128, 500)
    print("Max value (should be <= 1):", np.max(roll))
else:
    print("MIDI had no notes.")

```

Piano roll shape: (128, 500)

Max value (should be <= 1): 5.866141732283465

Need to convert the MIDI files into piano roll for CNN models

```

[ ]: # Convert all MIDI files to fixed-size piano rolls
import numpy as np

```

```

X = []
y = []

for i, midi in enumerate(all_data):
    roll = midi_to_fixed_roll(midi, fs=10, max_len=500)
    if roll is not None:
        X.append(roll)
        y.append(labels[i])
    else:
        print(f" Skipping file #{i} - piano roll conversion failed")

X = np.array(X)
X = X[..., np.newaxis] # shape → (samples, 128, 500, 1)
y = np.array(y)

```

```

[ ]: print(" Total samples:", X.shape[0])
print(" Input shape (should be samples, 128, 500, 1):", X.shape)
print(" Label shape:", y.shape)
print("Unique classes:", np.unique(y))

```

```

Total samples: 1450
Input shape (should be samples, 128, 500, 1): (1450, 128, 500, 1)
Label shape: (1450,)
Unique classes: [0 1 2 3]

```

```

[17]: from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.2, stratify=y, random_state=42)

```

```

[18]: from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense,
↳ Dropout

from tensorflow.keras.layers import GlobalAveragePooling2D

model = Sequential([
    Conv2D(32, (3, 3), activation='relu', input_shape=(128, 500, 1)),
    MaxPooling2D((2, 2)),

    Conv2D(64, (3, 3), activation='relu'),
    MaxPooling2D((2, 2)),

    Conv2D(128, (3, 3), activation='relu'),
    MaxPooling2D((2, 2)),

    GlobalAveragePooling2D(), # Instead of Flatten()

```

```

        Dense(128, activation='relu'),
        Dropout(0.3),
        Dense(4, activation='softmax')
    ])

model.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
model.summary()

```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 126, 498, 32)	320
max_pooling2d (MaxPooling2D)	(None, 63, 249, 32)	0
conv2d_1 (Conv2D)	(None, 61, 247, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(None, 30, 123, 64)	0
conv2d_2 (Conv2D)	(None, 28, 121, 128)	73,856
max_pooling2d_2 (MaxPooling2D)	(None, 14, 60, 128)	0
global_average_pooling2d (GlobalAveragePooling2D)	(None, 128)	0
dense (Dense)	(None, 128)	16,512
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 4)	516

Total params: 109,700 (428.52 KB)

Trainable params: 109,700 (428.52 KB)

Non-trainable params: 0 (0.00 B)

```

[19]: # Add early stoppping
      from tensorflow.keras.callbacks import EarlyStopping

```

```

early_stopping = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True
)
history = model.fit(
    X_train, y_train,
    epochs=20,
    batch_size=32,
    validation_split=0.1,
    verbose=1,
    callbacks=[early_stopping]  # Add early stopping callback
)

```

```

Epoch 1/20
33/33          20s 367ms/step -
accuracy: 0.5562 - loss: 1.2346 - val_accuracy: 0.5948 - val_loss: 1.1062
Epoch 2/20
33/33          2s 66ms/step -
accuracy: 0.6184 - loss: 1.0983 - val_accuracy: 0.5948 - val_loss: 1.1042
Epoch 3/20
33/33          2s 61ms/step -
accuracy: 0.6197 - loss: 1.0945 - val_accuracy: 0.5948 - val_loss: 1.1147
Epoch 4/20
33/33          2s 58ms/step -
accuracy: 0.6349 - loss: 1.0604 - val_accuracy: 0.5948 - val_loss: 1.0953
Epoch 5/20
33/33          2s 58ms/step -
accuracy: 0.6070 - loss: 1.0804 - val_accuracy: 0.5948 - val_loss: 1.0703
Epoch 6/20
33/33          2s 58ms/step -
accuracy: 0.6146 - loss: 1.0431 - val_accuracy: 0.5948 - val_loss: 1.0583
Epoch 7/20
33/33          3s 58ms/step -
accuracy: 0.6404 - loss: 1.0356 - val_accuracy: 0.5948 - val_loss: 1.0300
Epoch 8/20
33/33          3s 62ms/step -
accuracy: 0.6130 - loss: 1.0183 - val_accuracy: 0.5948 - val_loss: 0.9975
Epoch 9/20
33/33          2s 59ms/step -
accuracy: 0.6146 - loss: 0.9841 - val_accuracy: 0.5948 - val_loss: 0.9729
Epoch 10/20
33/33          2s 61ms/step -
accuracy: 0.6225 - loss: 0.9442 - val_accuracy: 0.6379 - val_loss: 0.9065
Epoch 11/20
33/33          2s 58ms/step -
accuracy: 0.6209 - loss: 0.9380 - val_accuracy: 0.6207 - val_loss: 1.0046
Epoch 12/20

```



```

33/33          3s 61ms/step -
accuracy: 0.6487 - loss: 0.8739 - val_accuracy: 0.6897 - val_loss: 0.8277
Epoch 13/20
33/33          2s 62ms/step -
accuracy: 0.6537 - loss: 0.8530 - val_accuracy: 0.6724 - val_loss: 0.7861
Epoch 14/20
33/33          2s 63ms/step -
accuracy: 0.6874 - loss: 0.7779 - val_accuracy: 0.6983 - val_loss: 0.7610
Epoch 15/20
33/33          2s 59ms/step -
accuracy: 0.6613 - loss: 0.8371 - val_accuracy: 0.6983 - val_loss: 0.7526
Epoch 16/20
33/33          2s 59ms/step -
accuracy: 0.6985 - loss: 0.7782 - val_accuracy: 0.7155 - val_loss: 0.7096
Epoch 17/20
33/33          3s 58ms/step -
accuracy: 0.7216 - loss: 0.7363 - val_accuracy: 0.7328 - val_loss: 0.6715
Epoch 18/20
33/33          3s 59ms/step -
accuracy: 0.6883 - loss: 0.7427 - val_accuracy: 0.7414 - val_loss: 0.6647
Epoch 19/20
33/33          2s 60ms/step -
accuracy: 0.7082 - loss: 0.7195 - val_accuracy: 0.7500 - val_loss: 0.6667
Epoch 20/20
33/33          3s 59ms/step -
accuracy: 0.7119 - loss: 0.6992 - val_accuracy: 0.7500 - val_loss: 0.6434

```

```

[20]: test_loss, test_acc = model.evaluate(X_test, y_test)
      print(f" Test Accuracy: {test_acc:.2%}")

```

```

10/10          1s 104ms/step -
accuracy: 0.7496 - loss: 0.7089
Test Accuracy: 75.17%

```

```

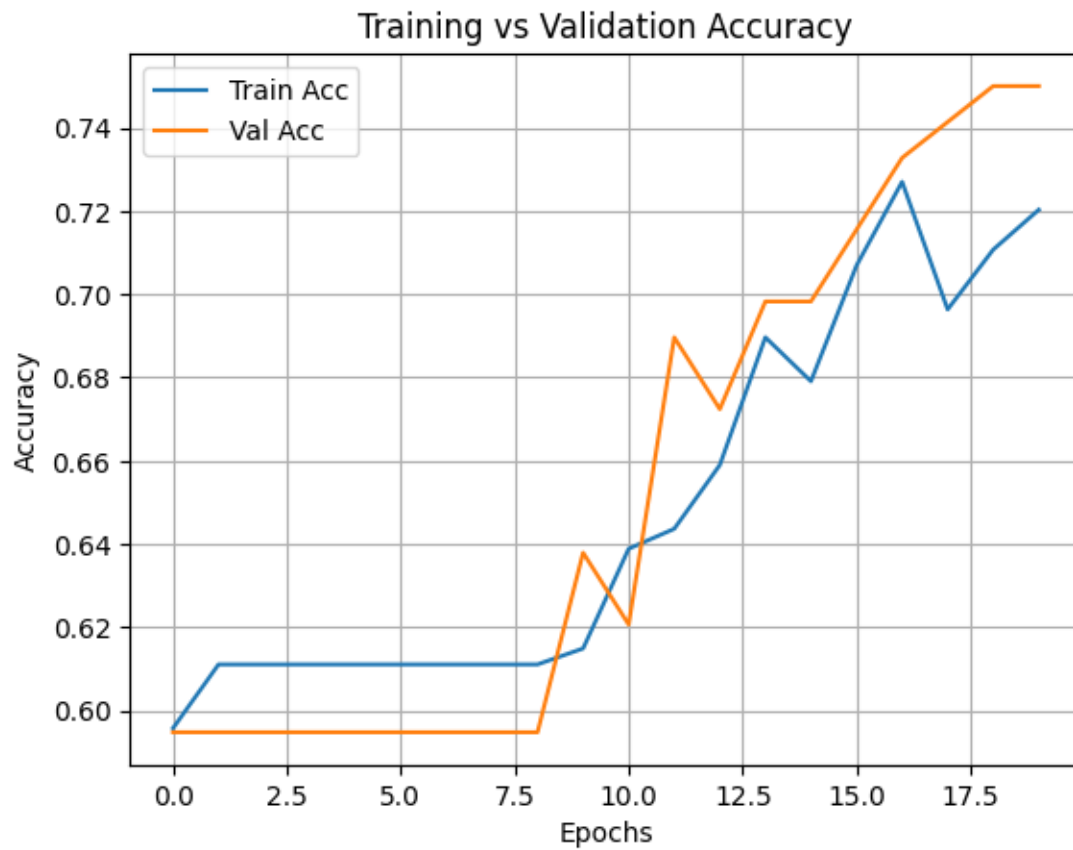
[21]: import matplotlib.pyplot as plt

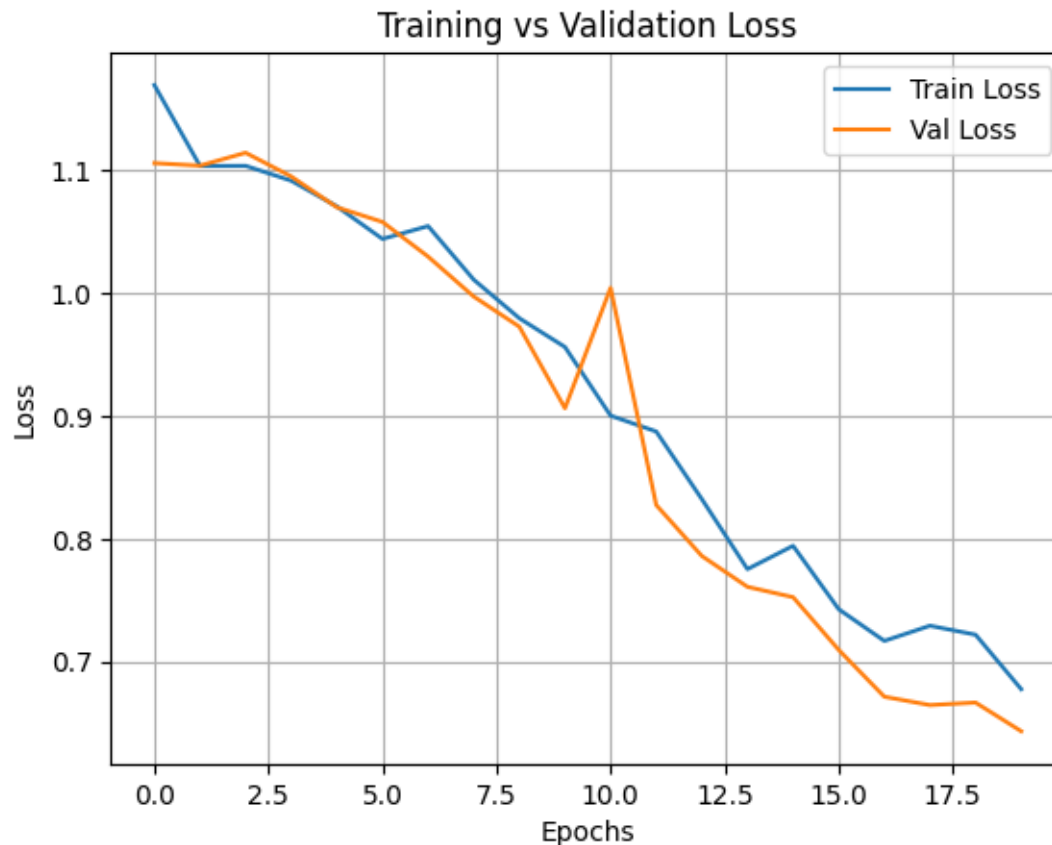
      # Accuracy plot
      plt.plot(history.history['accuracy'], label='Train Acc')
      plt.plot(history.history['val_accuracy'], label='Val Acc')
      plt.xlabel('Epochs')
      plt.ylabel('Accuracy')
      plt.title('Training vs Validation Accuracy')
      plt.legend()
      plt.grid(True)
      plt.show()

      # Loss plot
      plt.plot(history.history['loss'], label='Train Loss')

```

```
plt.plot(history.history['val_loss'], label='Val Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.title('Training vs Validation Loss')
plt.legend()
plt.grid(True)
plt.show()
```





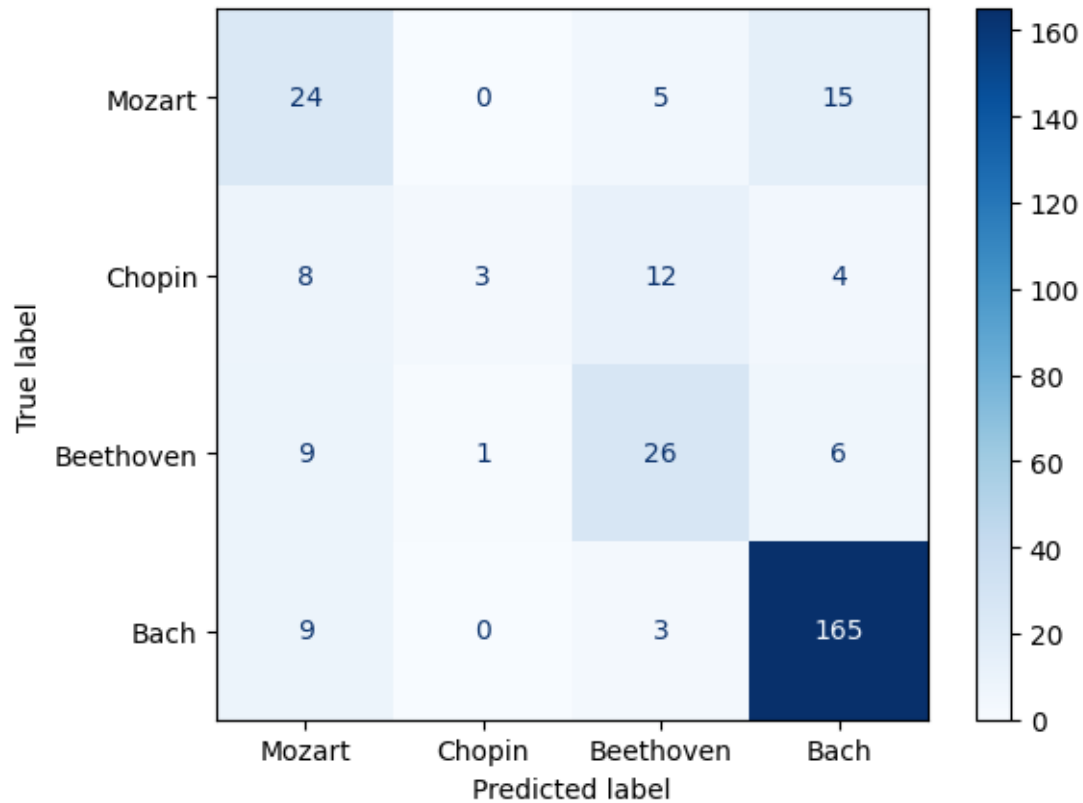
```
[22]: from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
import numpy as np

# Get predictions
y_pred_probs = model.predict(X_test)
y_pred = np.argmax(y_pred_probs, axis=1)

# Show confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(cm, display_labels=["Mozart", "Chopin",
↪ "Beethoven", "Bach"])
disp.plot(cmap="Blues")
```

10/10 1s 62ms/step

```
[22]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7b1280db0050>
```



it seems data is highly imbalanced

```
[23]: import numpy as np
from collections import Counter
from tqdm import tqdm

def transpose_roll(roll, semitone_shift):
    if semitone_shift == 0:
        return roll
    shifted = np.roll(roll, shift=semitone_shift, axis=0)
    if semitone_shift > 0:
        shifted[:semitone_shift, :] = 0
    else:
        shifted[semitone_shift:, :] = 0
    return shifted

def balance_dataset_with_augmentation(X_raw, y_raw, target_classes=[0, 1, 2, 3],
    max_shifts=[-2, -1, 1, 2]):
    print(" Original class distribution:")
    class_counts = Counter(y_raw)
    for label in sorted(class_counts):
```

```

    print(f" Class {label}: {class_counts[label]} samples")

max_count = max(class_counts.values())

X_aug = []
y_aug = []

for class_label in sorted(set(y_raw)):
    class_indices = [i for i, y in enumerate(y_raw) if y == class_label]
    class_samples = [X_raw[i] for i in class_indices]

    # Add original samples
    X_aug.extend(class_samples)
    y_aug.extend([class_label] * len(class_samples))

    needed = max_count - len(class_samples)
    if needed <= 0:
        continue # Already at or above max

    print(f" Augmenting class {class_label}: need {needed} more samples")

    count = 0
    while count < needed:
        for i in range(len(class_samples)):
            if count >= needed:
                break
            shift = np.random.choice(max_shifts)
            new_sample = transpose_roll(class_samples[i], shift)
            X_aug.append(new_sample)
            y_aug.append(class_label)
            count += 1

    print("\n Final class distribution after augmentation:")
    new_counts = Counter(y_aug)
    for label in sorted(new_counts):
        print(f" Class {label}: {new_counts[label]} samples")

X_aug = np.array(X_aug)[..., np.newaxis] # Add channel dim
y_aug = np.array(y_aug)
return X_aug, y_aug

```

```
[24]: X_balanced, y_balanced = balance_dataset_with_augmentation(X, y)
```

Original class distribution:

Class 0: 219 samples

Class 1: 136 samples

Class 2: 211 samples

Class 3: 884 samples

Augmenting class 0: need 665 more samples
Augmenting class 1: need 748 more samples
Augmenting class 2: need 673 more samples

Final class distribution after augmentation:

Class 0: 884 samples
Class 1: 884 samples
Class 2: 884 samples
Class 3: 884 samples

```
[25]: # Redefine the model before retraining
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, GlobalAveragePooling2D, Dense, Dropout

model = Sequential([
    Conv2D(32, (3, 3), activation='relu', input_shape=(128, 500, 1)),
    MaxPooling2D((2, 2)),

    Conv2D(64, (3, 3), activation='relu'),
    MaxPooling2D((2, 2)),

    Conv2D(128, (3, 3), activation='relu'),
    MaxPooling2D((2, 2)),

    GlobalAveragePooling2D(),

    Dense(128, activation='relu'),
    Dropout(0.3),
    Dense(4, activation='softmax')
])

model.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
model.summary()
```

Model: "sequential_1"

Layer (type)	Output Shape	Param #
conv2d_3 (Conv2D)	(None, 126, 498, 32)	320
max_pooling2d_3 (MaxPooling2D)	(None, 63, 249, 32)	0
conv2d_4 (Conv2D)	(None, 61, 247, 64)	18,496

max_pooling2d_4 (MaxPooling2D)	(None, 30, 123, 64)	0
conv2d_5 (Conv2D)	(None, 28, 121, 128)	73,856
max_pooling2d_5 (MaxPooling2D)	(None, 14, 60, 128)	0
global_average_pooling2d_1 (GlobalAveragePooling2D)	(None, 128)	0
dense_2 (Dense)	(None, 128)	16,512
dropout_1 (Dropout)	(None, 128)	0
dense_3 (Dense)	(None, 4)	516

Total params: 109,700 (428.52 KB)

Trainable params: 109,700 (428.52 KB)

Non-trainable params: 0 (0.00 B)

```
[26]: from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(
    X_balanced, y_balanced, test_size=0.2, stratify=y_balanced, random_state=42)
```

```
[27]: # Add early stopping
from tensorflow.keras.callbacks import EarlyStopping
early_stopping = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True
)
history = model.fit(
    X_train, y_train,
    epochs=20,
    batch_size=32,
    validation_split=0.1,
    verbose=1,
    callbacks=[early_stopping] # Add early stopping callback
)
```

Epoch 1/20

80/80 17s 147ms/step -

accuracy: 0.2808 - loss: 1.3759 - val_accuracy: 0.3074 - val_loss: 1.3433

Epoch 2/20
80/80 11s 62ms/step -
accuracy: 0.3632 - loss: 1.3235 - val_accuracy: 0.4134 - val_loss: 1.2732
Epoch 3/20
80/80 5s 59ms/step -
accuracy: 0.4124 - loss: 1.2409 - val_accuracy: 0.4205 - val_loss: 1.2343
Epoch 4/20
80/80 5s 59ms/step -
accuracy: 0.4951 - loss: 1.1304 - val_accuracy: 0.5194 - val_loss: 1.0342
Epoch 5/20
80/80 5s 60ms/step -
accuracy: 0.5436 - loss: 1.0068 - val_accuracy: 0.5265 - val_loss: 0.9801
Epoch 6/20
80/80 5s 59ms/step -
accuracy: 0.5481 - loss: 0.9809 - val_accuracy: 0.5795 - val_loss: 1.0075
Epoch 7/20
80/80 5s 60ms/step -
accuracy: 0.5889 - loss: 0.9225 - val_accuracy: 0.5512 - val_loss: 1.0799
Epoch 8/20
80/80 5s 61ms/step -
accuracy: 0.5909 - loss: 0.9382 - val_accuracy: 0.5689 - val_loss: 0.9230
Epoch 9/20
80/80 5s 60ms/step -
accuracy: 0.6227 - loss: 0.8454 - val_accuracy: 0.6042 - val_loss: 0.8979
Epoch 10/20
80/80 5s 63ms/step -
accuracy: 0.6234 - loss: 0.8289 - val_accuracy: 0.6184 - val_loss: 0.8831
Epoch 11/20
80/80 5s 61ms/step -
accuracy: 0.6335 - loss: 0.8117 - val_accuracy: 0.6360 - val_loss: 0.8601
Epoch 12/20
80/80 5s 60ms/step -
accuracy: 0.6642 - loss: 0.7827 - val_accuracy: 0.6643 - val_loss: 0.8120
Epoch 13/20
80/80 5s 61ms/step -
accuracy: 0.6492 - loss: 0.7606 - val_accuracy: 0.6714 - val_loss: 0.7961
Epoch 14/20
80/80 5s 61ms/step -
accuracy: 0.6461 - loss: 0.7775 - val_accuracy: 0.5830 - val_loss: 0.9583
Epoch 15/20
80/80 5s 62ms/step -
accuracy: 0.6511 - loss: 0.7833 - val_accuracy: 0.6996 - val_loss: 0.7546
Epoch 16/20
80/80 5s 59ms/step -
accuracy: 0.6823 - loss: 0.7169 - val_accuracy: 0.6643 - val_loss: 0.7622
Epoch 17/20
80/80 5s 59ms/step -
accuracy: 0.6815 - loss: 0.7467 - val_accuracy: 0.7067 - val_loss: 0.7358


```
Epoch 18/20
80/80          5s 60ms/step -
accuracy: 0.6934 - loss: 0.6919 - val_accuracy: 0.7244 - val_loss: 0.6955
Epoch 19/20
80/80          5s 61ms/step -
accuracy: 0.7209 - loss: 0.6303 - val_accuracy: 0.7420 - val_loss: 0.6963
Epoch 20/20
80/80          5s 59ms/step -
accuracy: 0.7576 - loss: 0.6243 - val_accuracy: 0.7102 - val_loss: 0.6862
```

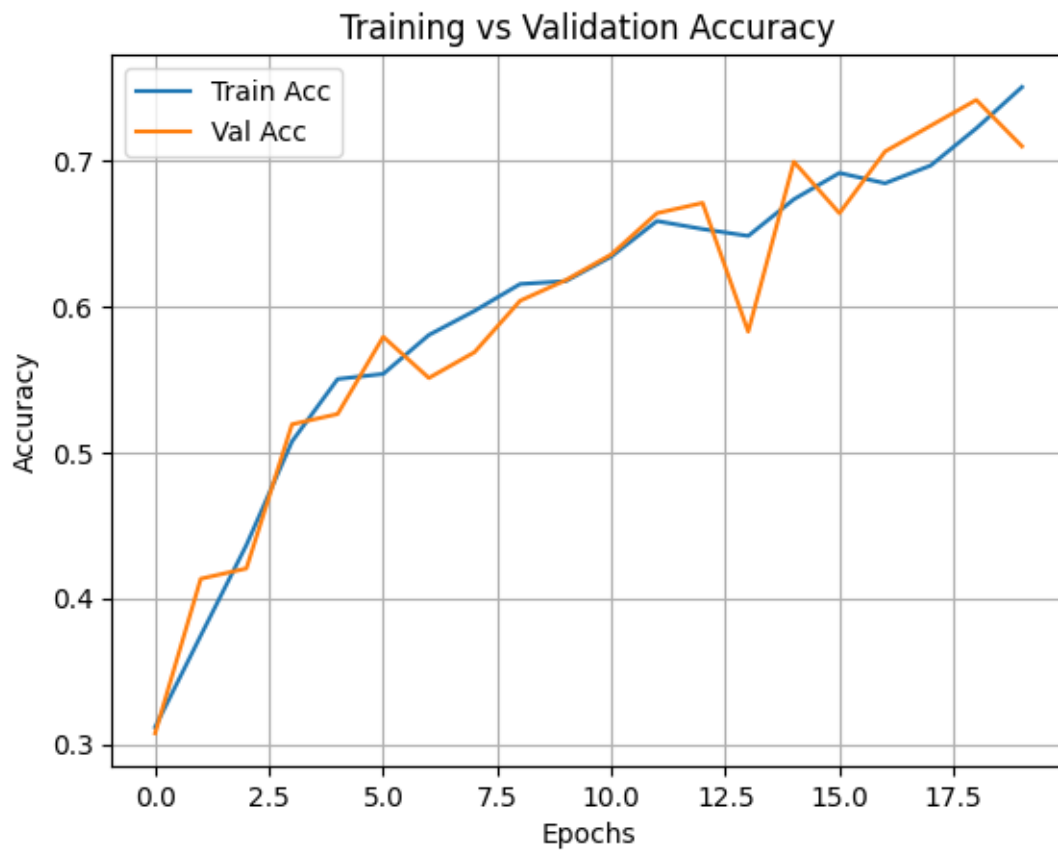
```
[28]: test_loss, test_acc = model.evaluate(X_test, y_test)
      print(f" Test Accuracy: {test_acc:.2%}")
```

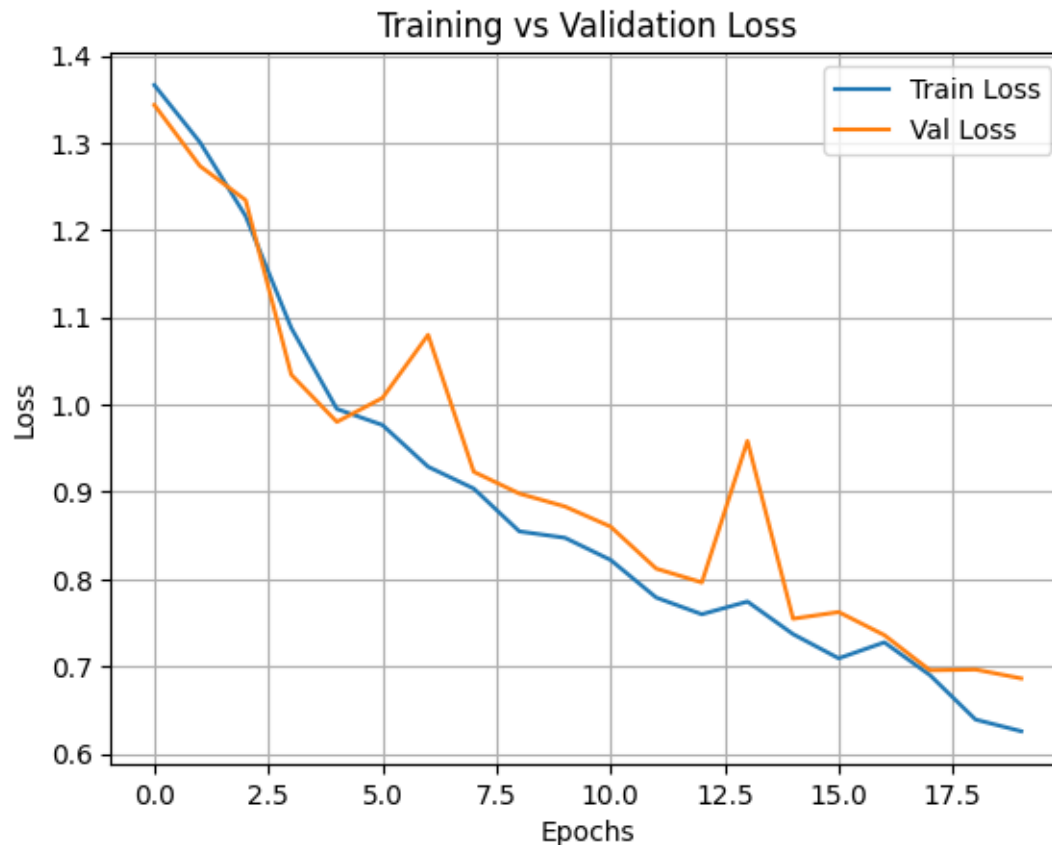
```
23/23          1s 54ms/step -
accuracy: 0.7102 - loss: 0.7353
Test Accuracy: 71.19%
```

```
[29]: import matplotlib.pyplot as plt

      # Accuracy plot
      plt.plot(history.history['accuracy'], label='Train Acc')
      plt.plot(history.history['val_accuracy'], label='Val Acc')
      plt.xlabel('Epochs')
      plt.ylabel('Accuracy')
      plt.title('Training vs Validation Accuracy')
      plt.legend()
      plt.grid(True)
      plt.show()

      # Loss plot
      plt.plot(history.history['loss'], label='Train Loss')
      plt.plot(history.history['val_loss'], label='Val Loss')
      plt.xlabel('Epochs')
      plt.ylabel('Loss')
      plt.title('Training vs Validation Loss')
      plt.legend()
      plt.grid(True)
```





```
[30]: from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
import numpy as np

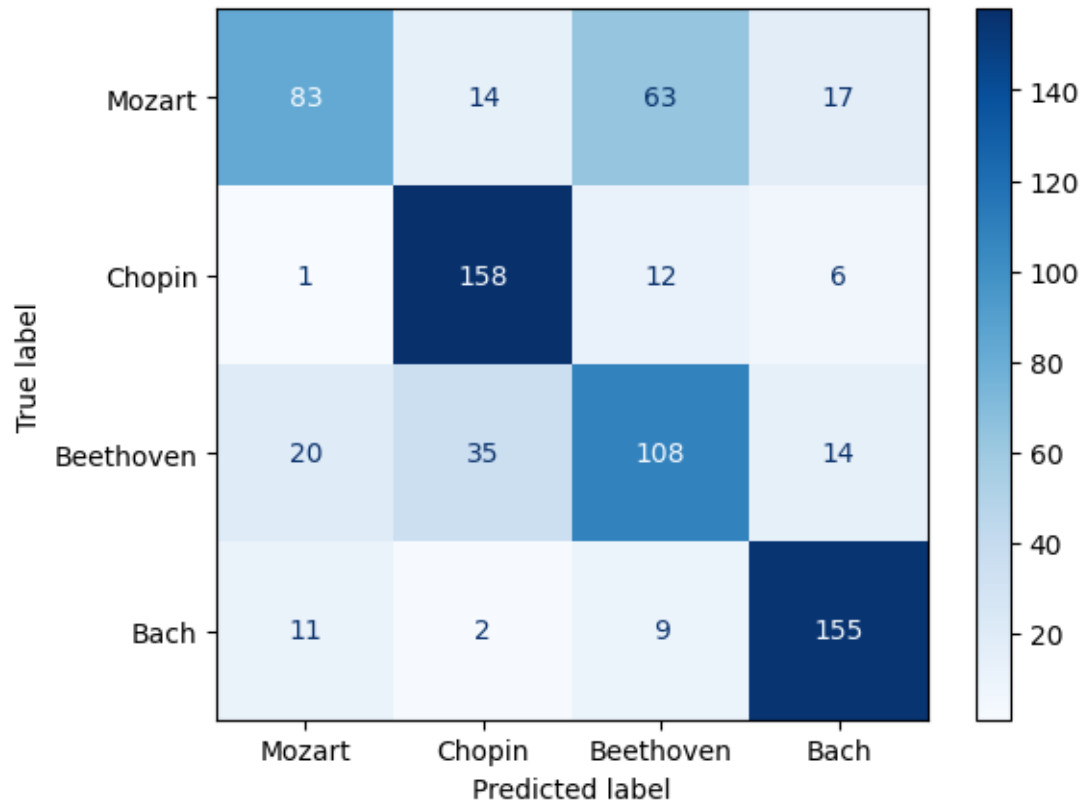
# Get predictions
y_pred_probs = model.predict(X_test)
y_pred = np.argmax(y_pred_probs, axis=1)

# Show confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(cm, display_labels=["Mozart", "Chopin",
↪ "Beethoven", "Bach"])
disp.plot(cmap="Blues")
```

23/23

2s 49ms/step

```
[30]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7b12e3bc6d50>
```



```
[31]: from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred, target_names=["Mozart", "Chopin",
↪ "Beethoven", "Bach"]))
```

	precision	recall	f1-score	support
Mozart	0.72	0.47	0.57	177
Chopin	0.76	0.89	0.82	177
Beethoven	0.56	0.61	0.59	177
Bach	0.81	0.88	0.84	177
accuracy			0.71	708
macro avg	0.71	0.71	0.70	708
weighted avg	0.71	0.71	0.70	708

```
[32]: from tensorflow.keras.models import Model
from tensorflow.keras.layers import Input, Conv2D, MaxPooling2D,
↪ GlobalAveragePooling2D, Dense, Dropout

input_layer = Input(shape=(128, 500, 1))
```

```

x = Conv2D(32, (3, 3), activation='relu')(input_layer)
x = MaxPooling2D((2, 2), name='max_pooling2d_1')(x)

x = Conv2D(64, (3, 3), activation='relu')(x)
x = MaxPooling2D((2, 2), name='max_pooling2d_2')(x)

x = Conv2D(128, (3, 3), activation='relu')(x)
x = MaxPooling2D((2, 2), name='max_pooling2d_3')(x)

x = MaxPooling2D((2, 2), name='max_pooling2d_4')(x) # Shape: (None, 14, 60, 128) for piano roll input

# Save this point for extraction:
cnn_features = x # (14, 60, 128)

# Classification layers
x = GlobalAveragePooling2D()(cnn_features)
x = Dense(128, activation='relu')(x)
x = Dropout(0.3)(x)
output = Dense(4, activation='softmax')(x)

# Final model
model = Model(inputs=input_layer, outputs=output)
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
model.summary()

```

Model: "functional_2"

Layer (type)	Output Shape	Param #
input_layer_2 (InputLayer)	(None, 128, 500, 1)	0
conv2d_6 (Conv2D)	(None, 126, 498, 32)	320
max_pooling2d_1 (MaxPooling2D)	(None, 63, 249, 32)	0
conv2d_7 (Conv2D)	(None, 61, 247, 64)	18,496
max_pooling2d_2 (MaxPooling2D)	(None, 30, 123, 64)	0
conv2d_8 (Conv2D)	(None, 28, 121, 128)	73,856
max_pooling2d_3 (MaxPooling2D)	(None, 14, 60, 128)	0
max_pooling2d_4 (MaxPooling2D)	(None, 7, 30, 128)	0

global_average_pooling2d_2 (GlobalAveragePooling2D)	(None, 128)	0
dense_4 (Dense)	(None, 128)	16,512
dropout_2 (Dropout)	(None, 128)	0
dense_5 (Dense)	(None, 4)	516

Total params: 109,700 (428.52 KB)

Trainable params: 109,700 (428.52 KB)

Non-trainable params: 0 (0.00 B)

```
[33]: # Add early stoppping
from tensorflow.keras.callbacks import EarlyStopping
early_stopping = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True
)
history = model.fit(
    X_train, y_train,
    epochs=20,
    batch_size=32,
    validation_split=0.1,
    verbose=1,
    callbacks=[early_stopping] # Add early stopping callback
)
```

```
Epoch 1/20
80/80          12s 100ms/step -
accuracy: 0.2746 - loss: 1.3770 - val_accuracy: 0.3534 - val_loss: 1.3379
Epoch 2/20
80/80          5s 63ms/step -
accuracy: 0.4074 - loss: 1.3156 - val_accuracy: 0.3746 - val_loss: 1.2771
Epoch 3/20
80/80          5s 62ms/step -
accuracy: 0.4088 - loss: 1.2571 - val_accuracy: 0.4028 - val_loss: 1.2194
Epoch 4/20
80/80          5s 61ms/step -
accuracy: 0.4824 - loss: 1.1653 - val_accuracy: 0.4523 - val_loss: 1.1426
Epoch 5/20
```

80/80 5s 62ms/step -
 accuracy: 0.5385 - loss: 0.9860 - val_accuracy: 0.5512 - val_loss: 0.9341
 Epoch 6/20
 80/80 5s 62ms/step -
 accuracy: 0.5390 - loss: 1.0318 - val_accuracy: 0.5618 - val_loss: 0.9232
 Epoch 7/20
 80/80 5s 61ms/step -
 accuracy: 0.6047 - loss: 0.8852 - val_accuracy: 0.5972 - val_loss: 0.8619
 Epoch 8/20
 80/80 5s 64ms/step -
 accuracy: 0.6072 - loss: 0.8785 - val_accuracy: 0.6219 - val_loss: 0.8334
 Epoch 9/20
 80/80 10s 60ms/step -
 accuracy: 0.6437 - loss: 0.8234 - val_accuracy: 0.5548 - val_loss: 0.8875
 Epoch 10/20
 80/80 5s 61ms/step -
 accuracy: 0.6242 - loss: 0.8254 - val_accuracy: 0.6572 - val_loss: 0.7696
 Epoch 11/20
 80/80 5s 60ms/step -
 accuracy: 0.6737 - loss: 0.7247 - val_accuracy: 0.7032 - val_loss: 0.7188
 Epoch 12/20
 80/80 5s 61ms/step -
 accuracy: 0.6838 - loss: 0.7185 - val_accuracy: 0.6961 - val_loss: 0.6856
 Epoch 13/20
 80/80 5s 61ms/step -
 accuracy: 0.6998 - loss: 0.6579 - val_accuracy: 0.6926 - val_loss: 0.7513
 Epoch 14/20
 80/80 5s 61ms/step -
 accuracy: 0.7139 - loss: 0.6851 - val_accuracy: 0.7208 - val_loss: 0.6773
 Epoch 15/20
 80/80 5s 62ms/step -
 accuracy: 0.7306 - loss: 0.6424 - val_accuracy: 0.7597 - val_loss: 0.7185
 Epoch 16/20
 80/80 5s 63ms/step -
 accuracy: 0.7369 - loss: 0.6354 - val_accuracy: 0.7739 - val_loss: 0.5944
 Epoch 17/20
 80/80 5s 63ms/step -
 accuracy: 0.7519 - loss: 0.5938 - val_accuracy: 0.7774 - val_loss: 0.6231
 Epoch 18/20
 80/80 5s 62ms/step -
 accuracy: 0.7501 - loss: 0.6009 - val_accuracy: 0.7880 - val_loss: 0.6166
 Epoch 19/20
 80/80 5s 61ms/step -
 accuracy: 0.7649 - loss: 0.5676 - val_accuracy: 0.7809 - val_loss: 0.5609
 Epoch 20/20
 80/80 5s 64ms/step -
 accuracy: 0.7796 - loss: 0.5261 - val_accuracy: 0.7562 - val_loss: 0.5790

```
[34]: feature_extractor = Model(
        inputs=model.input,
        outputs=model.get_layer("max_pooling2d_4").output
    )

    features = feature_extractor.predict(X_balanced, batch_size=32, verbose=1)
    print("Extracted feature shape:", features.shape)  # (samples, 14, 60, 128)
```

```
111/111          6s 29ms/step
Extracted feature shape: (3536, 7, 30, 128)
```

```
[35]: X_lstm = features.transpose(0, 2, 1, 3).reshape(features.shape[0], 30, 7 * 128)

    print("X_lstm shape:", X_lstm.shape)  # (3536, 30, 896)
```

```
X_lstm shape: (3536, 30, 896)
```

Need to convert the MIDI files into numerical sequences that the LSTM model can better understand and learn from

```
[36]: def get_notes_at_time(midi_data, time_point):
        """
        Find all notes playing at a specific time point.

        WHY: We need to know what notes are active at each moment to understand
        the musical content. This helps us track melody, harmony, and rhythm.

        Args:
            midi_data: The loaded MIDI file
            time_point: The time (in seconds) we want to check

        Returns:
            List of note pitches playing at that time
        """
        active_notes = []

        # Look through all instruments in the MIDI file
        for instrument in midi_data.instruments:
            # Skip drum tracks (we focus on pitched instruments)
            if instrument.is_drum:
                continue

            # Look through all notes in this instrument
            for note in instrument.notes:
                # Check if this note is playing at our time point
                if note.start <= time_point < note.end:
                    active_notes.append(note.pitch)

        return active_notes
```



```
[37]: def extract_basic_features_from_midi(midi_data):
    """
    Extract simple musical features from a MIDI file.

    WHY EACH FEATURE MATTERS FOR COMPOSER IDENTIFICATION:

    1. PITCH SEQUENCE: Different composers use different melodic patterns
        - Bach: Complex counterpoint, wide ranges
        - Mozart: Elegant, balanced melodies
        - Beethoven: Bold, dramatic pitch movements
        - Chopin: Ornate, flowing melodic lines

    2. NOTE DENSITY: How many notes play simultaneously
        - Bach: Dense, polyphonic textures
        - Chopin: Varied density with accompaniment patterns
        - Classical composers: Different orchestration styles

    3. PITCH RANGE: The span between highest and lowest notes
        - Shows compositional complexity and instrument usage
        - Some composers write in wider ranges than others

    4. RHYTHM PATTERNS: When notes start and stop
        - Each composer has characteristic rhythmic signatures
        - Helps distinguish between musical periods and styles
    """

    # Step 1: Set up time grid
    # WHY: Need consistent time intervals to create sequences for LSTM
    time_step = 0.1 # Check every 0.1 seconds (100 milliseconds)
    total_duration = midi_data.get_end_time()

    print(f"    Processing MIDI file: {total_duration:.2f} seconds long")

    # Create time points from start to end
    time_points = []
    current_time = 0.0
    while current_time < total_duration:
        time_points.append(current_time)
        current_time += time_step

    # Step 2: Initialize the feature lists
    pitch_sequence = [] # Main melody line over time
    note_count_sequence = [] # How many notes at each time point
    pitch_range_sequence = [] # Range between high and low notes

    # Step 3: Extract features at each time point
    print(f"    Analyzing {len(time_points)} time points...")
```

```

for i, time_point in enumerate(time_points):
    # Show progress every 1000 time points
    if i % 1000 == 0 and i > 0:
        print(f"        Processed {i}/{len(time_points)} time points")

    # Get all notes playing at this time
    active_notes = get_notes_at_time(midi_data, time_point)

    if len(active_notes) > 0:
        # FEATURE 1: Primary pitch (highest note - often the melody)
        # WHY: The melody is usually the most characteristic part
        highest_pitch = max(active_notes)
        pitch_sequence.append(highest_pitch)

        # FEATURE 2: Note density (polyphony)
        # WHY: Bach uses more simultaneous notes than Chopin typically
        note_count = len(active_notes)
        note_count_sequence.append(note_count)

        # FEATURE 3: Pitch range at this moment
        # WHY: Shows harmonic complexity and voicing style
        lowest_pitch = min(active_notes)
        pitch_range = highest_pitch - lowest_pitch
        pitch_range_sequence.append(pitch_range)

    else:
        # No notes playing - this is silence
        pitch_sequence.append(0)          # 0 = silence
        note_count_sequence.append(0)    # No notes
        pitch_range_sequence.append(0)   # No range

# Step 4: Calculate additional features

# TEMPO INFORMATION
# WHY: Different composers prefer different tempos and tempo stability
tempo_changes = midi_data.get_tempo_changes()
if len(tempo_changes[1]) > 0:
    average_tempo = float(np.mean(tempo_changes[1]))
    initial_tempo = float(tempo_changes[1][0])
    tempo_variation = float(np.std(tempo_changes[1])) if
↪len(tempo_changes[1]) > 1 else 0.0
else:
    average_tempo = 120.0 # Default tempo
    initial_tempo = 120.0
    tempo_variation = 0.0

```

```

# OVERALL STATISTICS
# WHY: These give us composer "signatures"
total_notes = 0
for instrument in midi_data.instruments:
    if not instrument.is_drum:
        total_notes += len(instrument.notes)

# Calculate average values
avg_pitch = float(np.mean([p for p in pitch_sequence if p > 0])) if any(p > 0
↪ for p in pitch_sequence) else 0.0
avg_note_density = float(np.mean(note_count_sequence))
max_simultaneous_notes = float(max(note_count_sequence)) if
↪ note_count_sequence else 0.0

# Step 5: Package all features together
features = {
    # Time series features (for LSTM input)
    'pitch_sequence': pitch_sequence,
    'note_density_sequence': note_count_sequence,
    'pitch_range_sequence': pitch_range_sequence,

    # Summary statistics
    'total_duration': float(total_duration),
    'sequence_length': len(pitch_sequence),
    'total_notes': total_notes,
    'average_tempo': average_tempo,
    'initial_tempo': initial_tempo,
    'tempo_variation': tempo_variation,
    'average_pitch': avg_pitch,
    'average_note_density': avg_note_density,
    'max_simultaneous_notes': max_simultaneous_notes,

    # File info
    'num_instruments': len([inst for inst in midi_data.instruments if not
↪ inst.is_drum])
}

return features

```

```

[38]: def process_one_composer(midi_dictionary, composer_name):
    """
    Extract features from all MIDI files for one composer.

    Args:
        midi_dictionary: Dictionary containing MIDI files (like
↪ mozart_midi_data)
        composer_name: Name of composer (like "Mozart")

```

```

Returns:
    List of feature dictionaries, one for each MIDI file
    """
print(f"\n--- Processing {composer_name} ---")
print(f"Found {len(midi_dictionary)} MIDI files for {composer_name}")

composer_features = []
successful_files = 0
failed_files = 0

# Process each MIDI file
for filename, midi_data in midi_dictionary.items():
    print(f"    Processing: {filename}")

    try:
        # Extract features from this MIDI file
        features = extract_basic_features_from_midi(midi_data)

        # Add composer label and filename
        features['composer'] = composer_name
        features['filename'] = filename

        # Add to the list
        composer_features.append(features)
        successful_files += 1

    except Exception as error:
        print(f"    ERROR processing {filename}: {error}")
        failed_files += 1
        continue

print(f"    Successfully processed: {successful_files} files")
if failed_files > 0:
    print(f"    Failed to process: {failed_files} files")

return composer_features

```

```

[39]: def extract_features_from_all_composers():
    """
    Main function to extract features from all four composers.

    This function will use the MIDI dictionaries:
    - mozart_midi_data
    - chopin_midi_data
    - beethoven_midi_data
    - bach_midi_data
    """

```

```

Returns:
    List containing features from all MIDI files
    """
    print("=== STARTING FEATURE EXTRACTION ===")
    print("This will convert MIDI files into numerical features for machine_
↪learning")
    print()

    all_features = []

    # Process each composer one by one
    # WHY THIS ORDER: Start with smaller datasets to test, then process Bach_
↪(largest)

    # 1. Mozart (219 files)
    mozart_features = process_one_composer(mozart_midi_data, "Mozart")
    all_features.extend(mozart_features)

    # 2. Chopin (136 files)
    chopin_features = process_one_composer(chopin_midi_data, "Chopin")
    all_features.extend(chopin_features)

    # 3. Beethoven (211 files)
    beethoven_features = process_one_composer(beethoven_midi_data, "Beethoven")
    all_features.extend(beethoven_features)

    # 4. Bach (876 files) - largest dataset
    bach_features = process_one_composer(bach_midi_data, "Bach")
    all_features.extend(bach_features)

    # Print final summary
    print(f"\n=== FEATURE EXTRACTION COMPLETE ===")
    print(f"Total files processed: {len(all_features)}")

    # Count by composer
    for composer in ["Mozart", "Chopin", "Beethoven", "Bach"]:
        count = sum(1 for f in all_features if f['composer'] == composer)
        print(f" {composer}: {count} files")

    return all_features

```

```

[40]: # Run the feature extraction
print("Starting feature extraction process...")
print()

# Extract features from all composers

```

```
all_extracted_features = extract_features_from_all_composers()
```

Streaming output truncated to the last 5000 lines.

```
Processing MIDI file: 441.00 seconds long
Analyzing 4411 time points...
  Processed 1000/4411 time points
  Processed 2000/4411 time points
  Processed 3000/4411 time points
  Processed 4000/4411 time points
Processing: Overture_InaugurationoftheHouse_op214.mid
Processing MIDI file: 641.75 seconds long
Analyzing 6418 time points...
  Processed 1000/6418 time points
  Processed 2000/6418 time points
  Processed 3000/6418 time points
  Processed 4000/6418 time points
  Processed 5000/6418 time points
  Processed 6000/6418 time points
Processing: Bagatellaop33n3.mid
Processing MIDI file: 99.58 seconds long
Analyzing 996 time points...
Processing: Bagatellaop33n1.mid
Processing MIDI file: 204.81 seconds long
Analyzing 2049 time points...
  Processed 1000/2049 time points
  Processed 2000/2049 time points
Processing: PianoConcerton5op732-3mov_Emperor_.mid
Processing MIDI file: 1108.85 seconds long
Analyzing 11089 time points...
  Processed 1000/11089 time points
  Processed 2000/11089 time points
  Processed 3000/11089 time points
  Processed 4000/11089 time points
  Processed 5000/11089 time points
  Processed 6000/11089 time points
  Processed 7000/11089 time points
  Processed 8000/11089 time points
  Processed 9000/11089 time points
  Processed 10000/11089 time points
  Processed 11000/11089 time points
Processing: Liederop99_DerMannVonWort_.mid
Processing MIDI file: 115.95 seconds long
Analyzing 1160 time points...
  Processed 1000/1160 time points
Processing: Op51.mid
Processing MIDI file: 269.45 seconds long
Analyzing 2695 time points...
  Processed 1000/2695 time points
```

Processed 2000/2695 time points
 Processing: FurElise.mid
 Processing MIDI file: 157.61 seconds long
 Analyzing 1577 time points...
 Processed 1000/1577 time points
 Processing: PianoConcerton4op583mov.mid
 Processing MIDI file: 552.84 seconds long
 Analyzing 5529 time points...
 Processed 1000/5529 time points
 Processed 2000/5529 time points
 Processed 3000/5529 time points
 Processed 4000/5529 time points
 Processed 5000/5529 time points
 Processing: PianoConcerton4op581mov.mid
 Processing MIDI file: 1045.90 seconds long
 Analyzing 10460 time points...
 Processed 1000/10460 time points
 Processed 2000/10460 time points
 Processed 3000/10460 time points
 Processed 4000/10460 time points
 Processed 5000/10460 time points
 Processed 6000/10460 time points
 Processed 7000/10460 time points
 Processed 8000/10460 time points
 Processed 9000/10460 time points
 Processed 10000/10460 time points
 Processing: 32Variationsonatheme.mid
 Processing MIDI file: 618.94 seconds long
 Analyzing 6190 time points...
 Processed 1000/6190 time points
 Processed 2000/6190 time points
 Processed 3000/6190 time points
 Processed 4000/6190 time points
 Processed 5000/6190 time points
 Processed 6000/6190 time points
 Processing: PianoConcertoNo5Mov1.mid
 Processing MIDI file: 1129.31 seconds long
 Analyzing 11294 time points...
 Processed 1000/11294 time points
 Processed 2000/11294 time points
 Processed 3000/11294 time points
 Processed 4000/11294 time points
 Processed 5000/11294 time points
 Processed 6000/11294 time points
 Processed 7000/11294 time points
 Processed 8000/11294 time points
 Processed 9000/11294 time points
 Processed 10000/11294 time points

Processed 11000/11294 time points
 Processing: AndanteinFMajor.mid
 Processing MIDI file: 250.50 seconds long
 Analyzing 2506 time points...
 Processed 1000/2506 time points
 Processed 2000/2506 time points
 Processing: Liederop48n3_VomTode_.mid
 Processing MIDI file: 110.25 seconds long
 Analyzing 1103 time points...
 Processed 1000/1103 time points
 Processing: PianoConcerton1op152mov.mid
 Processing MIDI file: 482.49 seconds long
 Analyzing 4825 time points...
 Processed 1000/4825 time points
 Processed 2000/4825 time points
 Processed 3000/4825 time points
 Processed 4000/4825 time points
 Processing: Overture_Leonore_op138n1.mid
 Processing MIDI file: 581.17 seconds long
 Analyzing 5812 time points...
 Processed 1000/5812 time points
 Processed 2000/5812 time points
 Processed 3000/5812 time points
 Processed 4000/5812 time points
 Processed 5000/5812 time points
 Processing: Liederop48n6_Busslied_.mid
 Processing MIDI file: 260.50 seconds long
 Analyzing 2606 time points...
 Processed 1000/2606 time points
 Processed 2000/2606 time points
 Processing: PianoConcertoNo5Mov3.mid
 Processing MIDI file: 601.95 seconds long
 Analyzing 6020 time points...
 Processed 1000/6020 time points
 Processed 2000/6020 time points
 Processed 3000/6020 time points
 Processed 4000/6020 time points
 Processed 5000/6020 time points
 Processed 6000/6020 time points
 Processing: PianoSonataNo273rdmov.mid
 Processing MIDI file: 414.93 seconds long
 Analyzing 4150 time points...
 Processed 1000/4150 time points
 Processed 2000/4150 time points
 Processed 3000/4150 time points
 Processed 4000/4150 time points
 Processing: HessA21Bagatella.mid
 Processing MIDI file: 63.72 seconds long

Analyzing 638 time points...
 Processing: Bagatellaop33n6.mid
 Processing MIDI file: 134.03 seconds long
 Analyzing 1341 time points...
 Processed 1000/1341 time points
 Processing: Op33No4.mid
 Processing MIDI file: 172.00 seconds long
 Analyzing 1721 time points...
 Processed 1000/1721 time points
 Processing: Liederop48n5_GottesMachtUndVorsehung_.mid
 Processing MIDI file: 32.14 seconds long
 Analyzing 322 time points...
 Processing: PianoSonataNo2Assaivivace.mid
 Processing MIDI file: 150.85 seconds long
 Analyzing 1509 time points...
 Processed 1000/1509 time points
 Processing: Overture_Corolian_op62.mid
 Processing MIDI file: 462.62 seconds long
 Analyzing 4627 time points...
 Processed 1000/4627 time points
 Processed 2000/4627 time points
 Processed 3000/4627 time points
 Processed 4000/4627 time points
 Processing: PianoSonataNo28inBflat-Hammerklavier-Op1062ndMovScherzo.mid
 Processing MIDI file: 150.85 seconds long
 Analyzing 1509 time points...
 Processed 1000/1509 time points
 Processing: Bagatellaop33n5.mid
 Processing MIDI file: 143.08 seconds long
 Analyzing 1431 time points...
 Processed 1000/1431 time points
 Processing: op126SixBagatellas.mid
 Processing MIDI file: 908.27 seconds long
 Analyzing 9083 time points...
 Processed 1000/9083 time points
 Processed 2000/9083 time points
 Processed 3000/9083 time points
 Processed 4000/9083 time points
 Processed 5000/9083 time points
 Processed 6000/9083 time points
 Processed 7000/9083 time points
 Processed 8000/9083 time points
 Processed 9000/9083 time points
 Processing: SonatainBflatMajorOp106.mid
 Processing MIDI file: 149.50 seconds long
 Analyzing 1495 time points...
 Processed 1000/1495 time points
 Processing: SonataOpus81a-LesAdieux-EflatNo23.mid

Processing MIDI file: 548.52 seconds long
Analyzing 5486 time points...
 Processed 1000/5486 time points
 Processed 2000/5486 time points
 Processed 3000/5486 time points
 Processed 4000/5486 time points
 Processed 5000/5486 time points
Processing: SonatinaWo0050.mid
Processing MIDI file: 249.96 seconds long
Analyzing 2500 time points...
 Processed 1000/2500 time points
 Processed 2000/2500 time points
Processing: StringQuartetn1op181mov.mid
Processing MIDI file: 490.16 seconds long
Analyzing 4902 time points...
 Processed 1000/4902 time points
 Processed 2000/4902 time points
 Processed 3000/4902 time points
 Processed 4000/4902 time points
Processing: Wo0048Rondo.mid
Processing MIDI file: 142.23 seconds long
Analyzing 1423 time points...
 Processed 1000/1423 time points
Processing: SonataOpus111CminorNo2.mid
Processing MIDI file: 666.56 seconds long
Analyzing 6666 time points...
 Processed 1000/6666 time points
 Processed 2000/6666 time points
 Processed 3000/6666 time points
 Processed 4000/6666 time points
 Processed 5000/6666 time points
 Processed 6000/6666 time points
Processing: StringQuartetn16op1351mov.mid
Processing MIDI file: 362.54 seconds long
Analyzing 3626 time points...
 Processed 1000/3626 time points
 Processed 2000/3626 time points
 Processed 3000/3626 time points
Processing: StringQuartetn2op18n24mov.mid
Processing MIDI file: 323.16 seconds long
Analyzing 3232 time points...
 Processed 1000/3232 time points
 Processed 2000/3232 time points
 Processed 3000/3232 time points
Processing: StringQuartetn2op18n21mov.mid
Processing MIDI file: 393.09 seconds long
Analyzing 3931 time points...
 Processed 1000/3931 time points

Processed 2000/3931 time points
 Processed 3000/3931 time points
 Processing: PianoSonatinaNo2Op49.mid
 Processing MIDI file: 270.70 seconds long
 Analyzing 2708 time points...
 Processed 1000/2708 time points
 Processed 2000/2708 time points
 Processing: StringQuartetn2op18n23mov.mid
 Processing MIDI file: 261.00 seconds long
 Analyzing 2610 time points...
 Processed 1000/2610 time points
 Processed 2000/2610 time points
 Processing: op0513Rondos.mid
 Processing MIDI file: 1063.03 seconds long
 Analyzing 10631 time points...
 Processed 1000/10631 time points
 Processed 2000/10631 time points
 Processed 3000/10631 time points
 Processed 4000/10631 time points
 Processed 5000/10631 time points
 Processed 6000/10631 time points
 Processed 7000/10631 time points
 Processed 8000/10631 time points
 Processed 9000/10631 time points
 Processed 10000/10631 time points
 Processing: SiebenBagatelleninAMajorOpus33No4.mid
 Processing MIDI file: 97.24 seconds long
 Analyzing 973 time points...
 Processing: SiebenBagatelleninFMajorOpus33No3.mid
 Processing MIDI file: 99.58 seconds long
 Analyzing 996 time points...
 Processing: RondoOpus51No1.mid
 Processing MIDI file: 228.70 seconds long
 Analyzing 2288 time points...
 Processed 1000/2288 time points
 Processed 2000/2288 time points
 Processing: StringQuartetn1op184mov.mid
 Processing MIDI file: 389.36 seconds long
 Analyzing 3894 time points...
 Processed 1000/3894 time points
 Processed 2000/3894 time points
 Processed 3000/3894 time points
 Processing: StringQuartetn16op1352mov.mid
 Processing MIDI file: 258.40 seconds long
 Analyzing 2585 time points...
 Processed 1000/2585 time points
 Processed 2000/2585 time points
 Processing: Wo0051Sonatina1-2movs.mid

Processing MIDI file: 5032.31 seconds long

Analyzing 50324 time points...

Processed 1000/50324 time points
Processed 2000/50324 time points
Processed 3000/50324 time points
Processed 4000/50324 time points
Processed 5000/50324 time points
Processed 6000/50324 time points
Processed 7000/50324 time points
Processed 8000/50324 time points
Processed 9000/50324 time points
Processed 10000/50324 time points
Processed 11000/50324 time points
Processed 12000/50324 time points
Processed 13000/50324 time points
Processed 14000/50324 time points
Processed 15000/50324 time points
Processed 16000/50324 time points
Processed 17000/50324 time points
Processed 18000/50324 time points
Processed 19000/50324 time points
Processed 20000/50324 time points
Processed 21000/50324 time points
Processed 22000/50324 time points
Processed 23000/50324 time points
Processed 24000/50324 time points
Processed 25000/50324 time points
Processed 26000/50324 time points
Processed 27000/50324 time points
Processed 28000/50324 time points
Processed 29000/50324 time points
Processed 30000/50324 time points
Processed 31000/50324 time points
Processed 32000/50324 time points
Processed 33000/50324 time points
Processed 34000/50324 time points
Processed 35000/50324 time points
Processed 36000/50324 time points
Processed 37000/50324 time points
Processed 38000/50324 time points
Processed 39000/50324 time points
Processed 40000/50324 time points
Processed 41000/50324 time points
Processed 42000/50324 time points
Processed 43000/50324 time points
Processed 44000/50324 time points
Processed 45000/50324 time points
Processed 46000/50324 time points

Processed 47000/50324 time points
 Processed 48000/50324 time points
 Processed 49000/50324 time points
 Processed 50000/50324 time points
 Processing: Wo0086Scotish.mid
 Processing MIDI file: 30.07 seconds long
 Analyzing 301 time points...
 Processing: Wo0061aMouvementPourPiano.mid
 Processing MIDI file: 30.97 seconds long
 Analyzing 310 time points...
 Processing: ViolinConcertoop612-3movs.mid
 Processing MIDI file: 1029.51 seconds long
 Analyzing 10296 time points...
 Processed 1000/10296 time points
 Processed 2000/10296 time points
 Processed 3000/10296 time points
 Processed 4000/10296 time points
 Processed 5000/10296 time points
 Processed 6000/10296 time points
 Processed 7000/10296 time points
 Processed 8000/10296 time points
 Processed 9000/10296 time points
 Processed 10000/10296 time points
 Processing: SiebenBagatellenCMajorOpus33No2.mid
 Processing MIDI file: 202.08 seconds long
 Analyzing 2021 time points...
 Processed 1000/2021 time points
 Processed 2000/2021 time points
 Processing: RondoinBflat.mid
 Processing MIDI file: 337.82 seconds long
 Analyzing 3379 time points...
 Processed 1000/3379 time points
 Processed 2000/3379 time points
 Processed 3000/3379 time points
 Processing: SketchforPianoAllaMarcia.mid
 Processing MIDI file: 26.77 seconds long
 Analyzing 268 time points...
 Processing: PianoSonatinainGOp79.mid
 Processing MIDI file: 625.49 seconds long
 Analyzing 6255 time points...
 Processed 1000/6255 time points
 Processed 2000/6255 time points
 Processed 3000/6255 time points
 Processed 4000/6255 time points
 Processed 5000/6255 time points
 Processed 6000/6255 time points
 Processing: Wo0060MouvementPourPiano.mid
 Processing MIDI file: 55.66 seconds long

Analyzing 557 time points...

Processing: StringQuartetn16op1353mov.mid

Processing MIDI file: 368.73 seconds long

Analyzing 3688 time points...

Processed 1000/3688 time points

Processed 2000/3688 time points

Processed 3000/3688 time points

Processing: SonatinaInC.mid

Processing MIDI file: 539.97 seconds long

Analyzing 5400 time points...

Processed 1000/5400 time points

Processed 2000/5400 time points

Processed 3000/5400 time points

Processed 4000/5400 time points

Processed 5000/5400 time points

Processing: Romancepiano.mid

Processing MIDI file: 529.71 seconds long

Analyzing 5298 time points...

Processed 1000/5298 time points

Processed 2000/5298 time points

Processed 3000/5298 time points

Processed 4000/5298 time points

Processed 5000/5298 time points

Processing: Wo0055Prelude.mid

Processing MIDI file: 247.71 seconds long

Analyzing 2478 time points...

Processed 1000/2478 time points

Processed 2000/2478 time points

Processing: SiebenBagatelleninDMajorOpus33No6.mid

Processing MIDI file: 134.03 seconds long

Analyzing 1341 time points...

Processed 1000/1341 time points

Processing: SonataOpus81a-LesAdieux-EflatNo1.mid

Processing MIDI file: 376.36 seconds long

Analyzing 3764 time points...

Processed 1000/3764 time points

Processed 2000/3764 time points

Processed 3000/3764 time points

Processing: SonataNo14Op27MoonlightSonata.mid

Processing MIDI file: 347.12 seconds long

Analyzing 3472 time points...

Processed 1000/3472 time points

Processed 2000/3472 time points

Processed 3000/3472 time points

Processing: Sonatinaop334mov.mid

Processing MIDI file: 172.00 seconds long

Analyzing 1721 time points...

Processed 1000/1721 time points

Processing: Sonataop781stmov.mid
 Processing MIDI file: 234.49 seconds long
 Analyzing 2345 time points...
 Processed 1000/2345 time points
 Processed 2000/2345 time points

Processing: RondoOpus51No2.mid
 Processing MIDI file: 330.18 seconds long
 Analyzing 3302 time points...
 Processed 1000/3302 time points
 Processed 2000/3302 time points
 Processed 3000/3302 time points

Processing: SonataNo14Op27SonataQuasiUnaFantasia.mid
 Processing MIDI file: 169.95 seconds long
 Analyzing 1700 time points...
 Processed 1000/1700 time points

Processing: SiebenBagatelleninEflatMajorOpus33No1.mid
 Processing MIDI file: 204.81 seconds long
 Analyzing 2049 time points...
 Processed 1000/2049 time points
 Processed 2000/2049 time points

Processing: op077Fantaisie.mid
 Processing MIDI file: 504.80 seconds long
 Analyzing 5048 time points...
 Processed 1000/5048 time points
 Processed 2000/5048 time points
 Processed 3000/5048 time points
 Processed 4000/5048 time points
 Processed 5000/5048 time points

Processing: SonatinaFamajwoo.mid
 Processing MIDI file: 308.72 seconds long
 Analyzing 3088 time points...
 Processed 1000/3088 time points
 Processed 2000/3088 time points
 Processed 3000/3088 time points

Processing: StringQuartetn2op18n22mov.mid
 Processing MIDI file: 263.23 seconds long
 Analyzing 2633 time points...
 Processed 1000/2633 time points
 Processed 2000/2633 time points

Processing: SonataPresto.mid
 Processing MIDI file: 270.70 seconds long
 Analyzing 2708 time points...
 Processed 1000/2708 time points
 Processed 2000/2708 time points

Processing: SketchforPianoAllegretto.mid
 Processing MIDI file: 66.40 seconds long
 Analyzing 665 time points...

Processing: Sonatinan1op05.mid

Processing MIDI file: 212.44 seconds long
 Analyzing 2125 time points...
 Processed 1000/2125 time points
 Processed 2000/2125 time points
 Processing: Wo0083SixEscotishDancesforPiano.mid
 Processing MIDI file: 245.10 seconds long
 Analyzing 2451 time points...
 Processed 1000/2451 time points
 Processed 2000/2451 time points
 Processing: SketchforPianoPresto.mid
 Processing MIDI file: 40.58 seconds long
 Analyzing 406 time points...
 Processing: Wo0061MouvementPourPiano.mid
 Processing MIDI file: 106.65 seconds long
 Analyzing 1067 time points...
 Processed 1000/1067 time points
 Processing: op119DouzeBagatellas.mid
 Processing MIDI file: 831.50 seconds long
 Analyzing 8316 time points...
 Processed 1000/8316 time points
 Processed 2000/8316 time points
 Processed 3000/8316 time points
 Processed 4000/8316 time points
 Processed 5000/8316 time points
 Processed 6000/8316 time points
 Processed 7000/8316 time points
 Processed 8000/8316 time points
 Processing: Wo0054LustigTraurig.mid
 Processing MIDI file: 67.73 seconds long
 Analyzing 678 time points...
 Processing: op089Polonaise.mid
 Processing MIDI file: 330.86 seconds long
 Analyzing 3309 time points...
 Processed 1000/3309 time points
 Processed 2000/3309 time points
 Processed 3000/3309 time points
 Processing: SevenInversionsofGodSavetheKing.mid
 Processing MIDI file: 448.44 seconds long
 Analyzing 4485 time points...
 Processed 1000/4485 time points
 Processed 2000/4485 time points
 Processed 3000/4485 time points
 Processed 4000/4485 time points
 Processing: SketchforPianoAllegroGiocoso.mid
 Processing MIDI file: 21.87 seconds long
 Analyzing 219 time points...
 Processing: SiebenBagatelleninCMajorOpus33No5.mid
 Processing MIDI file: 143.08 seconds long

Analyzing 1431 time points...
 Processed 1000/1431 time points
 Processing: Wo0081Allemande.mid
 Processing MIDI file: 72.90 seconds long
 Analyzing 729 time points...
 Processing: StringQuartetn16op1354mov.mid
 Processing MIDI file: 685.64 seconds long
 Analyzing 6857 time points...
 Processed 1000/6857 time points
 Processed 2000/6857 time points
 Processed 3000/6857 time points
 Processed 4000/6857 time points
 Processed 5000/6857 time points
 Processed 6000/6857 time points
 Processing: SechsVariationen.mid
 Processing MIDI file: 272.36 seconds long
 Analyzing 2724 time points...
 Processed 1000/2724 time points
 Processed 2000/2724 time points
 Processing: Wo0049Rondo.mid
 Processing MIDI file: 135.42 seconds long
 Analyzing 1355 time points...
 Processed 1000/1355 time points
 Processing: Wo0052Bagatella.mid
 Processing MIDI file: 353.90 seconds long
 Analyzing 3540 time points...
 Processed 1000/3540 time points
 Processed 2000/3540 time points
 Processed 3000/3540 time points
 Processing: Preludes2ThroughMajorkeys39.mid
 Processing MIDI file: 617.51 seconds long
 Analyzing 6176 time points...
 Processed 1000/6176 time points
 Processed 2000/6176 time points
 Processed 3000/6176 time points
 Processed 4000/6176 time points
 Processed 5000/6176 time points
 Processed 6000/6176 time points
 Processing: SketchforPianoAllegro.mid
 Processing MIDI file: 31.26 seconds long
 Analyzing 313 time points...
 Processing: StringQuartetn1op182mov.mid
 Processing MIDI file: 575.48 seconds long
 Analyzing 5755 time points...
 Processed 1000/5755 time points
 Processed 2000/5755 time points
 Processed 3000/5755 time points
 Processed 4000/5755 time points

Processed 5000/5755 time points
 Processing: ViolinConcerto611mov.mid
 Processing MIDI file: 1318.20 seconds long
 Analyzing 13183 time points...
 Processed 1000/13183 time points
 Processed 2000/13183 time points
 Processed 3000/13183 time points
 Processed 4000/13183 time points
 Processed 5000/13183 time points
 Processed 6000/13183 time points
 Processed 7000/13183 time points
 Processed 8000/13183 time points
 Processed 9000/13183 time points
 Processed 10000/13183 time points
 Processed 11000/13183 time points
 Processed 12000/13183 time points
 Processed 13000/13183 time points
 Processing: Wo0010SixMenuetsforOrchestra.mid
 Processing MIDI file: 607.17 seconds long
 Analyzing 6072 time points...
 Processed 1000/6072 time points
 Processed 2000/6072 time points
 Processed 3000/6072 time points
 Processed 4000/6072 time points
 Processed 5000/6072 time points
 Processed 6000/6072 time points
 Processing: StringQuartetn1op183mov.mid
 Processing MIDI file: 239.22 seconds long
 Analyzing 2393 time points...
 Processed 1000/2393 time points
 Processed 2000/2393 time points
 Processing: Wo0082Menuet.mid
 Processing MIDI file: 253.78 seconds long
 Analyzing 2538 time points...
 Processed 1000/2538 time points
 Processed 2000/2538 time points
 Processing: SonataOpus111CminorNo1.mid
 Processing MIDI file: 504.08 seconds long
 Analyzing 5041 time points...
 Processed 1000/5041 time points
 Processed 2000/5041 time points
 Processed 3000/5041 time points
 Processed 4000/5041 time points
 Processed 5000/5041 time points
 Processing: Rageoveralostpennny.mid
 Processing MIDI file: 402.13 seconds long
 Analyzing 4022 time points...
 Processed 1000/4022 time points

Processed 2000/4022 time points
 Processed 3000/4022 time points
 Processed 4000/4022 time points
 Processing: Wo0056Bagatella.mid
 Processing MIDI file: 119.49 seconds long
 Analyzing 1195 time points...
 Processed 1000/1195 time points
 Processing: Symphonyop93n83mov.mid
 Processing MIDI file: 319.30 seconds long
 Analyzing 3193 time points...
 Processed 1000/3193 time points
 Processed 2000/3193 time points
 Processed 3000/3193 time points
 Processing: Symphonyop68n62mov_Pastorale_.mid
 Processing MIDI file: 822.42 seconds long
 Analyzing 8225 time points...
 Processed 1000/8225 time points
 Processed 2000/8225 time points
 Processed 3000/8225 time points
 Processed 4000/8225 time points
 Processed 5000/8225 time points
 Processed 6000/8225 time points
 Processed 7000/8225 time points
 Processed 8000/8225 time points
 Processing: Symphonyn41mov.mid
 Processing MIDI file: 721.73 seconds long
 Analyzing 7218 time points...
 Processed 1000/7218 time points
 Processed 2000/7218 time points
 Processed 3000/7218 time points
 Processed 4000/7218 time points
 Processed 5000/7218 time points
 Processed 6000/7218 time points
 Processed 7000/7218 time points
 Processing: Symphonyn72mov.mid
 Processing MIDI file: 279.94 seconds long
 Analyzing 2800 time points...
 Processed 1000/2800 time points
 Processed 2000/2800 time points
 Processing: Symphonyn34mov_Eroica_.mid
 Processing MIDI file: 556.50 seconds long
 Analyzing 5566 time points...
 Processed 1000/5566 time points
 Processed 2000/5566 time points
 Processed 3000/5566 time points
 Processed 4000/5566 time points
 Processed 5000/5566 time points
 Processing: Symphonyn43mov.mid

Processing MIDI file: 315.88 seconds long
Analyzing 3159 time points...
 Processed 1000/3159 time points
 Processed 2000/3159 time points
 Processed 3000/3159 time points
Processing: Symphonyop125n91mov_Choral_.mid
Processing MIDI file: 890.15 seconds long
Analyzing 8902 time points...
 Processed 1000/8902 time points
 Processed 2000/8902 time points
 Processed 3000/8902 time points
 Processed 4000/8902 time points
 Processed 5000/8902 time points
 Processed 6000/8902 time points
 Processed 7000/8902 time points
 Processed 8000/8902 time points
Processing: Symphonyop125n93mov_Choral_.mid
Processing MIDI file: 858.98 seconds long
Analyzing 8590 time points...
 Processed 1000/8590 time points
 Processed 2000/8590 time points
 Processed 3000/8590 time points
 Processed 4000/8590 time points
 Processed 5000/8590 time points
 Processed 6000/8590 time points
 Processed 7000/8590 time points
 Processed 8000/8590 time points
Processing: Symphonyop125n92mov_Choral_.mid
Processing MIDI file: 837.96 seconds long
Analyzing 8380 time points...
 Processed 1000/8380 time points
 Processed 2000/8380 time points
 Processed 3000/8380 time points
 Processed 4000/8380 time points
 Processed 5000/8380 time points
 Processed 6000/8380 time points
 Processed 7000/8380 time points
 Processed 8000/8380 time points
Processing: Symphonyn73mov.mid
Processing MIDI file: 727.38 seconds long
Analyzing 7274 time points...
 Processed 1000/7274 time points
 Processed 2000/7274 time points
 Processed 3000/7274 time points
 Processed 4000/7274 time points
 Processed 5000/7274 time points
 Processed 6000/7274 time points
 Processed 7000/7274 time points

Processing: Symphonyop125n94mov_Choral_.mid
Processing MIDI file: 1275.98 seconds long
Analyzing 12760 time points...

Processed 1000/12760 time points
Processed 2000/12760 time points
Processed 3000/12760 time points
Processed 4000/12760 time points
Processed 5000/12760 time points
Processed 6000/12760 time points
Processed 7000/12760 time points
Processed 8000/12760 time points
Processed 9000/12760 time points
Processed 10000/12760 time points
Processed 11000/12760 time points
Processed 12000/12760 time points

Processing: Symphonyop68n6_Pastorale_.mid
Processing MIDI file: 1713.12 seconds long
Analyzing 17132 time points...

Processed 1000/17132 time points
Processed 2000/17132 time points
Processed 3000/17132 time points
Processed 4000/17132 time points
Processed 5000/17132 time points
Processed 6000/17132 time points
Processed 7000/17132 time points
Processed 8000/17132 time points
Processed 9000/17132 time points
Processed 10000/17132 time points
Processed 11000/17132 time points
Processed 12000/17132 time points
Processed 13000/17132 time points
Processed 14000/17132 time points
Processed 15000/17132 time points
Processed 16000/17132 time points
Processed 17000/17132 time points

Processing: Symphonyop68n61mov_Pastorale_.mid
Processing MIDI file: 762.52 seconds long
Analyzing 7626 time points...

Processed 1000/7626 time points
Processed 2000/7626 time points
Processed 3000/7626 time points
Processed 4000/7626 time points
Processed 5000/7626 time points
Processed 6000/7626 time points
Processed 7000/7626 time points

Processing: Symphonyn42mov.mid
Processing MIDI file: 629.72 seconds long
Analyzing 6298 time points...

Processed 1000/6298 time points
 Processed 2000/6298 time points
 Processed 3000/6298 time points
 Processed 4000/6298 time points
 Processed 5000/6298 time points
 Processed 6000/6298 time points
 Processing: Symphonyop93n84mov.mid
 Processing MIDI file: 458.00 seconds long
 Analyzing 4581 time points...
 Processed 1000/4581 time points
 Processed 2000/4581 time points
 Processed 3000/4581 time points
 Processed 4000/4581 time points
 Processing: Symphonyn11mov.mid
 Processing MIDI file: 531.36 seconds long
 Analyzing 5314 time points...
 Processed 1000/5314 time points
 Processed 2000/5314 time points
 Processed 3000/5314 time points
 Processed 4000/5314 time points
 Processed 5000/5314 time points
 Processing: Symphonyn2op362mov.mid
 Processing MIDI file: 648.83 seconds long
 Analyzing 6489 time points...
 Processed 1000/6489 time points
 Processed 2000/6489 time points
 Processed 3000/6489 time points
 Processed 4000/6489 time points
 Processed 5000/6489 time points
 Processed 6000/6489 time points
 Processing: Symphonyn74mov.mid
 Processing MIDI file: 506.16 seconds long
 Analyzing 5062 time points...
 Processed 1000/5062 time points
 Processed 2000/5062 time points
 Processed 3000/5062 time points
 Processed 4000/5062 time points
 Processed 5000/5062 time points
 Processing: Symphonyop93n82mov.mid
 Processing MIDI file: 232.00 seconds long
 Analyzing 2321 time points...
 Processed 1000/2321 time points
 Processed 2000/2321 time points
 Processing: Symphonyn14mov.mid
 Processing MIDI file: 348.82 seconds long
 Analyzing 3489 time points...
 Processed 1000/3489 time points
 Processed 2000/3489 time points

Processed 3000/3489 time points
 Processing: Symphonyn12mov.mid
 Processing MIDI file: 534.91 seconds long
 Analyzing 5350 time points...
 Processed 1000/5350 time points
 Processed 2000/5350 time points
 Processed 3000/5350 time points
 Processed 4000/5350 time points
 Processed 5000/5350 time points
 Processing: Symphonyn44mov.mid
 Processing MIDI file: 421.07 seconds long
 Analyzing 4211 time points...
 Processed 1000/4211 time points
 Processed 2000/4211 time points
 Processed 3000/4211 time points
 Processed 4000/4211 time points
 Processing: Symphonyn71mov.mid
 Processing MIDI file: 946.81 seconds long
 Analyzing 9469 time points...
 Processed 1000/9469 time points
 Processed 2000/9469 time points
 Processed 3000/9469 time points
 Processed 4000/9469 time points
 Processed 5000/9469 time points
 Processed 6000/9469 time points
 Processed 7000/9469 time points
 Processed 8000/9469 time points
 Processed 9000/9469 time points
 Processing: Symphonyn31mov_Eroica_.mid
 Processing MIDI file: 841.33 seconds long
 Analyzing 8414 time points...
 Processed 1000/8414 time points
 Processed 2000/8414 time points
 Processed 3000/8414 time points
 Processed 4000/8414 time points
 Processed 5000/8414 time points
 Processed 6000/8414 time points
 Processed 7000/8414 time points
 Processed 8000/8414 time points
 Processing: Symphonyn2op364mov.mid
 Processing MIDI file: 380.24 seconds long
 Analyzing 3803 time points...
 Processed 1000/3803 time points
 Processed 2000/3803 time points
 Processed 3000/3803 time points
 Processing: Symphonyn2op361mov.mid
 Processing MIDI file: 719.30 seconds long
 Analyzing 7193 time points...

Processed 1000/7193 time points
 Processed 2000/7193 time points
 Processed 3000/7193 time points
 Processed 4000/7193 time points
 Processed 5000/7193 time points
 Processed 6000/7193 time points
 Processed 7000/7193 time points
 Processing: Symphonym5op671mov.mid
 Processing MIDI file: 401.75 seconds long
 Analyzing 4018 time points...
 Processed 1000/4018 time points
 Processed 2000/4018 time points
 Processed 3000/4018 time points
 Processed 4000/4018 time points
 Processing: Symphonym32mov_Eroica_.mid
 Processing MIDI file: 769.23 seconds long
 Analyzing 7693 time points...
 Processed 1000/7693 time points
 Processed 2000/7693 time points
 Processed 3000/7693 time points
 Processed 4000/7693 time points
 Processed 5000/7693 time points
 Processed 6000/7693 time points
 Processed 7000/7693 time points
 Processing: Symphonym33mov_Eroica_.mid
 Processing MIDI file: 330.69 seconds long
 Analyzing 3307 time points...
 Processed 1000/3307 time points
 Processed 2000/3307 time points
 Processed 3000/3307 time points
 Processing: Symphonyop93n81mov.mid
 Processing MIDI file: 529.68 seconds long
 Analyzing 5297 time points...
 Processed 1000/5297 time points
 Processed 2000/5297 time points
 Processed 3000/5297 time points
 Processed 4000/5297 time points
 Processed 5000/5297 time points
 Processing: Symphonyop68n63mov_Pastorale_.mid
 Processing MIDI file: 1082.42 seconds long
 Analyzing 10825 time points...
 Processed 1000/10825 time points
 Processed 2000/10825 time points
 Processed 3000/10825 time points
 Processed 4000/10825 time points
 Processed 5000/10825 time points
 Processed 6000/10825 time points
 Processed 7000/10825 time points

Processed 8000/10825 time points
 Processed 9000/10825 time points
 Processed 10000/10825 time points
 Processing: Symphonyn2op363mov.mid
 Processing MIDI file: 232.32 seconds long
 Analyzing 2324 time points...
 Processed 1000/2324 time points
 Processed 2000/2324 time points
 Processing: Symphonyn5op673-4mov.mid
 Processing MIDI file: 789.11 seconds long
 Analyzing 7892 time points...
 Processed 1000/7892 time points
 Processed 2000/7892 time points
 Processed 3000/7892 time points
 Processed 4000/7892 time points
 Processed 5000/7892 time points
 Processed 6000/7892 time points
 Processed 7000/7892 time points
 Processing: Symphonyn13mov.mid
 Processing MIDI file: 223.75 seconds long
 Analyzing 2238 time points...
 Processed 1000/2238 time points
 Processed 2000/2238 time points
 Processing: PianoSonatan04.mid
 Processing MIDI file: 1281.99 seconds long
 Analyzing 12820 time points...
 Processed 1000/12820 time points
 Processed 2000/12820 time points
 Processed 3000/12820 time points
 Processed 4000/12820 time points
 Processed 5000/12820 time points
 Processed 6000/12820 time points
 Processed 7000/12820 time points
 Processed 8000/12820 time points
 Processed 9000/12820 time points
 Processed 10000/12820 time points
 Processed 11000/12820 time points
 Processed 12000/12820 time points
 Processing: PianoSonatan08op132mov_Pathetique_.mid
 Processing MIDI file: 290.88 seconds long
 Analyzing 2909 time points...
 Processed 1000/2909 time points
 Processed 2000/2909 time points
 Processing: PianoSonatan02.mid
 Processing MIDI file: 1243.82 seconds long
 Analyzing 12439 time points...
 Processed 1000/12439 time points
 Processed 2000/12439 time points

Processed 3000/12439 time points
 Processed 4000/12439 time points
 Processed 5000/12439 time points
 Processed 6000/12439 time points
 Processed 7000/12439 time points
 Processed 8000/12439 time points
 Processed 9000/12439 time points
 Processed 10000/12439 time points
 Processed 11000/12439 time points
 Processed 12000/12439 time points
 Processing: PianoSonatan06.mid
 Processing MIDI file: 549.72 seconds long
 Analyzing 5498 time points...
 Processed 1000/5498 time points
 Processed 2000/5498 time points
 Processed 3000/5498 time points
 Processed 4000/5498 time points
 Processed 5000/5498 time points
 Processing: PianoSonatan08op131mov_Pathetique_.mid
 Processing MIDI file: 498.64 seconds long
 Analyzing 4987 time points...
 Processed 1000/4987 time points
 Processed 2000/4987 time points
 Processed 3000/4987 time points
 Processed 4000/4987 time points
 Processing: PianoSonatan05.mid
 Processing MIDI file: 1047.23 seconds long
 Analyzing 10473 time points...
 Processed 1000/10473 time points
 Processed 2000/10473 time points
 Processed 3000/10473 time points
 Processed 4000/10473 time points
 Processed 5000/10473 time points
 Processed 6000/10473 time points
 Processed 7000/10473 time points
 Processed 8000/10473 time points
 Processed 9000/10473 time points
 Processed 10000/10473 time points
 Processing: PianoSonatan07.mid
 Processing MIDI file: 1364.78 seconds long
 Analyzing 13648 time points...
 Processed 1000/13648 time points
 Processed 2000/13648 time points
 Processed 3000/13648 time points
 Processed 4000/13648 time points
 Processed 5000/13648 time points
 Processed 6000/13648 time points
 Processed 7000/13648 time points

Processed 8000/13648 time points
 Processed 9000/13648 time points
 Processed 10000/13648 time points
 Processed 11000/13648 time points
 Processed 12000/13648 time points
 Processed 13000/13648 time points
 Processing: PianoSonatan08op133mov_Pathetique_.mid
 Processing MIDI file: 272.39 seconds long
 Analyzing 2724 time points...
 Processed 1000/2724 time points
 Processed 2000/2724 time points
 Processing: PianoSonatan09.mid
 Processing MIDI file: 651.32 seconds long
 Analyzing 6514 time points...
 Processed 1000/6514 time points
 Processed 2000/6514 time points
 Processed 3000/6514 time points
 Processed 4000/6514 time points
 Processed 5000/6514 time points
 Processed 6000/6514 time points
 Processing: PianoSonatan01.mid
 Processing MIDI file: 861.41 seconds long
 Analyzing 8615 time points...
 Processed 1000/8615 time points
 Processed 2000/8615 time points
 Processed 3000/8615 time points
 Processed 4000/8615 time points
 Processed 5000/8615 time points
 Processed 6000/8615 time points
 Processed 7000/8615 time points
 Processed 8000/8615 time points
 Processing: PianoSonatan101mov.mid
 Processing MIDI file: 355.24 seconds long
 Analyzing 3553 time points...
 Processed 1000/3553 time points
 Processed 2000/3553 time points
 Processed 3000/3553 time points
 Processing: PianoSonatan03.mid
 Processing MIDI file: 1489.68 seconds long
 Analyzing 14897 time points...
 Processed 1000/14897 time points
 Processed 2000/14897 time points
 Processed 3000/14897 time points
 Processed 4000/14897 time points
 Processed 5000/14897 time points
 Processed 6000/14897 time points
 Processed 7000/14897 time points
 Processed 8000/14897 time points

Processed 9000/14897 time points
Processed 10000/14897 time points
Processed 11000/14897 time points
Processed 12000/14897 time points
Processed 13000/14897 time points
Processed 14000/14897 time points
Processing: PianoSonatan22.mid
Processing MIDI file: 493.55 seconds long
Analyzing 4936 time points...
Processed 1000/4936 time points
Processed 2000/4936 time points
Processed 3000/4936 time points
Processed 4000/4936 time points
Processing: PianoSonatan102mov.mid
Processing MIDI file: 317.25 seconds long
Analyzing 3173 time points...
Processed 1000/3173 time points
Processed 2000/3173 time points
Processed 3000/3173 time points
Processing: PianoSonatan20.mid
Processing MIDI file: 429.53 seconds long
Analyzing 4296 time points...
Processed 1000/4296 time points
Processed 2000/4296 time points
Processed 3000/4296 time points
Processed 4000/4296 time points
Processing: PianoSonatan10.mid
Processing MIDI file: 892.36 seconds long
Analyzing 8924 time points...
Processed 1000/8924 time points
Processed 2000/8924 time points
Processed 3000/8924 time points
Processed 4000/8924 time points
Processed 5000/8924 time points
Processed 6000/8924 time points
Processed 7000/8924 time points
Processed 8000/8924 time points
Processing: PianoSonatan23op572mov_Apassionata_.mid
Processing MIDI file: 369.88 seconds long
Analyzing 3699 time points...
Processed 1000/3699 time points
Processed 2000/3699 time points
Processed 3000/3699 time points
Processing: PianoSonatan16.mid
Processing MIDI file: 1183.80 seconds long
Analyzing 11838 time points...
Processed 1000/11838 time points
Processed 2000/11838 time points

Processed 3000/11838 time points
 Processed 4000/11838 time points
 Processed 5000/11838 time points
 Processed 6000/11838 time points
 Processed 7000/11838 time points
 Processed 8000/11838 time points
 Processed 9000/11838 time points
 Processed 10000/11838 time points
 Processed 11000/11838 time points
 Processing: PianoSonatan14op273mov_Moonlight_.mid
 Processing MIDI file: 410.36 seconds long
 Analyzing 4104 time points...
 Processed 1000/4104 time points
 Processed 2000/4104 time points
 Processed 3000/4104 time points
 Processed 4000/4104 time points
 Processing: PianoSonatan24.mid
 Processing MIDI file: 436.35 seconds long
 Analyzing 4364 time points...
 Processed 1000/4364 time points
 Processed 2000/4364 time points
 Processed 3000/4364 time points
 Processed 4000/4364 time points
 Processing: PianoSonatan14op27_Moonlight_.mid
 Processing MIDI file: 848.01 seconds long
 Analyzing 8481 time points...
 Processed 1000/8481 time points
 Processed 2000/8481 time points
 Processed 3000/8481 time points
 Processed 4000/8481 time points
 Processed 5000/8481 time points
 Processed 6000/8481 time points
 Processed 7000/8481 time points
 Processed 8000/8481 time points
 Processing: Pianosonatan32op111.mid
 Processing MIDI file: 1260.45 seconds long
 Analyzing 12605 time points...
 Processed 1000/12605 time points
 Processed 2000/12605 time points
 Processed 3000/12605 time points
 Processed 4000/12605 time points
 Processed 5000/12605 time points
 Processed 6000/12605 time points
 Processed 7000/12605 time points
 Processed 8000/12605 time points
 Processed 9000/12605 time points
 Processed 10000/12605 time points
 Processed 11000/12605 time points

Processed 12000/12605 time points
 Processing: PianoSonatan15_Pastoral_.mid
 Processing MIDI file: 1471.30 seconds long
 Analyzing 14714 time points...
 Processed 1000/14714 time points
 Processed 2000/14714 time points
 Processed 3000/14714 time points
 Processed 4000/14714 time points
 Processed 5000/14714 time points
 Processed 6000/14714 time points
 Processed 7000/14714 time points
 Processed 8000/14714 time points
 Processed 9000/14714 time points
 Processed 10000/14714 time points
 Processed 11000/14714 time points
 Processed 12000/14714 time points
 Processed 13000/14714 time points
 Processed 14000/14714 time points
 Processing: PianoSonatan30.mid
 Processing MIDI file: 918.96 seconds long
 Analyzing 9190 time points...
 Processed 1000/9190 time points
 Processed 2000/9190 time points
 Processed 3000/9190 time points
 Processed 4000/9190 time points
 Processed 5000/9190 time points
 Processed 6000/9190 time points
 Processed 7000/9190 time points
 Processed 8000/9190 time points
 Processed 9000/9190 time points
 Processing: PianoSonatan31op110.mid
 Processing MIDI file: 1151.73 seconds long
 Analyzing 11518 time points...
 Processed 1000/11518 time points
 Processed 2000/11518 time points
 Processed 3000/11518 time points
 Processed 4000/11518 time points
 Processed 5000/11518 time points
 Processed 6000/11518 time points
 Processed 7000/11518 time points
 Processed 8000/11518 time points
 Processed 9000/11518 time points
 Processed 10000/11518 time points
 Processed 11000/11518 time points
 Processing: PianoSonatan18_TheHunt_.mid
 Processing MIDI file: 908.42 seconds long
 Analyzing 9085 time points...
 Processed 1000/9085 time points

Processed 2000/9085 time points
 Processed 3000/9085 time points
 Processed 4000/9085 time points
 Processed 5000/9085 time points
 Processed 6000/9085 time points
 Processed 7000/9085 time points
 Processed 8000/9085 time points
 Processed 9000/9085 time points
 Processing: Pianosonatan26_LesAdieux_.mid
 Processing MIDI file: 799.01 seconds long
 Analyzing 7991 time points...
 Processed 1000/7991 time points
 Processed 2000/7991 time points
 Processed 3000/7991 time points
 Processed 4000/7991 time points
 Processed 5000/7991 time points
 Processed 6000/7991 time points
 Processed 7000/7991 time points
 Processing: PianoSonatan212mov_Waldstein_.mid
 Processing MIDI file: 246.08 seconds long
 Analyzing 2461 time points...
 Processed 1000/2461 time points
 Processed 2000/2461 time points
 Processing: PianoSonatan152mov_Pastoral_.mid
 Processing MIDI file: 391.01 seconds long
 Analyzing 3911 time points...
 Processed 1000/3911 time points
 Processed 2000/3911 time points
 Processed 3000/3911 time points
 Processing: PianoSonatan11.mid
 Processing MIDI file: 1389.97 seconds long
 Analyzing 13900 time points...
 Processed 1000/13900 time points
 Processed 2000/13900 time points
 Processed 3000/13900 time points
 Processed 4000/13900 time points
 Processed 5000/13900 time points
 Processed 6000/13900 time points
 Processed 7000/13900 time points
 Processed 8000/13900 time points
 Processed 9000/13900 time points
 Processed 10000/13900 time points
 Processed 11000/13900 time points
 Processed 12000/13900 time points
 Processed 13000/13900 time points
 Processing: PianoSonatan13.mid
 Processing MIDI file: 799.14 seconds long
 Analyzing 7992 time points...

Processed 1000/7992 time points
 Processed 2000/7992 time points
 Processed 3000/7992 time points
 Processed 4000/7992 time points
 Processed 5000/7992 time points
 Processed 6000/7992 time points
 Processed 7000/7992 time points
 Processing: PianoSonatan14op271mov_Moonlight_.mid
 Processing MIDI file: 361.98 seconds long
 Analyzing 3620 time points...
 Processed 1000/3620 time points
 Processed 2000/3620 time points
 Processed 3000/3620 time points
 Processing: PianoSonatan29Op106_Hammerklavier_.mid
 Processing MIDI file: 2499.97 seconds long
 Analyzing 25000 time points...
 Processed 1000/25000 time points
 Processed 2000/25000 time points
 Processed 3000/25000 time points
 Processed 4000/25000 time points
 Processed 5000/25000 time points
 Processed 6000/25000 time points
 Processed 7000/25000 time points
 Processed 8000/25000 time points
 Processed 9000/25000 time points
 Processed 10000/25000 time points
 Processed 11000/25000 time points
 Processed 12000/25000 time points
 Processed 13000/25000 time points
 Processed 14000/25000 time points
 Processed 15000/25000 time points
 Processed 16000/25000 time points
 Processed 17000/25000 time points
 Processed 18000/25000 time points
 Processed 19000/25000 time points
 Processed 20000/25000 time points
 Processed 21000/25000 time points
 Processed 22000/25000 time points
 Processed 23000/25000 time points
 Processed 24000/25000 time points
 Processing: PianoSonatan17_Tempestat_.mid
 Processing MIDI file: 1072.39 seconds long
 Analyzing 10724 time points...
 Processed 1000/10724 time points
 Processed 2000/10724 time points
 Processed 3000/10724 time points
 Processed 4000/10724 time points
 Processed 5000/10724 time points

Processed 6000/10724 time points
 Processed 7000/10724 time points
 Processed 8000/10724 time points
 Processed 9000/10724 time points
 Processed 10000/10724 time points
 Processing: PianoSonatan213mov_Waldstein_.mid
 Processing MIDI file: 579.60 seconds long
 Analyzing 5796 time points...
 Processed 1000/5796 time points
 Processed 2000/5796 time points
 Processed 3000/5796 time points
 Processed 4000/5796 time points
 Processed 5000/5796 time points
 Processing: PianoSonatan211mov_Waldstein_.mid
 Processing MIDI file: 621.51 seconds long
 Analyzing 6216 time points...
 Processed 1000/6216 time points
 Processed 2000/6216 time points
 Processed 3000/6216 time points
 Processed 4000/6216 time points
 Processed 5000/6216 time points
 Processed 6000/6216 time points
 Processing: PianoSonatan12op26.mid
 Processing MIDI file: 1011.33 seconds long
 Analyzing 10114 time points...
 Processed 1000/10114 time points
 Processed 2000/10114 time points
 Processed 3000/10114 time points
 Processed 4000/10114 time points
 Processed 5000/10114 time points
 Processed 6000/10114 time points
 Processed 7000/10114 time points
 Processed 8000/10114 time points
 Processed 9000/10114 time points
 Processed 10000/10114 time points
 Processing: PianoSonatan28.mid
 Processing MIDI file: 952.99 seconds long
 Analyzing 9530 time points...
 Processed 1000/9530 time points
 Processed 2000/9530 time points
 Processed 3000/9530 time points
 Processed 4000/9530 time points
 Processed 5000/9530 time points
 Processed 6000/9530 time points
 Processed 7000/9530 time points
 Processed 8000/9530 time points
 Processed 9000/9530 time points
 Processing: PianoSonatan153mov_Pastoral_.mid

Processing MIDI file: 115.22 seconds long
Analyzing 1153 time points...
Processed 1000/1153 time points
Processing: PianoSonatan23op571mov_Apassionata_.mid
Processing MIDI file: 558.18 seconds long
Analyzing 5582 time points...
Processed 1000/5582 time points
Processed 2000/5582 time points
Processed 3000/5582 time points
Processed 4000/5582 time points
Processed 5000/5582 time points
Processing: PianoSonatan23op573mov_Apassionata_.mid
Processing MIDI file: 465.00 seconds long
Analyzing 4651 time points...
Processed 1000/4651 time points
Processed 2000/4651 time points
Processed 3000/4651 time points
Processed 4000/4651 time points
Processing: PianoSonatan25.mid
Processing MIDI file: 415.71 seconds long
Analyzing 4158 time points...
Processed 1000/4158 time points
Processed 2000/4158 time points
Processed 3000/4158 time points
Processed 4000/4158 time points
Processing: PianoSonatan27.mid
Processing MIDI file: 716.42 seconds long
Analyzing 7165 time points...
Processed 1000/7165 time points
Processed 2000/7165 time points
Processed 3000/7165 time points
Processed 4000/7165 time points
Processed 5000/7165 time points
Processed 6000/7165 time points
Processed 7000/7165 time points
Processing: PianoSonatan19.mid
Processing MIDI file: 455.92 seconds long
Analyzing 4560 time points...
Processed 1000/4560 time points
Processed 2000/4560 time points
Processed 3000/4560 time points
Processed 4000/4560 time points
Processing: PianoSonatan14op272mov_Moonlight_.mid
Processing MIDI file: 124.20 seconds long
Analyzing 1242 time points...
Processed 1000/1242 time points
Successfully processed: 211 files

```

--- Processing Bach ---
Found 884 MIDI files for Bach
Processing: Bwv0539PreludeandFugue.mid
  Processing MIDI file: 370.25 seconds long
  Analyzing 3703 time points...
    Processed 1000/3703 time points
    Processed 2000/3703 time points
    Processed 3000/3703 time points
Processing: Bwv0544PreludeandFugue.mid
  Processing MIDI file: 747.73 seconds long
  Analyzing 7478 time points...
    Processed 1000/7478 time points
    Processed 2000/7478 time points
    Processed 3000/7478 time points
    Processed 4000/7478 time points
    Processed 5000/7478 time points
    Processed 6000/7478 time points
    Processed 7000/7478 time points
Processing: Bwv0811EnglishSuiten68mov.mid
  Processing MIDI file: 223.90 seconds long
  Analyzing 2240 time points...
    Processed 1000/2240 time points
    Processed 2000/2240 time points
Processing: Bwv0938LittlePreluden6.mid
  Processing MIDI file: 96.22 seconds long
  Analyzing 963 time points...
Processing: Bwv0811EnglishSuiten64mov.mid
  Processing MIDI file: 136.76 seconds long
  Analyzing 1368 time points...
    Processed 1000/1368 time points
Processing: Bwv1005ViolinSonatan31movAdagio.mid
  Processing MIDI file: 188.86 seconds long
  Analyzing 1889 time points...
    Processed 1000/1889 time points
Processing: Bwv0529Sonateentrion5.mid
  Processing MIDI file: 919.47 seconds long
  Analyzing 9195 time points...
    Processed 1000/9195 time points
    Processed 2000/9195 time points
    Processed 3000/9195 time points
    Processed 4000/9195 time points
    Processed 5000/9195 time points
    Processed 6000/9195 time points
    Processed 7000/9195 time points
    Processed 8000/9195 time points
    Processed 9000/9195 time points
Processing: Bwv0560ShortPreludeandFuguen8Spurious.mid
  Processing MIDI file: 241.10 seconds long

```

Analyzing 2411 time points...
 Processed 1000/2411 time points
 Processed 2000/2411 time points
 Processing: Bwv0997PartitaforLute3mov.mid
 Processing MIDI file: 230.40 seconds long
 Analyzing 2305 time points...
 Processed 1000/2305 time points
 Processed 2000/2305 time points
 Processing: Bwv0537FantasiaandFugue.mid
 Processing MIDI file: 488.42 seconds long
 Analyzing 4885 time points...
 Processed 1000/4885 time points
 Processed 2000/4885 time points
 Processed 3000/4885 time points
 Processed 4000/4885 time points
 Processing: Bwv0806EnglishSuiten106mov.mid
 Processing MIDI file: 120.25 seconds long
 Analyzing 1203 time points...
 Processed 1000/1203 time points
 Processing: Bwv0559ShortPreludeandFuguen7Spurious1.mid
 Processing MIDI file: 234.99 seconds long
 Analyzing 2350 time points...
 Processed 1000/2350 time points
 Processed 2000/2350 time points
 Processing: Bwv0582PassacagliaandFugue.mid
 Processing MIDI file: 732.43 seconds long
 Analyzing 7325 time points...
 Processed 1000/7325 time points
 Processed 2000/7325 time points
 Processed 3000/7325 time points
 Processed 4000/7325 time points
 Processed 5000/7325 time points
 Processed 6000/7325 time points
 Processed 7000/7325 time points
 Processing: Bwv0933LittlePreluden11.mid
 Processing MIDI file: 87.16 seconds long
 Analyzing 872 time points...
 Processing: Bwv0549PreludeandFugue.mid
 Processing MIDI file: 315.36 seconds long
 Analyzing 3154 time points...
 Processed 1000/3154 time points
 Processed 2000/3154 time points
 Processed 3000/3154 time points
 Processing: Bwv0543PreludeandFugue.mid
 Processing MIDI file: 642.46 seconds long
 Analyzing 6425 time points...
 Processed 1000/6425 time points
 Processed 2000/6425 time points

Processed 3000/6425 time points
 Processed 4000/6425 time points
 Processed 5000/6425 time points
 Processed 6000/6425 time points
 Processing: Bwv0997PartitaforLute2mov.mid
 Processing MIDI file: 283.20 seconds long
 Analyzing 2833 time points...
 Processed 1000/2833 time points
 Processed 2000/2833 time points
 Processing: Bwv0554ShortPreludeandFuguen2Spurious.mid
 Processing MIDI file: 206.90 seconds long
 Analyzing 2069 time points...
 Processed 1000/2069 time points
 Processed 2000/2069 time points
 Processing: Bwv0568Prelude.mid
 Processing MIDI file: 164.00 seconds long
 Analyzing 1640 time points...
 Processed 1000/1640 time points
 Processing: Bwv1005ViolinSonatan33movLargo1.mid
 Processing MIDI file: 148.24 seconds long
 Analyzing 1483 time points...
 Processed 1000/1483 time points
 Processing: Bwv1014HarpsicordandViolinSonata2mov1.mid
 Processing MIDI file: 188.50 seconds long
 Analyzing 1886 time points...
 Processed 1000/1886 time points
 Processing: Bwv0570Fantasia.mid
 Processing MIDI file: 201.59 seconds long
 Analyzing 2016 time points...
 Processed 1000/2016 time points
 Processed 2000/2016 time points
 Processing: Bwv0811EnglishSuiten66mov.mid
 Processing MIDI file: 95.85 seconds long
 Analyzing 959 time points...
 Processing: Bwv0811EnglishSuiten62mov1.mid
 Processing MIDI file: 160.32 seconds long
 Analyzing 1604 time points...
 Processed 1000/1604 time points
 Processing: Bwv1014HarpsicordandViolinSonata1mov.mid
 Processing MIDI file: 267.52 seconds long
 Analyzing 2676 time points...
 Processed 1000/2676 time points
 Processed 2000/2676 time points
 Processing: Bwv0551PreludeandFugue.mid
 Processing MIDI file: 302.15 seconds long
 Analyzing 3022 time points...
 Processed 1000/3022 time points
 Processed 2000/3022 time points

Processed 3000/3022 time points
 Processing: Bwv1005ViolinSonatan32movFugue1.mid
 Processing MIDI file: 609.65 seconds long
 Analyzing 6097 time points...
 Processed 1000/6097 time points
 Processed 2000/6097 time points
 Processed 3000/6097 time points
 Processed 4000/6097 time points
 Processed 5000/6097 time points
 Processed 6000/6097 time points
 Processing: Bwv0558ShortPreludeandFuguen6Spurious.mid
 Processing MIDI file: 333.90 seconds long
 Analyzing 3340 time points...
 Processed 1000/3340 time points
 Processed 2000/3340 time points
 Processed 3000/3340 time points
 Processing: Bwv0527Sonateentrion3.mid
 Processing MIDI file: 920.43 seconds long
 Analyzing 9205 time points...
 Processed 1000/9205 time points
 Processed 2000/9205 time points
 Processed 3000/9205 time points
 Processed 4000/9205 time points
 Processed 5000/9205 time points
 Processed 6000/9205 time points
 Processed 7000/9205 time points
 Processed 8000/9205 time points
 Processed 9000/9205 time points
 Processing: Bwv0806EnglishSuiten103mov.mid
 Processing MIDI file: 100.29 seconds long
 Analyzing 1003 time points...
 Processed 1000/1003 time points
 Processing: Bwv0533PreludeandFugue.mid
 Processing MIDI file: 273.05 seconds long
 Analyzing 2731 time points...
 Processed 1000/2731 time points
 Processed 2000/2731 time points
 Processing: Bwv0555ShortPreludeandFuguen3Spurious.mid
 Processing MIDI file: 222.43 seconds long
 Analyzing 2225 time points...
 Processed 1000/2225 time points
 Processed 2000/2225 time points
 Processing: Bwv0815FrenchSuiten4.mid
 Processing MIDI file: 1152.91 seconds long
 Analyzing 11530 time points...
 Processed 1000/11530 time points
 Processed 2000/11530 time points
 Processed 3000/11530 time points

Processed 4000/11530 time points
 Processed 5000/11530 time points
 Processed 6000/11530 time points
 Processed 7000/11530 time points
 Processed 8000/11530 time points
 Processed 9000/11530 time points
 Processed 10000/11530 time points
 Processed 11000/11530 time points
 Processing: Bwv0816FrenchSuiten5.mid
 Processing MIDI file: 1179.42 seconds long
 Analyzing 11795 time points...
 Processed 1000/11795 time points
 Processed 2000/11795 time points
 Processed 3000/11795 time points
 Processed 4000/11795 time points
 Processed 5000/11795 time points
 Processed 6000/11795 time points
 Processed 7000/11795 time points
 Processed 8000/11795 time points
 Processed 9000/11795 time points
 Processed 10000/11795 time points
 Processed 11000/11795 time points
 Processing: Bwv1046aSinfoniah.mid
 Processing MIDI file: 191.12 seconds long
 Analyzing 1912 time points...
 Processed 1000/1912 time points
 Processing: Bwv0997PartitaforLute1mov.mid
 Processing MIDI file: 166.00 seconds long
 Analyzing 1661 time points...
 Processed 1000/1661 time points
 Processing: Bwv1014HarpicordandViolinSonata4mov.mid
 Processing MIDI file: 222.74 seconds long
 Analyzing 2228 time points...
 Processed 1000/2228 time points
 Processed 2000/2228 time points
 Processing: Bwv0556ShortPreludeandFuguen4Spurious1.mid
 Processing MIDI file: 193.32 seconds long
 Analyzing 1934 time points...
 Processed 1000/1934 time points
 Processing: Bwv0530Sonateentrion6.mid
 Processing MIDI file: 996.20 seconds long
 Analyzing 9963 time points...
 Processed 1000/9963 time points
 Processed 2000/9963 time points
 Processed 3000/9963 time points
 Processed 4000/9963 time points
 Processed 5000/9963 time points
 Processed 6000/9963 time points

Processed 7000/9963 time points
 Processed 8000/9963 time points
 Processed 9000/9963 time points
 Processing: Bwv0936LittlePreluden4.mid
 Processing MIDI file: 130.80 seconds long
 Analyzing 1308 time points...
 Processed 1000/1308 time points
 Processing: Bwv0540ToccataandFugue.mid
 Processing MIDI file: 908.38 seconds long
 Analyzing 9084 time points...
 Processed 1000/9084 time points
 Processed 2000/9084 time points
 Processed 3000/9084 time points
 Processed 4000/9084 time points
 Processed 5000/9084 time points
 Processed 6000/9084 time points
 Processed 7000/9084 time points
 Processed 8000/9084 time points
 Processed 9000/9084 time points
 Processing: Bwv0811EnglishSuiten65mov.mid
 Processing MIDI file: 107.91 seconds long
 Analyzing 1080 time points...
 Processed 1000/1080 time points
 Processing: Bwv0963Sonata.mid
 Processing MIDI file: 515.66 seconds long
 Analyzing 5157 time points...
 Processed 1000/5157 time points
 Processed 2000/5157 time points
 Processed 3000/5157 time points
 Processed 4000/5157 time points
 Processed 5000/5157 time points
 Processing: Bwv0992Capriccio.mid
 Processing MIDI file: 494.22 seconds long
 Analyzing 4943 time points...
 Processed 1000/4943 time points
 Processed 2000/4943 time points
 Processed 3000/4943 time points
 Processed 4000/4943 time points
 Processing: Bwv1005ViolinSonatan34movAllegro.mid
 Processing MIDI file: 299.07 seconds long
 Analyzing 2991 time points...
 Processed 1000/2991 time points
 Processed 2000/2991 time points
 Processing: Bwv0546PreludeandFugue.mid
 Processing MIDI file: 745.17 seconds long
 Analyzing 7452 time points...
 Processed 1000/7452 time points
 Processed 2000/7452 time points

Processed 3000/7452 time points
 Processed 4000/7452 time points
 Processed 5000/7452 time points
 Processed 6000/7452 time points
 Processed 7000/7452 time points
 Processing: Bwv0563Fantasieconimitation.mid
 Processing MIDI file: 242.55 seconds long
 Analyzing 2426 time points...
 Processed 1000/2426 time points
 Processed 2000/2426 time points
 Processing: Bwv0572Fantasia.mid
 Processing MIDI file: 982.87 seconds long
 Analyzing 9829 time points...
 Processed 1000/9829 time points
 Processed 2000/9829 time points
 Processed 3000/9829 time points
 Processed 4000/9829 time points
 Processed 5000/9829 time points
 Processed 6000/9829 time points
 Processed 7000/9829 time points
 Processed 8000/9829 time points
 Processed 9000/9829 time points
 Processing: Bwv0547PreludeandFugue.mid
 Processing MIDI file: 601.41 seconds long
 Analyzing 6015 time points...
 Processed 1000/6015 time points
 Processed 2000/6015 time points
 Processed 3000/6015 time points
 Processed 4000/6015 time points
 Processed 5000/6015 time points
 Processed 6000/6015 time points
 Processing: Bwv0532ToccataandFugue.mid
 Processing MIDI file: 704.72 seconds long
 Analyzing 7048 time points...
 Processed 1000/7048 time points
 Processed 2000/7048 time points
 Processed 3000/7048 time points
 Processed 4000/7048 time points
 Processed 5000/7048 time points
 Processed 6000/7048 time points
 Processed 7000/7048 time points
 Processing: Bwv0538ToccataandFugue_Dorian_.mid
 Processing MIDI file: 770.91 seconds long
 Analyzing 7710 time points...
 Processed 1000/7710 time points
 Processed 2000/7710 time points
 Processed 3000/7710 time points
 Processed 4000/7710 time points

Processed 5000/7710 time points
 Processed 6000/7710 time points
 Processed 7000/7710 time points
 Processing: Bwv0590Pastorale.mid
 Processing MIDI file: 704.55 seconds long
 Analyzing 7046 time points...
 Processed 1000/7046 time points
 Processed 2000/7046 time points
 Processed 3000/7046 time points
 Processed 4000/7046 time points
 Processed 5000/7046 time points
 Processed 6000/7046 time points
 Processed 7000/7046 time points
 Processing: Bwv0998PreludeFugueAllegroforLute1mov.mid
 Processing MIDI file: 159.45 seconds long
 Analyzing 1595 time points...
 Processed 1000/1595 time points
 Processing: Bwv0556ShortPreludeandFuguen4Spurious.mid
 Processing MIDI file: 193.32 seconds long
 Analyzing 1934 time points...
 Processed 1000/1934 time points
 Processing: Bwv0806EnglishSuiten105mov.mid
 Processing MIDI file: 120.25 seconds long
 Analyzing 1203 time points...
 Processed 1000/1203 time points
 Processing: Bwv0528Sonateentrion4.mid
 Processing MIDI file: 628.28 seconds long
 Analyzing 6283 time points...
 Processed 1000/6283 time points
 Processed 2000/6283 time points
 Processed 3000/6283 time points
 Processed 4000/6283 time points
 Processed 5000/6283 time points
 Processed 6000/6283 time points
 Processing: Bwv0582PassacagliaandFugueOrchestral.mid
 Processing MIDI file: 857.38 seconds long
 Analyzing 8574 time points...
 Processed 1000/8574 time points
 Processed 2000/8574 time points
 Processed 3000/8574 time points
 Processed 4000/8574 time points
 Processed 5000/8574 time points
 Processed 6000/8574 time points
 Processed 7000/8574 time points
 Processed 8000/8574 time points
 Processing: Bwv0565ToccataandFugueInDmB.mid
 Processing MIDI file: 541.99 seconds long
 Analyzing 5420 time points...

Processed 1000/5420 time points
 Processed 2000/5420 time points
 Processed 3000/5420 time points
 Processed 4000/5420 time points
 Processed 5000/5420 time points
 Processing: Bwv0593VivaldiConcertoArrangementRV522.mid
 Processing MIDI file: 682.37 seconds long
 Analyzing 6824 time points...
 Processed 1000/6824 time points
 Processed 2000/6824 time points
 Processed 3000/6824 time points
 Processed 4000/6824 time points
 Processed 5000/6824 time points
 Processed 6000/6824 time points
 Processing: Bwv0817FrenchSuiten6.mid
 Processing MIDI file: 992.48 seconds long
 Analyzing 9925 time points...
 Processed 1000/9925 time points
 Processed 2000/9925 time points
 Processed 3000/9925 time points
 Processed 4000/9925 time points
 Processed 5000/9925 time points
 Processed 6000/9925 time points
 Processed 7000/9925 time points
 Processed 8000/9925 time points
 Processed 9000/9925 time points
 Processing: Bwv0531PreludeandFugue.mid
 Processing MIDI file: 378.69 seconds long
 Analyzing 3787 time points...
 Processed 1000/3787 time points
 Processed 2000/3787 time points
 Processed 3000/3787 time points
 Processing: Bwv0536PreludeandFugue.mid
 Processing MIDI file: 418.71 seconds long
 Analyzing 4188 time points...
 Processed 1000/4188 time points
 Processed 2000/4188 time points
 Processed 3000/4188 time points
 Processed 4000/4188 time points
 Processing: Bwv0535PreludeandFugue.mid
 Processing MIDI file: 412.77 seconds long
 Analyzing 4128 time points...
 Processed 1000/4128 time points
 Processed 2000/4128 time points
 Processed 3000/4128 time points
 Processed 4000/4128 time points
 Processing: Bwv0542FantasiaandFugue.mid
 Processing MIDI file: 694.10 seconds long

Analyzing 6942 time points...

- Processed 1000/6942 time points
- Processed 2000/6942 time points
- Processed 3000/6942 time points
- Processed 4000/6942 time points
- Processed 5000/6942 time points
- Processed 6000/6942 time points

Processing: Bwv0811EnglishSuiten67mov.mid

Processing MIDI file: 71.85 seconds long

Analyzing 719 time points...

Processing: Bwv0806EnglishSuiten104mov.mid

Processing MIDI file: 120.25 seconds long

Analyzing 1203 time points...

- Processed 1000/1203 time points

Processing: Bwv0996SuiteforLute1.mid

Processing MIDI file: 945.71 seconds long

Analyzing 9458 time points...

- Processed 1000/9458 time points
- Processed 2000/9458 time points
- Processed 3000/9458 time points
- Processed 4000/9458 time points
- Processed 5000/9458 time points
- Processed 6000/9458 time points
- Processed 7000/9458 time points
- Processed 8000/9458 time points
- Processed 9000/9458 time points

Processing: Bwv0566PreludeandFugue.mid

Processing MIDI file: 618.16 seconds long

Analyzing 6182 time points...

- Processed 1000/6182 time points
- Processed 2000/6182 time points
- Processed 3000/6182 time points
- Processed 4000/6182 time points
- Processed 5000/6182 time points
- Processed 6000/6182 time points

Processing: Bwv1014HarpsicordandViolinSonata2mov.mid

Processing MIDI file: 188.50 seconds long

Analyzing 1886 time points...

- Processed 1000/1886 time points

Processing: Bwv0561FantasieandFuga.mid

Processing MIDI file: 559.45 seconds long

Analyzing 5595 time points...

- Processed 1000/5595 time points
- Processed 2000/5595 time points
- Processed 3000/5595 time points
- Processed 4000/5595 time points
- Processed 5000/5595 time points

Processing: Bwv0996SuiteforLute.mid

Processing MIDI file: 945.71 seconds long
Analyzing 9458 time points...
 Processed 1000/9458 time points
 Processed 2000/9458 time points
 Processed 3000/9458 time points
 Processed 4000/9458 time points
 Processed 5000/9458 time points
 Processed 6000/9458 time points
 Processed 7000/9458 time points
 Processed 8000/9458 time points
 Processed 9000/9458 time points
Processing: Bwv0998PreludeFugueAllegroforLute3mov.mid
 Processing MIDI file: 93.00 seconds long
 Analyzing 931 time points...
Processing: Bwv1005ViolinSonatan33movLargo.mid
 Processing MIDI file: 148.24 seconds long
 Analyzing 1483 time points...
 Processed 1000/1483 time points
Processing: Bwv0811EnglishSuiten62mov.mid
 Processing MIDI file: 160.32 seconds long
 Analyzing 1604 time points...
 Processed 1000/1604 time points
Processing: Bwv0557ShortPreludeandFuguen5Spurious.mid
 Processing MIDI file: 201.83 seconds long
 Analyzing 2019 time points...
 Processed 1000/2019 time points
 Processed 2000/2019 time points
Processing: Bwv0806EnglishSuiten101mov.mid
 Processing MIDI file: 91.84 seconds long
 Analyzing 919 time points...
Processing: Bwv0997PartitaforLute5mov.mid
 Processing MIDI file: 174.25 seconds long
 Analyzing 1743 time points...
 Processed 1000/1743 time points
Processing: Bwv0967Sonata.mid
 Processing MIDI file: 282.77 seconds long
 Analyzing 2828 time points...
 Processed 1000/2828 time points
 Processed 2000/2828 time points
Processing: Bwv1005ViolinSonatan32movFugue.mid
 Processing MIDI file: 609.65 seconds long
 Analyzing 6097 time points...
 Processed 1000/6097 time points
 Processed 2000/6097 time points
 Processed 3000/6097 time points
 Processed 4000/6097 time points
 Processed 5000/6097 time points
 Processed 6000/6097 time points

Processing: Bwv0541PreludeandFugue.mid
 Processing MIDI file: 440.05 seconds long
 Analyzing 4401 time points...
 Processed 1000/4401 time points
 Processed 2000/4401 time points
 Processed 3000/4401 time points
 Processed 4000/4401 time points

Processing: Bwv0806EnglishSuiten110mov.mid
 Processing MIDI file: 145.33 seconds long
 Analyzing 1454 time points...
 Processed 1000/1454 time points

Processing: Bwv0806EnglishSuiten109mov.mid
 Processing MIDI file: 86.34 seconds long
 Analyzing 864 time points...

Processing: Bwv0565ToccataandFugueInDmA.mid
 Processing MIDI file: 144.58 seconds long
 Analyzing 1446 time points...
 Processed 1000/1446 time points

Processing: Bwv0811EnglishSuiten63mov.mid
 Processing MIDI file: 143.66 seconds long
 Analyzing 1437 time points...
 Processed 1000/1437 time points

Processing: Bwv0935LittlePreluden3.mid
 Processing MIDI file: 87.27 seconds long
 Analyzing 873 time points...

Processing: Bwv0559ShortPreludeandFuguen7Spurious.mid
 Processing MIDI file: 234.99 seconds long
 Analyzing 2350 time points...
 Processed 1000/2350 time points
 Processed 2000/2350 time points

Processing: Bwv0733FugaSopraMagnificat.mid
 Processing MIDI file: 214.83 seconds long
 Analyzing 2149 time points...
 Processed 1000/2149 time points
 Processed 2000/2149 time points

Processing: Bwv0806EnglishSuiten102mov.mid
 Processing MIDI file: 213.21 seconds long
 Analyzing 2133 time points...
 Processed 1000/2133 time points
 Processed 2000/2133 time points

Processing: Bwv1014HarpsicordandViolinSonata3mov.mid
 Processing MIDI file: 195.30 seconds long
 Analyzing 1954 time points...
 Processed 1000/1954 time points

Processing: Bwv0906FantasiaandFugue.mid
 Processing MIDI file: 458.60 seconds long
 Analyzing 4587 time points...
 Processed 1000/4587 time points

Processed 2000/4587 time points
 Processed 3000/4587 time points
 Processed 4000/4587 time points
 Processing: Bwv0594VivaldiConcertoArrangementRV208.mid
 Processing MIDI file: 1121.87 seconds long
 Analyzing 11219 time points...
 Processed 1000/11219 time points
 Processed 2000/11219 time points
 Processed 3000/11219 time points
 Processed 4000/11219 time points
 Processed 5000/11219 time points
 Processed 6000/11219 time points
 Processed 7000/11219 time points
 Processed 8000/11219 time points
 Processed 9000/11219 time points
 Processed 10000/11219 time points
 Processed 11000/11219 time points
 Processing: Bwv0550PreludeandFugue.mid
 Processing MIDI file: 431.26 seconds long
 Analyzing 4313 time points...
 Processed 1000/4313 time points
 Processed 2000/4313 time points
 Processed 3000/4313 time points
 Processed 4000/4313 time points
 Processing: Bwv0997PartitaforLute4mov.mid
 Processing MIDI file: 174.62 seconds long
 Analyzing 1747 time points...
 Processed 1000/1747 time points
 Processing: Bwv0934LittlePreluden2.mid
 Processing MIDI file: 114.21 seconds long
 Analyzing 1143 time points...
 Processed 1000/1143 time points
 Processing: Bwv0552PreludeandFugue_StAnne_.mid
 Processing MIDI file: 876.74 seconds long
 Analyzing 8768 time points...
 Processed 1000/8768 time points
 Processed 2000/8768 time points
 Processed 3000/8768 time points
 Processed 4000/8768 time points
 Processed 5000/8768 time points
 Processed 6000/8768 time points
 Processed 7000/8768 time points
 Processed 8000/8768 time points
 Processing: Bwv0998PreludeFugueAllegroforLute2mov.mid
 Processing MIDI file: 357.21 seconds long
 Analyzing 3573 time points...
 Processed 1000/3573 time points
 Processed 2000/3573 time points

Processed 3000/3573 time points
 Processing: Bwv0806EnglishSuiten108mov.mid
 Processing MIDI file: 115.14 seconds long
 Analyzing 1152 time points...
 Processed 1000/1152 time points
 Processing: Bwv0806EnglishSuiten107mov.mid
 Processing MIDI file: 191.88 seconds long
 Analyzing 1919 time points...
 Processed 1000/1919 time points
 Processing: Bwv0526Sonateentrion2.mid
 Processing MIDI file: 760.31 seconds long
 Analyzing 7604 time points...
 Processed 1000/7604 time points
 Processed 2000/7604 time points
 Processed 3000/7604 time points
 Processed 4000/7604 time points
 Processed 5000/7604 time points
 Processed 6000/7604 time points
 Processed 7000/7604 time points
 Processing: Bwv0525Sonateentrion1.mid
 Processing MIDI file: 851.97 seconds long
 Analyzing 8520 time points...
 Processed 1000/8520 time points
 Processed 2000/8520 time points
 Processed 3000/8520 time points
 Processed 4000/8520 time points
 Processed 5000/8520 time points
 Processed 6000/8520 time points
 Processed 7000/8520 time points
 Processed 8000/8520 time points
 Processing: Bwv0811EnglishSuiten61mov.mid
 Processing MIDI file: 474.07 seconds long
 Analyzing 4741 time points...
 Processed 1000/4741 time points
 Processed 2000/4741 time points
 Processed 3000/4741 time points
 Processed 4000/4741 time points
 Processing: AveMaria.mid
 Processing MIDI file: 82.00 seconds long
 Analyzing 821 time points...
 Processing: Bwv0937LittlePreluden5.mid
 Processing MIDI file: 99.90 seconds long
 Analyzing 999 time points...
 Processing: Bwv0933LittlePreluden1.mid
 Processing MIDI file: 87.16 seconds long
 Analyzing 872 time points...
 Processing: PianoversionofBachstwopartinventionsNo5.mid
 Processing MIDI file: 127.35 seconds long

Analyzing 1274 time points...
 Processed 1000/1274 time points
 Processing: PianoversionofBachstwopartinventionsNo9.mid
 Processing MIDI file: 70.75 seconds long
 Analyzing 708 time points...
 Processing: PianoversionofBachstwopartinventionsNo14.mid
 Processing MIDI file: 110.62 seconds long
 Analyzing 1107 time points...
 Processed 1000/1107 time points
 Processing: PianoversionofBachstwopartinventionsNo8.mid
 Processing MIDI file: 61.20 seconds long
 Analyzing 612 time points...
 Processing: JesuJoyofManDesiring.mid
 Processing MIDI file: 199.41 seconds long
 Analyzing 1995 time points...
 Processed 1000/1995 time points
 Processing: PianoversionofBachstwopartinventionsNo13.mid
 Processing MIDI file: 75.15 seconds long
 Analyzing 752 time points...
 Processing: TocattoNolinFSharpMinorBWV910.mid
 Processing MIDI file: 539.32 seconds long
 Analyzing 5394 time points...
 Processed 1000/5394 time points
 Processed 2000/5394 time points
 Processed 3000/5394 time points
 Processed 4000/5394 time points
 Processed 5000/5394 time points
 Processing: PianoversionofBachstwopartinventionsNo6.mid
 Processing MIDI file: 223.56 seconds long
 Analyzing 2236 time points...
 Processed 1000/2236 time points
 Processed 2000/2236 time points
 Processing: ToccataandFugueinDminorBWV565BusoniPianoArr.mid
 Processing MIDI file: 449.36 seconds long
 Analyzing 4494 time points...
 Processed 1000/4494 time points
 Processed 2000/4494 time points
 Processed 3000/4494 time points
 Processed 4000/4494 time points
 Processing: ClavierubungPart111DuetNo2inFMajor.mid
 Processing MIDI file: 163.30 seconds long
 Analyzing 1633 time points...
 Processed 1000/1633 time points
 Processing: PianoversionofBachstwopartinventionsNo11.mid
 Processing MIDI file: 90.50 seconds long
 Analyzing 905 time points...
 Processing: PianoversionofBachstwopartinventionsNo.mid
 Processing MIDI file: 69.81 seconds long

Analyzing 699 time points...
 Processing: PreludeandFugueinCSharpBWV872.mid
 Processing MIDI file: 194.88 seconds long
 Analyzing 1949 time points...
 Processed 1000/1949 time points
 Processing: PianoversionofBachstwopartinventionsNo12.mid
 Processing MIDI file: 100.49 seconds long
 Analyzing 1005 time points...
 Processed 1000/1005 time points
 Processing: PianoversionofBachstwopartinventionsNo7.mid
 Processing MIDI file: 70.60 seconds long
 Analyzing 706 time points...
 Processing: MinuetinG.mid
 Processing MIDI file: 42.11 seconds long
 Analyzing 422 time points...
 Processing: PianoversionofBachstwopartinventionsNo4.mid
 Processing MIDI file: 63.06 seconds long
 Analyzing 631 time points...
 Processing: PreludefromSonatan6.mid
 Processing MIDI file: 204.95 seconds long
 Analyzing 2050 time points...
 Processed 1000/2050 time points
 Processed 2000/2050 time points
 Processing: PianoversionofBachstwopartinventionsNo2.mid
 Processing MIDI file: 81.52 seconds long
 Analyzing 816 time points...
 Processing: PianoversionofBachstwopartinventionsNo10.mid
 Processing MIDI file: 72.74 seconds long
 Analyzing 728 time points...
 Processing: PianoversionofBachstwopartinventionsNo15.mid
 Processing MIDI file: 55.47 seconds long
 Analyzing 555 time points...
 Processing: PreludeandFugueinD.mid
 Processing MIDI file: 163.61 seconds long
 Analyzing 1637 time points...
 Processed 1000/1637 time points
 Processing: PianoversionofBachstwopartinventionsNo3.mid
 Processing MIDI file: 69.81 seconds long
 Analyzing 699 time points...
 Processing: PreludeandFugueinABWV888.mid
 Processing MIDI file: 126.72 seconds long
 Analyzing 1268 time points...
 Processed 1000/1268 time points
 Processing: Bwv802FourInventionsDuettosClavier-U_bungIIIn1.mid
 Processing MIDI file: 119.60 seconds long
 Analyzing 1196 time points...
 Processed 1000/1196 time points
 Processing: PianoversionofBachstwopartinventionsNo1.mid

Processing MIDI file: 80.16 seconds long
Analyzing 802 time points...
Processing: Bwv1056HarpsichordConcerton5.mid
Processing MIDI file: 548.30 seconds long
Analyzing 5483 time points...
 Processed 1000/5483 time points
 Processed 2000/5483 time points
 Processed 3000/5483 time points
 Processed 4000/5483 time points
 Processed 5000/5483 time points
Processing: Bwv1055HarpsichordConcerton41mov.mid
Processing MIDI file: 284.32 seconds long
Analyzing 2844 time points...
 Processed 1000/2844 time points
 Processed 2000/2844 time points
Processing: Bwv1058HarpsichordConcerton73mov.mid
Processing MIDI file: 207.88 seconds long
Analyzing 2079 time points...
 Processed 1000/2079 time points
 Processed 2000/2079 time points
Processing: Bwv1064ThreeHarpsichordsConcerton23mov.mid
Processing MIDI file: 287.85 seconds long
Analyzing 2879 time points...
 Processed 1000/2879 time points
 Processed 2000/2879 time points
Processing: Bwv1057HarpsichordConcerton62mov.mid
Processing MIDI file: 185.22 seconds long
Analyzing 1853 time points...
 Processed 1000/1853 time points
Processing: Bwv1058HarpsichordConcerton71mov.mid
Processing MIDI file: 205.20 seconds long
Analyzing 2053 time points...
 Processed 1000/2053 time points
 Processed 2000/2053 time points
Processing: Bwv1052HarpsichordConcerton12mov.mid
Processing MIDI file: 431.67 seconds long
Analyzing 4317 time points...
 Processed 1000/4317 time points
 Processed 2000/4317 time points
 Processed 3000/4317 time points
 Processed 4000/4317 time points
Processing: Bwv1061TwoHarpsichordsConcerton2.mid
Processing MIDI file: 1036.75 seconds long
Analyzing 10368 time points...
 Processed 1000/10368 time points
 Processed 2000/10368 time points
 Processed 3000/10368 time points
 Processed 4000/10368 time points

Processed 5000/10368 time points
 Processed 6000/10368 time points
 Processed 7000/10368 time points
 Processed 8000/10368 time points
 Processed 9000/10368 time points
 Processed 10000/10368 time points
 Processing: Bwv1060TwoHarpsichordsConcerton1.mid
 Processing MIDI file: 885.15 seconds long
 Analyzing 8852 time points...
 Processed 1000/8852 time points
 Processed 2000/8852 time points
 Processed 3000/8852 time points
 Processed 4000/8852 time points
 Processed 5000/8852 time points
 Processed 6000/8852 time points
 Processed 7000/8852 time points
 Processed 8000/8852 time points
 Processing: Bwv1052HarpsichordConcerton1b.mid
 Processing MIDI file: 1341.47 seconds long
 Analyzing 13415 time points...
 Processed 1000/13415 time points
 Processed 2000/13415 time points
 Processed 3000/13415 time points
 Processed 4000/13415 time points
 Processed 5000/13415 time points
 Processed 6000/13415 time points
 Processed 7000/13415 time points
 Processed 8000/13415 time points
 Processed 9000/13415 time points
 Processed 10000/13415 time points
 Processed 11000/13415 time points
 Processed 12000/13415 time points
 Processed 13000/13415 time points
 Processing: Bwv1053HarpsichordConcerton22mov.mid
 Processing MIDI file: 326.25 seconds long
 Analyzing 3263 time points...
 Processed 1000/3263 time points
 Processed 2000/3263 time points
 Processed 3000/3263 time points
 Processing: Bwv1055HarpsichordConcerton42mov.mid
 Processing MIDI file: 218.57 seconds long
 Analyzing 2186 time points...
 Processed 1000/2186 time points
 Processed 2000/2186 time points
 Processing: Bwv1054HarpsichordConcerton33mov.mid
 Processing MIDI file: 156.52 seconds long
 Analyzing 1566 time points...
 Processed 1000/1566 time points

Processing: Bwv1054HarpsichordConcerton31mov.mid

Processing MIDI file: 464.27 seconds long

Analyzing 4643 time points...

Processed 1000/4643 time points

Processed 2000/4643 time points

Processed 3000/4643 time points

Processed 4000/4643 time points

Processing: Bwv1062TwoHarpsichordsConcerton3.mid

Processing MIDI file: 916.16 seconds long

Analyzing 9162 time points...

Processed 1000/9162 time points

Processed 2000/9162 time points

Processed 3000/9162 time points

Processed 4000/9162 time points

Processed 5000/9162 time points

Processed 6000/9162 time points

Processed 7000/9162 time points

Processed 8000/9162 time points

Processed 9000/9162 time points

Processing: Bwv1058HarpsichordConcerton72mov.mid

Processing MIDI file: 276.00 seconds long

Analyzing 2761 time points...

Processed 1000/2761 time points

Processed 2000/2761 time points

Processing: Bwv1054HarpsichordConcerton32mov.mid

Processing MIDI file: 310.91 seconds long

Analyzing 3110 time points...

Processed 1000/3110 time points

Processed 2000/3110 time points

Processed 3000/3110 time points

Processing: Bwv1065FourHarpsichordsConcerto.mid

Processing MIDI file: 553.81 seconds long

Analyzing 5539 time points...

Processed 1000/5539 time points

Processed 2000/5539 time points

Processed 3000/5539 time points

Processed 4000/5539 time points

Processed 5000/5539 time points

Processing: Bwv1052HarpsichordConcerton11mov.mid

Processing MIDI file: 444.91 seconds long

Analyzing 4450 time points...

Processed 1000/4450 time points

Processed 2000/4450 time points

Processed 3000/4450 time points

Processed 4000/4450 time points

Processing: Bwv1057HarpsichordConcerton63mov.mid

Processing MIDI file: 366.00 seconds long

Analyzing 3660 time points...

Processed 1000/3660 time points
 Processed 2000/3660 time points
 Processed 3000/3660 time points
 Processing: Bwv1053HarpsichordConcerton21mov.mid
 Processing MIDI file: 478.64 seconds long
 Analyzing 4787 time points...
 Processed 1000/4787 time points
 Processed 2000/4787 time points
 Processed 3000/4787 time points
 Processed 4000/4787 time points
 Processing: Bwv1053HarpsichordConcerton23mov.mid
 Processing MIDI file: 444.00 seconds long
 Analyzing 4440 time points...
 Processed 1000/4440 time points
 Processed 2000/4440 time points
 Processed 3000/4440 time points
 Processed 4000/4440 time points
 Processing: Bwv1052HarpsichordConcerton13mov.mid
 Processing MIDI file: 538.12 seconds long
 Analyzing 5382 time points...
 Processed 1000/5382 time points
 Processed 2000/5382 time points
 Processed 3000/5382 time points
 Processed 4000/5382 time points
 Processed 5000/5382 time points
 Processing: Bwv1064ThreeHarpsichordsConcerton22mov.mid
 Processing MIDI file: 346.69 seconds long
 Analyzing 3467 time points...
 Processed 1000/3467 time points
 Processed 2000/3467 time points
 Processed 3000/3467 time points
 Processing: Bwv1063ThreeHarpsichordsConcerton1.mid
 Processing MIDI file: 899.16 seconds long
 Analyzing 8992 time points...
 Processed 1000/8992 time points
 Processed 2000/8992 time points
 Processed 3000/8992 time points
 Processed 4000/8992 time points
 Processed 5000/8992 time points
 Processed 6000/8992 time points
 Processed 7000/8992 time points
 Processed 8000/8992 time points
 Processing: Bwv1055HarpsichordConcerton43mov.mid
 Processing MIDI file: 260.87 seconds long
 Analyzing 2609 time points...
 Processed 1000/2609 time points
 Processed 2000/2609 time points
 Processing: Bwv1064ThreeHarpsichordsConcerton21mov.mid

Processing MIDI file: 391.33 seconds long
 Analyzing 3914 time points...
 Processed 1000/3914 time points
 Processed 2000/3914 time points
 Processed 3000/3914 time points
 Processing: Bwv1047BrandenburgConcertn23mov.mid
 Processing MIDI file: 140.80 seconds long
 Analyzing 1409 time points...
 Processed 1000/1409 time points
 Processing: Bwv1047BrandenburgConcertn22mov.mid
 Processing MIDI file: 148.05 seconds long
 Analyzing 1481 time points...
 Processed 1000/1481 time points
 Processing: Bwv1046BrandenburgConcertn12mov.mid
 Processing MIDI file: 202.07 seconds long
 Analyzing 2021 time points...
 Processed 1000/2021 time points
 Processed 2000/2021 time points
 Processing: Bwv1041ViolinConcertn12mov.mid
 Processing MIDI file: 394.29 seconds long
 Analyzing 3943 time points...
 Processed 1000/3943 time points
 Processed 2000/3943 time points
 Processed 3000/3943 time points
 Processing: Bwv1047BrandenburgConcertn21mov.mid
 Processing MIDI file: 327.06 seconds long
 Analyzing 3271 time points...
 Processed 1000/3271 time points
 Processed 2000/3271 time points
 Processed 3000/3271 time points
 Processing: Bwv1043TwoViolinsConcertn32mov.mid
 Processing MIDI file: 150.47 seconds long
 Analyzing 1505 time points...
 Processed 1000/1505 time points
 Processing: Bwv1051BrandenburgConcertn62mov.mid
 Processing MIDI file: 277.56 seconds long
 Analyzing 2776 time points...
 Processed 1000/2776 time points
 Processed 2000/2776 time points
 Processing: Bwv1049BrandenburgConcertn43mov.mid
 Processing MIDI file: 346.27 seconds long
 Analyzing 3463 time points...
 Processed 1000/3463 time points
 Processed 2000/3463 time points
 Processed 3000/3463 time points
 Processing: Bwv1048BrandenburgConcertn31mov.mid
 Processing MIDI file: 621.63 seconds long
 Analyzing 6217 time points...

Processed 1000/6217 time points
 Processed 2000/6217 time points
 Processed 3000/6217 time points
 Processed 4000/6217 time points
 Processed 5000/6217 time points
 Processed 6000/6217 time points
 Processing: Bwv1051BrandenburgConcertn61mov.mid
 Processing MIDI file: 390.15 seconds long
 Analyzing 3902 time points...
 Processed 1000/3902 time points
 Processed 2000/3902 time points
 Processed 3000/3902 time points
 Processing: Bwv1043TwoViolinsConcertn33mov.mid
 Processing MIDI file: 266.25 seconds long
 Analyzing 2663 time points...
 Processed 1000/2663 time points
 Processed 2000/2663 time points
 Processing: Bwv1044FluteViolinandHarpsichordConcerto3mov.mid
 Processing MIDI file: 419.06 seconds long
 Analyzing 4191 time points...
 Processed 1000/4191 time points
 Processed 2000/4191 time points
 Processed 3000/4191 time points
 Processed 4000/4191 time points
 Processing: Bwv1046BrandenburgConcertn11mov.mid
 Processing MIDI file: 229.69 seconds long
 Analyzing 2297 time points...
 Processed 1000/2297 time points
 Processed 2000/2297 time points
 Processing: Bwv1051BrandenburgConcertn63mov.mid
 Processing MIDI file: 319.40 seconds long
 Analyzing 3194 time points...
 Processed 1000/3194 time points
 Processed 2000/3194 time points
 Processed 3000/3194 time points
 Processing: Bwv1042ViolinConcertn21mov.mid
 Processing MIDI file: 422.33 seconds long
 Analyzing 4224 time points...
 Processed 1000/4224 time points
 Processed 2000/4224 time points
 Processed 3000/4224 time points
 Processed 4000/4224 time points
 Processing: Bwv1044FluteViolinandHarpsichordConcerto1mov.mid
 Processing MIDI file: 508.20 seconds long
 Analyzing 5082 time points...
 Processed 1000/5082 time points
 Processed 2000/5082 time points
 Processed 3000/5082 time points

Processed 4000/5082 time points
 Processed 5000/5082 time points
 Processing: Bwv1042ViolinConcerton22mov.mid
 Processing MIDI file: 287.71 seconds long
 Analyzing 2878 time points...
 Processed 1000/2878 time points
 Processed 2000/2878 time points
 Processing: Bwv1043TwoViolinsConcerton31mov.mid
 Processing MIDI file: 212.10 seconds long
 Analyzing 2122 time points...
 Processed 1000/2122 time points
 Processed 2000/2122 time points
 Processing: Bwv1049BrandenburgConcertn42mov.mid
 Processing MIDI file: 222.48 seconds long
 Analyzing 2225 time points...
 Processed 1000/2225 time points
 Processed 2000/2225 time points
 Processing: Bwv1046BrandenburgConcertn13mov.mid
 Processing MIDI file: 228.88 seconds long
 Analyzing 2289 time points...
 Processed 1000/2289 time points
 Processed 2000/2289 time points
 Processing: Bwv1042ViolinConcerton23mov.mid
 Processing MIDI file: 156.40 seconds long
 Analyzing 1564 time points...
 Processed 1000/1564 time points
 Processing: Bwv1041ViolinConcerton13mov.mid
 Processing MIDI file: 206.76 seconds long
 Analyzing 2068 time points...
 Processed 1000/2068 time points
 Processed 2000/2068 time points
 Processing: Bwv1041ViolinConcerton11mov.mid
 Processing MIDI file: 221.61 seconds long
 Analyzing 2217 time points...
 Processed 1000/2217 time points
 Processed 2000/2217 time points
 Processing: Bwv1049BrandenburgConcertn41mov.mid
 Processing MIDI file: 484.45 seconds long
 Analyzing 4845 time points...
 Processed 1000/4845 time points
 Processed 2000/4845 time points
 Processed 3000/4845 time points
 Processed 4000/4845 time points
 Processing: Bwv1044FluteViolinandHarpsichordConcerto2mov.mid
 Processing MIDI file: 296.78 seconds long
 Analyzing 2968 time points...
 Processed 1000/2968 time points
 Processed 2000/2968 time points

Processing: CounterFuguen1.mid
Processing MIDI file: 245.60 seconds long
Analyzing 2456 time points...
Processed 1000/2456 time points
Processed 2000/2456 time points
Processing: CounterFuguen2.mid
Processing MIDI file: 255.74 seconds long
Analyzing 2558 time points...
Processed 1000/2558 time points
Processed 2000/2558 time points
Processing: CanonFuguen4.mid
Processing MIDI file: 148.16 seconds long
Analyzing 1482 time points...
Processed 1000/1482 time points
Processing: SimpleFugueRegularSubjectn1.mid
Processing MIDI file: 211.66 seconds long
Analyzing 2117 time points...
Processed 1000/2117 time points
Processed 2000/2117 time points
Processing: CounterFuguen3.mid
Processing MIDI file: 249.31 seconds long
Analyzing 2494 time points...
Processed 1000/2494 time points
Processed 2000/2494 time points
Processing: SimpleFugueInvertedSubjectn1.mid
Processing MIDI file: 182.31 seconds long
Analyzing 1824 time points...
Processed 1000/1824 time points
Processing: CanonFuguen2.mid
Processing MIDI file: 157.93 seconds long
Analyzing 1580 time points...
Processed 1000/1580 time points
Processing: MirrorFuguen1.mid
Processing MIDI file: 272.63 seconds long
Analyzing 2727 time points...
Processed 1000/2727 time points
Processed 2000/2727 time points
Processing: DoubleFuguen2.mid
Processing MIDI file: 226.53 seconds long
Analyzing 2266 time points...
Processed 1000/2266 time points
Processed 2000/2266 time points
Processing: CanonFuguen3.mid
Processing MIDI file: 262.27 seconds long
Analyzing 2623 time points...
Processed 1000/2623 time points
Processed 2000/2623 time points
Processing: MirrorFuguen2.mid

Processing MIDI file: 317.47 seconds long
Analyzing 3175 time points...
 Processed 1000/3175 time points
 Processed 2000/3175 time points
 Processed 3000/3175 time points
Processing: DoubleFuguen1.mid
Processing MIDI file: 211.37 seconds long
Analyzing 2114 time points...
 Processed 1000/2114 time points
 Processed 2000/2114 time points
Processing: SimpleFugueInvertedSubjectn2.mid
Processing MIDI file: 262.50 seconds long
Analyzing 2626 time points...
 Processed 1000/2626 time points
 Processed 2000/2626 time points
Processing: CanonFuguen1.mid
Processing MIDI file: 263.69 seconds long
Analyzing 2637 time points...
 Processed 1000/2637 time points
 Processed 2000/2637 time points
Processing: TripleFuguen1.mid
Processing MIDI file: 362.57 seconds long
Analyzing 3626 time points...
 Processed 1000/3626 time points
 Processed 2000/3626 time points
 Processed 3000/3626 time points
Processing: TheArtoftheFugueBWV1080.mid
Processing MIDI file: 5209.31 seconds long
Analyzing 52094 time points...
 Processed 1000/52094 time points
 Processed 2000/52094 time points
 Processed 3000/52094 time points
 Processed 4000/52094 time points
 Processed 5000/52094 time points
 Processed 6000/52094 time points
 Processed 7000/52094 time points
 Processed 8000/52094 time points
 Processed 9000/52094 time points
 Processed 10000/52094 time points
 Processed 11000/52094 time points
 Processed 12000/52094 time points
 Processed 13000/52094 time points
 Processed 14000/52094 time points
 Processed 15000/52094 time points
 Processed 16000/52094 time points
 Processed 17000/52094 time points
 Processed 18000/52094 time points
 Processed 19000/52094 time points

Processed 20000/52094 time points
Processed 21000/52094 time points
Processed 22000/52094 time points
Processed 23000/52094 time points
Processed 24000/52094 time points
Processed 25000/52094 time points
Processed 26000/52094 time points
Processed 27000/52094 time points
Processed 28000/52094 time points
Processed 29000/52094 time points
Processed 30000/52094 time points
Processed 31000/52094 time points
Processed 32000/52094 time points
Processed 33000/52094 time points
Processed 34000/52094 time points
Processed 35000/52094 time points
Processed 36000/52094 time points
Processed 37000/52094 time points
Processed 38000/52094 time points
Processed 39000/52094 time points
Processed 40000/52094 time points
Processed 41000/52094 time points
Processed 42000/52094 time points
Processed 43000/52094 time points
Processed 44000/52094 time points
Processed 45000/52094 time points
Processed 46000/52094 time points
Processed 47000/52094 time points
Processed 48000/52094 time points
Processed 49000/52094 time points
Processed 50000/52094 time points
Processed 51000/52094 time points
Processed 52000/52094 time points
Processing: UnfinishedFugue.mid
Processing MIDI file: 574.58 seconds long
Analyzing 5746 time points...
Processed 1000/5746 time points
Processed 2000/5746 time points
Processed 3000/5746 time points
Processed 4000/5746 time points
Processed 5000/5746 time points
Processing: TripleFuguen2.mid
Processing MIDI file: 405.22 seconds long
Analyzing 4053 time points...
Processed 1000/4053 time points
Processed 2000/4053 time points
Processed 3000/4053 time points
Processed 4000/4053 time points

Processing: SimpleFugueRegularSubjectn2.mid
 Processing MIDI file: 204.67 seconds long
 Analyzing 2047 time points...
 Processed 1000/2047 time points
 Processed 2000/2047 time points

Processing: Bwv1067OrchestralSuiten27mov.mid
 Processing MIDI file: 86.05 seconds long
 Analyzing 861 time points...

Processing: Bwv1068OrchestralSuiten32mov.mid
 Processing MIDI file: 280.06 seconds long
 Analyzing 2801 time points...
 Processed 1000/2801 time points
 Processed 2000/2801 time points

Processing: Bwv1066OrchestralSuiten13mov.mid
 Processing MIDI file: 246.05 seconds long
 Analyzing 2461 time points...
 Processed 1000/2461 time points
 Processed 2000/2461 time points

Processing: Bwv1067OrchestralSuiten22mov.mid
 Processing MIDI file: 100.44 seconds long
 Analyzing 1005 time points...
 Processed 1000/1005 time points

Processing: Bwv1069OrchestralSuiten45mov.mid
 Processing MIDI file: 165.49 seconds long
 Analyzing 1655 time points...
 Processed 1000/1655 time points

Processing: Bwv1066OrchestralSuiten14mov.mid
 Processing MIDI file: 100.13 seconds long
 Analyzing 1002 time points...
 Processed 1000/1002 time points

Processing: Bwv1069OrchestralSuiten43mov.mid
 Processing MIDI file: 106.36 seconds long
 Analyzing 1064 time points...
 Processed 1000/1064 time points

Processing: Bwv1066OrchestralSuiten15mov.mid
 Processing MIDI file: 259.08 seconds long
 Analyzing 2591 time points...
 Processed 1000/2591 time points
 Processed 2000/2591 time points

Processing: Bwv1068OrchestralSuiten35mov.mid
 Processing MIDI file: 149.72 seconds long
 Analyzing 1498 time points...
 Processed 1000/1498 time points

Processing: Bwv1066OrchestralSuiten11mov.mid
 Processing MIDI file: 645.00 seconds long
 Analyzing 6450 time points...
 Processed 1000/6450 time points
 Processed 2000/6450 time points

Processed 3000/6450 time points
 Processed 4000/6450 time points
 Processed 5000/6450 time points
 Processed 6000/6450 time points
 Processing: Bwv1067OrchestralSuiten23mov.mid
 Processing MIDI file: 183.81 seconds long
 Analyzing 1839 time points...
 Processed 1000/1839 time points
 Processing: Bwv1066OrchestralSuiten17mov.mid
 Processing MIDI file: 186.41 seconds long
 Analyzing 1865 time points...
 Processed 1000/1865 time points
 Processing: Bwv1068OrchestralSuiten33mov.mid
 Processing MIDI file: 287.12 seconds long
 Analyzing 2872 time points...
 Processed 1000/2872 time points
 Processed 2000/2872 time points
 Processing: Bwv1067OrchestralSuiten21mov.mid
 Processing MIDI file: 819.07 seconds long
 Analyzing 8191 time points...
 Processed 1000/8191 time points
 Processed 2000/8191 time points
 Processed 3000/8191 time points
 Processed 4000/8191 time points
 Processed 5000/8191 time points
 Processed 6000/8191 time points
 Processed 7000/8191 time points
 Processed 8000/8191 time points
 Processing: Bwv1067OrchestralSuiten24mov.mid
 Processing MIDI file: 178.79 seconds long
 Analyzing 1788 time points...
 Processed 1000/1788 time points
 Processing: Bwv1068OrchestralSuiten31mov.mid
 Processing MIDI file: 724.28 seconds long
 Analyzing 7243 time points...
 Processed 1000/7243 time points
 Processed 2000/7243 time points
 Processed 3000/7243 time points
 Processed 4000/7243 time points
 Processed 5000/7243 time points
 Processed 6000/7243 time points
 Processed 7000/7243 time points
 Processing: Bwv1069OrchestralSuiten41mov.mid
 Processing MIDI file: 840.71 seconds long
 Analyzing 8408 time points...
 Processed 1000/8408 time points
 Processed 2000/8408 time points
 Processed 3000/8408 time points

Processed 4000/8408 time points
 Processed 5000/8408 time points
 Processed 6000/8408 time points
 Processed 7000/8408 time points
 Processed 8000/8408 time points
 Processing: Bwv1067OrchestralSuiten25mov.mid
 Processing MIDI file: 195.68 seconds long
 Analyzing 1957 time points...
 Processed 1000/1957 time points
 Processing: Bwv1067OrchestralSuiten26mov.mid
 Processing MIDI file: 83.38 seconds long
 Analyzing 834 time points...
 Processing: Bwv1069OrchestralSuiten42mov.mid
 Processing MIDI file: 224.14 seconds long
 Analyzing 2242 time points...
 Processed 1000/2242 time points
 Processed 2000/2242 time points
 Processing: Bwv1066OrchestralSuiten16mov.mid
 Processing MIDI file: 220.33 seconds long
 Analyzing 2204 time points...
 Processed 1000/2204 time points
 Processed 2000/2204 time points
 Processing: Bwv1069OrchestralSuiten44mov.mid
 Processing MIDI file: 309.56 seconds long
 Analyzing 3096 time points...
 Processed 1000/3096 time points
 Processed 2000/3096 time points
 Processed 3000/3096 time points
 Processing: Bwv1068OrchestralSuiten34mov.mid
 Processing MIDI file: 91.89 seconds long
 Analyzing 919 time points...
 Processing: Bwv1066OrchestralSuiten12mov.mid
 Processing MIDI file: 120.45 seconds long
 Analyzing 1205 time points...
 Processed 1000/1205 time points
 Processing: Variation18.mid
 Processing MIDI file: 76.80 seconds long
 Analyzing 769 time points...
 Processing: Variation16.mid
 Processing MIDI file: 159.00 seconds long
 Analyzing 1591 time points...
 Processed 1000/1591 time points
 Processing: Variation19.mid
 Processing MIDI file: 86.40 seconds long
 Analyzing 864 time points...
 Processing: Variation17.mid
 Processing MIDI file: 114.90 seconds long
 Analyzing 1150 time points...

Processed 1000/1150 time points
 Processing: Variation13.mid
 Processing MIDI file: 230.40 seconds long
 Analyzing 2305 time points...
 Processed 1000/2305 time points
 Processed 2000/2305 time points
 Processing: Variation22.mid
 Processing MIDI file: 76.80 seconds long
 Analyzing 769 time points...
 Processing: Variation21.mid
 Processing MIDI file: 153.60 seconds long
 Analyzing 1537 time points...
 Processed 1000/1537 time points
 Processing: Variation23.mid
 Processing MIDI file: 114.90 seconds long
 Analyzing 1150 time points...
 Processed 1000/1150 time points
 Processing: Variation14.mid
 Processing MIDI file: 114.90 seconds long
 Analyzing 1150 time points...
 Processed 1000/1150 time points
 Processing: Variation03.mid
 Processing MIDI file: 115.85 seconds long
 Analyzing 1159 time points...
 Processed 1000/1159 time points
 Processing: Variation01.mid
 Processing MIDI file: 115.85 seconds long
 Analyzing 1159 time points...
 Processed 1000/1159 time points
 Processing: Variation02.mid
 Processing MIDI file: 114.60 seconds long
 Analyzing 1147 time points...
 Processed 1000/1147 time points
 Processing: Variation07.mid
 Processing MIDI file: 115.85 seconds long
 Analyzing 1159 time points...
 Processed 1000/1159 time points
 Processing: Bwv108714Canons.mid
 Processing MIDI file: 234.00 seconds long
 Analyzing 2341 time points...
 Processed 1000/2341 time points
 Processed 2000/2341 time points
 Processing: Variation12.mid
 Processing MIDI file: 115.20 seconds long
 Analyzing 1153 time points...
 Processed 1000/1153 time points
 Processing: Variation27.mid
 Processing MIDI file: 171.90 seconds long

Analyzing 1720 time points...
 Processed 1000/1720 time points
Processing: Variation09.mid
 Processing MIDI file: 114.60 seconds long
 Analyzing 1147 time points...
 Processed 1000/1147 time points
Processing: Variation11.mid
 Processing MIDI file: 115.20 seconds long
 Analyzing 1153 time points...
 Processed 1000/1153 time points
Processing: Variation05.mid
 Processing MIDI file: 115.85 seconds long
 Analyzing 1159 time points...
 Processed 1000/1159 time points
Processing: Variation28.mid
 Processing MIDI file: 115.20 seconds long
 Analyzing 1153 time points...
 Processed 1000/1153 time points
Processing: Variation10.mid
 Processing MIDI file: 76.80 seconds long
 Analyzing 769 time points...
Processing: Variation04.mid
 Processing MIDI file: 237.00 seconds long
 Analyzing 2371 time points...
 Processed 1000/2371 time points
 Processed 2000/2371 time points
Processing: Variation24.mid
 Processing MIDI file: 173.70 seconds long
 Analyzing 1738 time points...
 Processed 1000/1738 time points
Processing: Variation00Aria.mid
 Processing MIDI file: 232.79 seconds long
 Analyzing 2328 time points...
 Processed 1000/2328 time points
 Processed 2000/2328 time points
Processing: Variation26.mid
 Processing MIDI file: 171.90 seconds long
 Analyzing 1720 time points...
 Processed 1000/1720 time points
Processing: Variation08.mid
 Processing MIDI file: 115.85 seconds long
 Analyzing 1159 time points...
 Processed 1000/1159 time points
Processing: Variation25.mid
 Processing MIDI file: 345.08 seconds long
 Analyzing 3451 time points...
 Processed 1000/3451 time points
 Processed 2000/3451 time points

Processed 3000/3451 time points
Processing: Variation06.mid
Processing MIDI file: 236.36 seconds long
Analyzing 2364 time points...
Processed 1000/2364 time points
Processed 2000/2364 time points
Processing: Variation29.mid
Processing MIDI file: 115.80 seconds long
Analyzing 1159 time points...
Processed 1000/1159 time points
Processing: Variation30.mid
Processing MIDI file: 78.90 seconds long
Analyzing 790 time points...
Processing: Variation15.mid
Processing MIDI file: 307.20 seconds long
Analyzing 3072 time points...
Processed 1000/3072 time points
Processed 2000/3072 time points
Processed 3000/3072 time points
Processing: Variation20.mid
Processing MIDI file: 114.90 seconds long
Analyzing 1150 time points...
Processed 1000/1150 time points
Processing: Wtcii01a.mid
Processing MIDI file: 117.74 seconds long
Analyzing 1178 time points...
Processed 1000/1178 time points
Processing: Wtcii18b.mid
Processing MIDI file: 277.93 seconds long
Analyzing 2780 time points...
Processed 1000/2780 time points
Processed 2000/2780 time points
Processing: Wtcii06b.mid
Processing MIDI file: 94.30 seconds long
Analyzing 943 time points...
Processing: Wtcii17b.mid
Processing MIDI file: 163.89 seconds long
Analyzing 1639 time points...
Processed 1000/1639 time points
Processing: Wtcii22b.mid
Processing MIDI file: 328.10 seconds long
Analyzing 3281 time points...
Processed 1000/3281 time points
Processed 2000/3281 time points
Processed 3000/3281 time points
Processing: Wtcii10a.mid
Processing MIDI file: 212.14 seconds long
Analyzing 2122 time points...

Processed 1000/2122 time points
Processed 2000/2122 time points
Processing: Wtcii20b.mid
Processing MIDI file: 94.50 seconds long
Analyzing 945 time points...
Processing: Wtcii23b.mid
Processing MIDI file: 210.97 seconds long
Analyzing 2110 time points...
Processed 1000/2110 time points
Processed 2000/2110 time points
Processing: Wtcii12b.mid
Processing MIDI file: 113.50 seconds long
Analyzing 1135 time points...
Processed 1000/1135 time points
Processing: Wtcii09b.mid
Processing MIDI file: 165.95 seconds long
Analyzing 1660 time points...
Processed 1000/1660 time points
Processing: Wtcii10b.mid
Processing MIDI file: 170.98 seconds long
Analyzing 1710 time points...
Processed 1000/1710 time points
Processing: Wtcii08b.mid
Processing MIDI file: 214.28 seconds long
Analyzing 2143 time points...
Processed 1000/2143 time points
Processed 2000/2143 time points
Processing: Wtcii15b.mid
Processing MIDI file: 67.76 seconds long
Analyzing 678 time points...
Processing: Wtcii21b.mid
Processing MIDI file: 155.77 seconds long
Analyzing 1558 time points...
Processed 1000/1558 time points
Processing: Wtcii24a.mid
Processing MIDI file: 114.35 seconds long
Analyzing 1144 time points...
Processed 1000/1144 time points
Processing: Wtcii24b.mid
Processing MIDI file: 104.42 seconds long
Analyzing 1045 time points...
Processed 1000/1045 time points
Processing: Wtcii14b.mid
Processing MIDI file: 240.96 seconds long
Analyzing 2410 time points...
Processed 1000/2410 time points
Processed 2000/2410 time points
Processing: Wtcii11b.mid

Processing MIDI file: 102.03 seconds long
Analyzing 1021 time points...
Processed 1000/1021 time points
Processing: Wtcii19b.mid
Processing MIDI file: 75.88 seconds long
Analyzing 759 time points...
Processing: Wtcii07b.mid
Processing MIDI file: 112.00 seconds long
Analyzing 1121 time points...
Processed 1000/1121 time points
Processing: Wtcii16b.mid
Processing MIDI file: 188.69 seconds long
Analyzing 1887 time points...
Processed 1000/1887 time points
Processing: Wtcii13b.mid
Processing MIDI file: 152.25 seconds long
Analyzing 1523 time points...
Processed 1000/1523 time points
Processing: Wtcii01b.mid
Processing MIDI file: 100.60 seconds long
Analyzing 1006 time points...
Processed 1000/1006 time points
Processing: Wtcii11a.mid
Processing MIDI file: 182.02 seconds long
Analyzing 1821 time points...
Processed 1000/1821 time points
Processing: Wtcii03b.mid
Processing MIDI file: 106.39 seconds long
Analyzing 1064 time points...
Processed 1000/1064 time points
Processing: Wtcii02b.mid
Processing MIDI file: 148.23 seconds long
Analyzing 1483 time points...
Processed 1000/1483 time points
Processing: Wtcii05b.mid
Processing MIDI file: 155.76 seconds long
Analyzing 1558 time points...
Processed 1000/1558 time points
Processing: Wtcii04b.mid
Processing MIDI file: 132.28 seconds long
Analyzing 1323 time points...
Processed 1000/1323 time points
Processing: Bwv0799Sinfonian13.mid
Processing MIDI file: 73.60 seconds long
Analyzing 736 time points...
Processing: Bwv0787Sinfonian1.mid
Processing MIDI file: 59.07 seconds long
Analyzing 591 time points...

Processing: Bwv0796Sinfonian10.mid
Processing MIDI file: 61.82 seconds long
Analyzing 619 time points...

Processing: Bwv0788Sinfonian2.mid
Processing MIDI file: 81.45 seconds long
Analyzing 815 time points...

Processing: Bwv0800Sinfonian14.mid
Processing MIDI file: 61.25 seconds long
Analyzing 613 time points...

Processing: Bwv0801Sinfonian15.mid
Processing MIDI file: 66.49 seconds long
Analyzing 665 time points...

Processing: Bwv0793Sinfonian7.mid
Processing MIDI file: 85.08 seconds long
Analyzing 851 time points...

Processing: Bwv0794Sinfonian8.mid
Processing MIDI file: 57.86 seconds long
Analyzing 579 time points...

Processing: Bwv0789Sinfonian3.mid
Processing MIDI file: 66.34 seconds long
Analyzing 664 time points...

Processing: Bwv0792Sinfonian6.mid
Processing MIDI file: 64.49 seconds long
Analyzing 645 time points...

Processing: Bwv0798Sinfonian12.mid
Processing MIDI file: 80.50 seconds long
Analyzing 806 time points...

Processing: Bwv0790Sinfonian4.mid
Processing MIDI file: 63.70 seconds long
Analyzing 638 time points...

Processing: Bwv0791Sinfonian5.mid
Processing MIDI file: 104.88 seconds long
Analyzing 1049 time points...

Processed 1000/1049 time points

Processing: Bwv0797Sinfonian11.mid
Processing MIDI file: 82.89 seconds long
Analyzing 829 time points...

Processing: Bwv0795Sinfonian9.mid
Processing MIDI file: 101.56 seconds long
Analyzing 1016 time points...

Processed 1000/1016 time points

Processing: Bwv781Inventionn10.mid
Processing MIDI file: 72.74 seconds long
Analyzing 728 time points...

Processing: Bwv773Inventionn02.mid
Processing MIDI file: 81.52 seconds long
Analyzing 816 time points...

Processing: Bwv779Inventionn08.mid

Processing MIDI file: 61.20 seconds long
 Analyzing 612 time points...
 Processing: Bwv775Inventionn04.mid
 Processing MIDI file: 63.06 seconds long
 Analyzing 631 time points...
 Processing: Bwv778Inventionn07.mid
 Processing MIDI file: 51.67 seconds long
 Analyzing 517 time points...
 Processing: Bwv772Inventionn01.mid
 Processing MIDI file: 80.16 seconds long
 Analyzing 802 time points...
 Processing: Bwv785Inventionn14.mid
 Processing MIDI file: 110.62 seconds long
 Analyzing 1107 time points...
 Processed 1000/1107 time points
 Processing: Bwv786Inventionn15.mid
 Processing MIDI file: 55.47 seconds long
 Analyzing 555 time points...
 Processing: Bwv784Inventionn13.mid
 Processing MIDI file: 75.15 seconds long
 Analyzing 752 time points...
 Processing: Bwv777Inventionn06.mid
 Processing MIDI file: 155.45 seconds long
 Analyzing 1555 time points...
 Processed 1000/1555 time points
 Processing: Bwv783Inventionn12.mid
 Processing MIDI file: 100.49 seconds long
 Analyzing 1005 time points...
 Processed 1000/1005 time points
 Processing: Bwv782Inventionn11.mid
 Processing MIDI file: 90.50 seconds long
 Analyzing 905 time points...
 Processing: Bwv774Inventionn03.mid
 Processing MIDI file: 69.81 seconds long
 Analyzing 699 time points...
 Processing: Bwv776Inventionn05.mid
 Processing MIDI file: 127.35 seconds long
 Analyzing 1274 time points...
 Processed 1000/1274 time points
 Processing: Bwv780Inventionn09.mid
 Processing MIDI file: 70.75 seconds long
 Analyzing 708 time points...
 Processing: 5ErbarmedichtmeinGottAltoAria.mid
 Processing MIDI file: 420.90 seconds long
 Analyzing 4210 time points...
 Processed 1000/4210 time points
 Processed 2000/4210 time points
 Processed 3000/4210 time points

Processed 4000/4210 time points
 Processing: 2AusLiebewillmeinHeilandsterbanSopranoAria.mid
 Processing MIDI file: 180.17 seconds long
 Analyzing 1802 time points...
 Processed 1000/1802 time points
 Processing: 10WirsetzenunsmiTra_nenniederChorus.mid
 Processing MIDI file: 324.92 seconds long
 Analyzing 3250 time points...
 Processed 1000/3250 time points
 Processed 2000/3250 time points
 Processed 3000/3250 time points
 Processing: 6HerzliebsterJesuChorus.mid
 Processing MIDI file: 48.91 seconds long
 Analyzing 490 time points...
 Processing: 8MachedichmeinherzBassAria.mid
 Processing MIDI file: 370.77 seconds long
 Analyzing 3708 time points...
 Processed 1000/3708 time points
 Processed 2000/3708 time points
 Processed 3000/3708 time points
 Processing: 1BassAria.mid
 Processing MIDI file: 199.99 seconds long
 Analyzing 2000 time points...
 Processed 1000/2000 time points
 Processing: 3GebtmirmeinenJesumweiderBassAria.mid
 Processing MIDI file: 205.25 seconds long
 Analyzing 2053 time points...
 Processed 1000/2053 time points
 Processed 2000/2053 time points
 Processing: 7Ko_nnenTra_nenmeinerWangennichtserlangenAltoAria.mid
 Processing MIDI file: 310.80 seconds long
 Analyzing 3109 time points...
 Processed 1000/3109 time points
 Processed 2000/3109 time points
 Processed 3000/3109 time points
 Processing: 4BlutenurduliebeshHerzSopranoAria.mid
 Processing MIDI file: 233.60 seconds long
 Analyzing 2337 time points...
 Processed 1000/2337 time points
 Processed 2000/2337 time points
 Processing: 90HauptvollBlutundWundenChorus.mid
 Processing MIDI file: 107.40 seconds long
 Analyzing 1074 time points...
 Processed 1000/1074 time points
 Processing: 10AriaQuoniam.mid
 Processing MIDI file: 265.50 seconds long
 Analyzing 2655 time points...
 Processed 1000/2655 time points

Processed 2000/2655 time points
 Processing: 21Benedictus.mid
 Processing MIDI file: 249.28 seconds long
 Analyzing 2493 time points...
 Processed 1000/2493 time points
 Processed 2000/2493 time points
 Processing: 200sanna.mid
 Processing MIDI file: 142.73 seconds long
 Analyzing 1428 time points...
 Processed 1000/1428 time points
 Processing: 05AriaForSoprano.mid
 Processing MIDI file: 234.83 seconds long
 Analyzing 2349 time points...
 Processed 1000/2349 time points
 Processed 2000/2349 time points
 Processing: 01KyrieEleison.mid
 Processing MIDI file: 572.45 seconds long
 Analyzing 5725 time points...
 Processed 1000/5725 time points
 Processed 2000/5725 time points
 Processed 3000/5725 time points
 Processed 4000/5725 time points
 Processed 5000/5725 time points
 Processing: 13ChorPatremOmnipotentem.mid
 Processing MIDI file: 105.78 seconds long
 Analyzing 1058 time points...
 Processed 1000/1058 time points
 Processing: 16EtRessurexit.mid
 Processing MIDI file: 231.88 seconds long
 Analyzing 2319 time points...
 Processed 1000/2319 time points
 Processed 2000/2319 time points
 Processing: 07DuetDomineDeus.mid
 Processing MIDI file: 327.54 seconds long
 Analyzing 3276 time points...
 Processed 1000/3276 time points
 Processed 2000/3276 time points
 Processed 3000/3276 time points
 Processing: 11ChorCumSancto.mid
 Processing MIDI file: 217.01 seconds long
 Analyzing 2171 time points...
 Processed 1000/2171 time points
 Processed 2000/2171 time points
 Processing: 19Sanctus.mid
 Processing MIDI file: 298.70 seconds long
 Analyzing 2988 time points...
 Processed 1000/2988 time points
 Processed 2000/2988 time points

Processing: 09AriaQuiSedes.mid
 Processing MIDI file: 237.00 seconds long
 Analyzing 2370 time points...
 Processed 1000/2370 time points
 Processed 2000/2370 time points

Processing: 15EtIncarnatusCricifixus.mid
 Processing MIDI file: 367.48 seconds long
 Analyzing 3675 time points...
 Processed 1000/3675 time points
 Processed 2000/3675 time points
 Processed 3000/3675 time points

Processing: 12ChorCredoInUnumDeum.mid
 Processing MIDI file: 123.22 seconds long
 Analyzing 1233 time points...
 Processed 1000/1233 time points

Processing: 08ChorQuiTollis.mid
 Processing MIDI file: 185.58 seconds long
 Analyzing 1856 time points...
 Processed 1000/1856 time points

Processing: 18Confiteor.mid
 Processing MIDI file: 341.78 seconds long
 Analyzing 3418 time points...
 Processed 1000/3418 time points
 Processed 2000/3418 time points
 Processed 3000/3418 time points

Processing: 17BassAriaEtInSpritum.mid
 Processing MIDI file: 291.86 seconds long
 Analyzing 2919 time points...
 Processed 1000/2919 time points
 Processed 2000/2919 time points

Processing: 14DuetInUnum.mid
 Processing MIDI file: 257.29 seconds long
 Analyzing 2573 time points...
 Processed 1000/2573 time points
 Processed 2000/2573 time points

Processing: 06ChorGratiasAnimusTibi.mid
 Processing MIDI file: 167.72 seconds long
 Analyzing 1678 time points...
 Processed 1000/1678 time points

Processing: 22AgnusDei.mid
 Processing MIDI file: 290.40 seconds long
 Analyzing 2905 time points...
 Processed 1000/2905 time points
 Processed 2000/2905 time points

Processing: 04ChorGloriaInExelcis.mid
 Processing MIDI file: 362.92 seconds long
 Analyzing 3630 time points...
 Processed 1000/3630 time points

Processed 2000/3630 time points
 Processed 3000/3630 time points
 Processing: 02ChristeEleison.mid
 Processing MIDI file: 294.54 seconds long
 Analyzing 2946 time points...
 Processed 1000/2946 time points
 Processed 2000/2946 time points
 Processing: 03KyrieEleison.mid
 Processing MIDI file: 224.22 seconds long
 Analyzing 2243 time points...
 Processed 1000/2243 time points
 Processed 2000/2243 time points
 Processing: 23DonnaNobisPacem.mid
 Processing MIDI file: 178.85 seconds long
 Analyzing 1789 time points...
 Processed 1000/1789 time points
 Processing: 013701b_.mid
 Processing MIDI file: 238.50 seconds long
 Analyzing 2386 time points...
 Processed 1000/2386 time points
 Processed 2000/2386 time points
 Processing: 007706b_.mid
 Processing MIDI file: 45.00 seconds long
 Analyzing 450 time points...
 Processing: 004507b_.mid
 Processing MIDI file: 41.88 seconds long
 Analyzing 419 time points...
 Processing: Bwv0286.mid
 Processing MIDI file: 47.86 seconds long
 Analyzing 479 time points...
 Processing: 007507b_.mid
 Processing MIDI file: 101.05 seconds long
 Analyzing 1011 time points...
 Processed 1000/1011 time points
 Processing: Bwv0207.mid
 Processing MIDI file: 51.00 seconds long
 Analyzing 510 time points...
 Processing: Bwv02011.mid
 Processing MIDI file: 51.00 seconds long
 Analyzing 510 time points...
 Processing: 013703b_.mid
 Processing MIDI file: 217.17 seconds long
 Analyzing 2172 time points...
 Processed 1000/2172 time points
 Processed 2000/2172 time points
 Processing: 008906b_.mid
 Processing MIDI file: 33.75 seconds long
 Analyzing 338 time points...

Processing: 041400b_.mid
Processing MIDI file: 39.38 seconds long
Analyzing 394 time points...

Processing: 028500b_.mid
Processing MIDI file: 33.91 seconds long
Analyzing 340 time points...

Processing: 024515B_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 069400b_.mid
Processing MIDI file: 188.28 seconds long
Analyzing 1883 time points...
Processed 1000/1883 time points

Processing: 015309b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 038200b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 024415b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 024833b3.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 024846b5.mid
Processing MIDI file: 35.45 seconds long
Analyzing 355 time points...

Processing: 036400b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...

Processing: 066800b_.mid
Processing MIDI file: 153.00 seconds long
Analyzing 1531 time points...
Processed 1000/1531 time points

Processing: 010707b_.mid
Processing MIDI file: 105.00 seconds long
Analyzing 1051 time points...
Processed 1000/1051 time points

Processing: 030000b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 024446b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 024864b6.mid
Processing MIDI file: 192.56 seconds long
Analyzing 1926 time points...

Processed 1000/1926 time points

Processing: 024828b3.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...

Processing: 040400bv.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...

Processing: 032400b_.mid
Processing MIDI file: 26.25 seconds long
Analyzing 263 time points...

Processing: 004106bs.mid
Processing MIDI file: 88.20 seconds long
Analyzing 883 time points...

Processing: 032300b_.mid
Processing MIDI file: 24.44 seconds long
Analyzing 245 time points...

Processing: 015301b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 035300b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...

Processing: 033900b_.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...

Processing: Bwv0048.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...

Processing: 040600b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...

Processing: 064800b_.mid
Processing MIDI file: 86.40 seconds long
Analyzing 865 time points...

Processing: 003907b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 014406b_.mid
Processing MIDI file: 52.50 seconds long
Analyzing 525 time points...

Processing: 031300b_.mid
Processing MIDI file: 38.18 seconds long
Analyzing 382 time points...

Processing: 027400b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...

Processing: 024462b_.mid
Processing MIDI file: 42.50 seconds long

Analyzing 425 time points...
Processing: 026700ba.mid
Processing MIDI file: 54.38 seconds long
Analyzing 544 time points...
Processing: 013705b_.mid
Processing MIDI file: 32.88 seconds long
Analyzing 329 time points...
Processing: 017206vn.mid
Processing MIDI file: 56.73 seconds long
Analyzing 568 time points...
Processing: 012805b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 026700b_.mid
Processing MIDI file: 54.38 seconds long
Analyzing 544 time points...
Processing: 030700b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 030900b_.mid
Processing MIDI file: 52.17 seconds long
Analyzing 522 time points...
Processing: 014806bv.mid
Processing MIDI file: 31.20 seconds long
Analyzing 312 time points...
Processing: 030200b_.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...
Processing: 004803b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 069100orn.mid
Processing MIDI file: 108.00 seconds long
Analyzing 1081 time points...
Processed 1000/1081 time points
Processing: 007011ch.mid
Processing MIDI file: 35.45 seconds long
Analyzing 355 time points...
Processing: 030400b_.mid
Processing MIDI file: 50.62 seconds long
Analyzing 507 time points...
Processing: 017705bv.mid
Processing MIDI file: 49.09 seconds long
Analyzing 491 time points...
Processing: 009005b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 025200b_.mid

Processing MIDI file: 44.67 seconds long
Analyzing 447 time points...
Processing: 032200b_.mid
Processing MIDI file: 70.43 seconds long
Analyzing 705 time points...
Processing: Bwv03624.mid
Processing MIDI file: 51.88 seconds long
Analyzing 519 time points...
Processing: 014608b_.mid
Processing MIDI file: 41.25 seconds long
Analyzing 413 time points...
Processing: Bwv0298.mid
Processing MIDI file: 69.83 seconds long
Analyzing 699 time points...
Processing: 033200b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 033400b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 013006b_.mid
Processing MIDI file: 28.33 seconds long
Analyzing 284 time points...
Processing: 003907bv.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 003706b_.mid
Processing MIDI file: 46.96 seconds long
Analyzing 470 time points...
Processing: 036500b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...
Processing: 076902b_.mid
Processing MIDI file: 62.73 seconds long
Analyzing 628 time points...
Processing: Bwv0097.mid
Processing MIDI file: 39.13 seconds long
Analyzing 392 time points...
Processing: 014505b_.mid
Processing MIDI file: 32.40 seconds long
Analyzing 324 time points...
Processing: 041500b_.mid
Processing MIDI file: 50.25 seconds long
Analyzing 503 time points...
Processing: 070100b_.mid
Processing MIDI file: 67.50 seconds long
Analyzing 675 time points...
Processing: 024425b_.mid

Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 065700b_.mid
Processing MIDI file: 219.23 seconds long
Analyzing 2193 time points...
Processed 1000/2193 time points
Processed 2000/2193 time points
Processing: 005505b_.mid
Processing MIDI file: 41.25 seconds long
Analyzing 413 time points...
Processing: 043800b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 065900b_.mid
Processing MIDI file: 153.33 seconds long
Analyzing 1534 time points...
Processed 1000/1534 time points
Processing: 032800b_.mid
Processing MIDI file: 291.82 seconds long
Analyzing 2919 time points...
Processed 1000/2919 time points
Processed 2000/2919 time points
Processing: 014004b_.mid
Processing MIDI file: 236.84 seconds long
Analyzing 2369 time points...
Processed 1000/2369 time points
Processed 2000/2369 time points
Processing: 011407b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 033800b_.mid
Processing MIDI file: 39.13 seconds long
Analyzing 392 time points...
Processing: 066300b_.mid
Processing MIDI file: 345.45 seconds long
Analyzing 3455 time points...
Processed 1000/3455 time points
Processed 2000/3455 time points
Processed 3000/3455 time points
Processing: 034500b_.mid
Processing MIDI file: 51.00 seconds long
Analyzing 510 time points...
Processing: 039100b_.mid
Processing MIDI file: 38.08 seconds long
Analyzing 381 time points...
Processing: 004008b_.mid
Processing MIDI file: 61.50 seconds long
Analyzing 615 time points...

Processing: 010107b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 006707b_.mid
Processing MIDI file: 38.18 seconds long
Analyzing 382 time points...

Processing: 037000b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...

Processing: 065600b_.mid
Processing MIDI file: 595.43 seconds long
Analyzing 5955 time points...
Processed 1000/5955 time points
Processed 2000/5955 time points
Processed 3000/5955 time points
Processed 4000/5955 time points
Processed 5000/5955 time points

Processing: 028600b_.mid
Processing MIDI file: 17.50 seconds long
Analyzing 176 time points...

Processing: 009507b_.mid
Processing MIDI file: 38.40 seconds long
Analyzing 384 time points...

Processing: 010602b_.mid
Processing MIDI file: 132.00 seconds long
Analyzing 1320 time points...
Processed 1000/1320 time points

Processing: Bwv0026.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...

Processing: 016806b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...

Processing: 076905b_.mid
Processing MIDI file: 155.45 seconds long
Analyzing 1555 time points...
Processed 1000/1555 time points

Processing: 007607b_.mid
Processing MIDI file: 113.33 seconds long
Analyzing 1134 time points...
Processed 1000/1134 time points

Processing: 022602bv.mid
Processing MIDI file: 65.22 seconds long
Analyzing 653 time points...

Processing: 031600b_.mid
Processing MIDI file: 44.35 seconds long
Analyzing 444 time points...

Processing: Bwv0016.mid

Processing MIDI file: 67.89 seconds long
Analyzing 679 time points...
Processing: 024503b_.mid
Processing MIDI file: 31.30 seconds long
Analyzing 314 time points...
Processing: 033500bv.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 015905b_.mid
Processing MIDI file: 41.74 seconds long
Analyzing 418 time points...
Processing: 035400b_.mid
Processing MIDI file: 42.67 seconds long
Analyzing 427 time points...
Processing: 016406b_.mid
Processing MIDI file: 34.62 seconds long
Analyzing 347 time points...
Processing: 010806b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 028300b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 033700b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 034600b_.mid
Processing MIDI file: 43.64 seconds long
Analyzing 437 time points...
Processing: 010406b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 024853b5.mid
Processing MIDI file: 36.00 seconds long
Analyzing 360 time points...
Processing: 018305b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 006507b_.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...
Processing: 066500b_.mid
Processing MIDI file: 173.33 seconds long
Analyzing 1734 time points...
Processed 1000/1734 time points
Processing: 034700b_.mid
Processing MIDI file: 60.86 seconds long
Analyzing 609 time points...

Processing: 041600b_.mid
Processing MIDI file: 33.91 seconds long
Analyzing 340 time points...

Processing: 031200b_.mid
Processing MIDI file: 55.00 seconds long
Analyzing 550 time points...

Processing: 060800qt.mid
Processing MIDI file: 75.68 seconds long
Analyzing 757 time points...

Processing: 011704v1.mid
Processing MIDI file: 38.71 seconds long
Analyzing 388 time points...

Processing: 076901b_.mid
Processing MIDI file: 81.00 seconds long
Analyzing 811 time points...

Processing: 010107bv.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 016606b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 029500b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 009106b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...

Processing: 037300bv.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 066800com.mid
Processing MIDI file: 270.00 seconds long
Analyzing 2701 time points...
Processed 1000/2701 time points
Processed 2000/2701 time points

Processing: Bwv018a5.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...

Processing: 025600b_.mid
Processing MIDI file: 40.91 seconds long
Analyzing 410 time points...

Processing: 039400b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 006206b_.mid
Processing MIDI file: 20.00 seconds long
Analyzing 200 time points...

Processing: 040400b_.mid

Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: Bwv0066.mid
Processing MIDI file: 23.48 seconds long
Analyzing 235 time points...
Processing: 025100b_.mid
Processing MIDI file: 39.13 seconds long
Analyzing 392 time points...
Processing: Bwv0256.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 004807b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 043500b_.mid
Processing MIDI file: 31.30 seconds long
Analyzing 314 time points...
Processing: 030300b_.mid
Processing MIDI file: 42.67 seconds long
Analyzing 427 time points...
Processing: 040800b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 032900b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...
Processing: 022709b_.mid
Processing MIDI file: 159.00 seconds long
Analyzing 1591 time points...
Processed 1000/1591 time points
Processing: 025400b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 013506b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 036800b_.mid
Processing MIDI file: 53.04 seconds long
Analyzing 531 time points...
Processing: 018707b_.mid
Processing MIDI file: 52.50 seconds long
Analyzing 525 time points...
Processing: 039900b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 033300b_.mid
Processing MIDI file: 39.13 seconds long
Analyzing 392 time points...

Processing: 030600b_.mid
Processing MIDI file: 31.88 seconds long
Analyzing 319 time points...

Processing: 026300b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 010506b_.mid
Processing MIDI file: 80.00 seconds long
Analyzing 800 time points...

Processing: 024310b_.mid
Processing MIDI file: 69.38 seconds long
Analyzing 694 time points...

Processing: 024809b1.mid
Processing MIDI file: 43.64 seconds long
Analyzing 437 time points...

Processing: 024417b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 037100b_.mid
Processing MIDI file: 121.50 seconds long
Analyzing 1216 time points...
Processed 1000/1216 time points

Processing: 039500b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 041300b_.mid
Processing MIDI file: 75.00 seconds long
Analyzing 750 time points...

Processing: 017807b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 009207b_.mid
Processing MIDI file: 116.84 seconds long
Analyzing 1169 time points...
Processed 1000/1169 time points

Processing: 007807b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...

Processing: 019007ch.mid
Processing MIDI file: 81.88 seconds long
Analyzing 819 time points...

Processing: Bwv0197ch.mid
Processing MIDI file: 40.50 seconds long
Analyzing 405 time points...

Processing: 064700b_.mid
Processing MIDI file: 279.07 seconds long
Analyzing 2791 time points...
Processed 1000/2791 time points

Processed 2000/2791 time points
Processing: 028100b_.mid
Processing MIDI file: 21.88 seconds long
Analyzing 219 time points...
Processing: 014001b_.mid
Processing MIDI file: 419.32 seconds long
Analyzing 4194 time points...
Processed 1000/4194 time points
Processed 2000/4194 time points
Processed 3000/4194 time points
Processed 4000/4194 time points
Processing: 031500b_.mid
Processing MIDI file: 46.96 seconds long
Analyzing 470 time points...
Processing: 027700b_.mid
Processing MIDI file: 51.00 seconds long
Analyzing 510 time points...
Processing: 043100b_.mid
Processing MIDI file: 25.00 seconds long
Analyzing 250 time points...
Processing: 008008b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 027800b_.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...
Processing: Bwv0326.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 037400b_.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...
Processing: 033600b_.mid
Processing MIDI file: 24.55 seconds long
Analyzing 246 time points...
Processing: 065400b_.mid
Processing MIDI file: 252.39 seconds long
Analyzing 2524 time points...
Processed 1000/2524 time points
Processed 2000/2524 time points
Processing: 007408b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...
Processing: 024514b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 013606b_.mid
Processing MIDI file: 36.14 seconds long

Analyzing 362 time points...
Processing: 028800b_.mid
Processing MIDI file: 36.28 seconds long
Analyzing 363 time points...
Processing: 015305b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 034100b_.mid
Processing MIDI file: 26.09 seconds long
Analyzing 261 time points...
Processing: 032500b_.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...
Processing: 040100b_.mid
Processing MIDI file: 43.64 seconds long
Analyzing 437 time points...
Processing: 026200b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 038700b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: Bwv0127.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 070000b_.mid
Processing MIDI file: 145.00 seconds long
Analyzing 1451 time points...
Processed 1000/1451 time points
Processing: 043000b_.mid
Processing MIDI file: 41.74 seconds long
Analyzing 418 time points...
Processing: Bwv0063.mid
Processing MIDI file: 230.77 seconds long
Analyzing 2308 time points...
Processed 1000/2308 time points
Processed 2000/2308 time points
Processing: 016907b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 026600b_.mid
Processing MIDI file: 41.25 seconds long
Analyzing 413 time points...
Processing: Bwv0057.mid
Processing MIDI file: 33.75 seconds long
Analyzing 338 time points...
Processing: 022711b_.mid
Processing MIDI file: 47.50 seconds long

Analyzing 475 time points...
 Processing: 037300b_.mid
 Processing MIDI file: 37.50 seconds long
 Analyzing 375 time points...
 Processing: 034800b_.mid
 Processing MIDI file: 42.50 seconds long
 Analyzing 425 time points...
 Processing: 007206b_.mid
 Processing MIDI file: 50.00 seconds long
 Analyzing 500 time points...
 Processing: 024537b_.mid
 Processing MIDI file: 42.50 seconds long
 Analyzing 425 time points...
 Processing: 033100b_.mid
 Processing MIDI file: 40.00 seconds long
 Analyzing 400 time points...
 Processing: 042200b_.mid
 Processing MIDI file: 35.45 seconds long
 Analyzing 355 time points...
 Processing: 038800b_.mid
 Processing MIDI file: 37.50 seconds long
 Analyzing 375 time points...
 Processing: 066100b_.mid
 Processing MIDI file: 160.00 seconds long
 Analyzing 1600 time points...
 Processed 1000/1600 time points
 Processing: 024842bs.mid
 Processing MIDI file: 48.46 seconds long
 Analyzing 485 time points...
 Processing: 028200b_.mid
 Processing MIDI file: 34.62 seconds long
 Analyzing 347 time points...
 Processing: 006606b_.mid
 Processing MIDI file: 25.00 seconds long
 Analyzing 250 time points...
 Processing: 014007b_.mid
 Processing MIDI file: 67.46 seconds long
 Analyzing 675 time points...
 Processing: 036700b_.mid
 Processing MIDI file: 32.50 seconds long
 Analyzing 325 time points...
 Processing: 065100b_.mid
 Processing MIDI file: 318.00 seconds long
 Analyzing 3180 time points...
 Processed 1000/3180 time points
 Processed 2000/3180 time points
 Processed 3000/3180 time points
 Processing: 041200b_.mid

Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 024528b_.mid
Processing MIDI file: 36.92 seconds long
Analyzing 370 time points...
Processing: 011606b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...
Processing: 038300b_.mid
Processing MIDI file: 80.00 seconds long
Analyzing 801 time points...
Processing: 037200b_.mid
Processing MIDI file: 46.25 seconds long
Analyzing 463 time points...
Processing: 028000b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...
Processing: 010306b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 024410b_.mid
Processing MIDI file: 31.20 seconds long
Analyzing 312 time points...
Processing: 024505b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 034900b_.mid
Processing MIDI file: 27.69 seconds long
Analyzing 277 time points...
Processing: 036100b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 019707ba.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 065300b_.mid
Processing MIDI file: 249.00 seconds long
Analyzing 2491 time points...
Processed 1000/2491 time points
Processed 2000/2491 time points
Processing: Bwv0166.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 037600b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 026800b_.mid
Processing MIDI file: 30.00 seconds long

Analyzing 300 time points...
Processing: 041800b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 024809bs.mid
Processing MIDI file: 24.55 seconds long
Analyzing 246 time points...
Processing: 031100b_.mid
Processing MIDI file: 65.45 seconds long
Analyzing 655 time points...
Processing: 019007b_.mid
Processing MIDI file: 82.50 seconds long
Analyzing 826 time points...
Processing: 017405b_.mid
Processing MIDI file: 70.91 seconds long
Analyzing 710 time points...
Processing: 037700b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 027000b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 006206bv.mid
Processing MIDI file: 20.00 seconds long
Analyzing 200 time points...
Processing: 007514b_.mid
Processing MIDI file: 101.05 seconds long
Analyzing 1011 time points...
Processed 1000/1011 time points
Processing: 014505bv.mid
Processing MIDI file: 32.40 seconds long
Analyzing 324 time points...
Processing: 030500b_.mid
Processing MIDI file: 54.00 seconds long
Analyzing 540 time points...
Processing: Bwv0177.mid
Processing MIDI file: 85.62 seconds long
Analyzing 857 time points...
Processing: 014403b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 034000b_.mid
Processing MIDI file: 69.33 seconds long
Analyzing 694 time points...
Processing: Bwv0185.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...
Processing: 029800b_.mid

Processing MIDI file: 26.25 seconds long
Analyzing 263 time points...
Processing: 010006b_.mid
Processing MIDI file: 124.74 seconds long
Analyzing 1248 time points...
Processed 1000/1248 time points
Processing: 009906b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 007906b_.mid
Processing MIDI file: 23.91 seconds long
Analyzing 240 time points...
Processing: Bwv0256v2.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 009307b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 015606b_.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...
Processing: 036200b_.mid
Processing MIDI file: 88.12 seconds long
Analyzing 882 time points...
Processing: 012006b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 008107b_.mid
Processing MIDI file: 49.57 seconds long
Analyzing 496 time points...
Processing: 027100b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 065500b_.mid
Processing MIDI file: 244.17 seconds long
Analyzing 2442 time points...
Processed 1000/2442 time points
Processed 2000/2442 time points
Processing: 003806b_.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...
Processing: 011704b_.mid
Processing MIDI file: 38.71 seconds long
Analyzing 388 time points...
Processing: 017606b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...
Processing: 027600b_.mid

Processing MIDI file: 82.50 seconds long
Analyzing 825 time points...
Processing: 015105b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 024842b4.mid
Processing MIDI file: 108.41 seconds long
Analyzing 1085 time points...
Processed 1000/1085 time points
Processing: 027500b_.mid
Processing MIDI file: 45.71 seconds long
Analyzing 458 time points...
Processing: 040700b_.mid
Processing MIDI file: 67.50 seconds long
Analyzing 675 time points...
Processing: 006906b_.mid
Processing MIDI file: 60.00 seconds long
Analyzing 600 time points...
Processing: 026400b_.mid
Processing MIDI file: 29.33 seconds long
Analyzing 294 time points...
Processing: 033500b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 064200b_.mid
Processing MIDI file: 81.60 seconds long
Analyzing 817 time points...
Processing: 004705b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 011506b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...
Processing: Bwv0276.mid
Processing MIDI file: 81.43 seconds long
Analyzing 815 time points...
Processing: 042700b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 004207b_.mid
Processing MIDI file: 70.00 seconds long
Analyzing 700 time points...
Processing: 018405b_.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...
Processing: 025900b_.mid
Processing MIDI file: 36.00 seconds long
Analyzing 360 time points...

Processing: 027300b_.mid
Processing MIDI file: 28.70 seconds long
Analyzing 287 time points...

Processing: 024437b_.mid
Processing MIDI file: 35.45 seconds long
Analyzing 355 time points...

Processing: 066600b_.mid
Processing MIDI file: 176.58 seconds long
Analyzing 1766 time points...
Processed 1000/1766 time points

Processing: 028900b_.mid
Processing MIDI file: 33.91 seconds long
Analyzing 340 time points...

Processing: 024517b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 043300b_.mid
Processing MIDI file: 72.50 seconds long
Analyzing 725 time points...

Processing: 066400b_.mid
Processing MIDI file: 325.00 seconds long
Analyzing 3250 time points...
Processed 1000/3250 time points
Processed 2000/3250 time points
Processed 3000/3250 time points

Processing: 041100b_.mid
Processing MIDI file: 43.87 seconds long
Analyzing 439 time points...

Processing: 017507ch.mid
Processing MIDI file: 66.92 seconds long
Analyzing 670 time points...

Processing: Bwv0048v.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...

Processing: 042400b_.mid
Processing MIDI file: 31.88 seconds long
Analyzing 319 time points...

Processing: 012705b_.mid
Processing MIDI file: 34.67 seconds long
Analyzing 347 time points...

Processing: 043700b_.mid
Processing MIDI file: 80.00 seconds long
Analyzing 801 time points...

Processing: 019412b_.mid
Processing MIDI file: 25.50 seconds long
Analyzing 255 time points...

Processing: 042000b_.mid
Processing MIDI file: 27.50 seconds long

Analyzing 275 time points...
Processing: 012606bv.mid
Processing MIDI file: 71.49 seconds long
Analyzing 715 time points...
Processing: 008606b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 024823b2.mid
Processing MIDI file: 52.43 seconds long
Analyzing 525 time points...
Processing: 017507b_.mid
Processing MIDI file: 66.92 seconds long
Analyzing 670 time points...
Processing: 004606b_.mid
Processing MIDI file: 60.00 seconds long
Analyzing 600 time points...
Processing: 013906b_.mid
Processing MIDI file: 31.84 seconds long
Analyzing 319 time points...
Processing: 019406bv.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 037900b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...
Processing: 032600b_.mid
Processing MIDI file: 31.88 seconds long
Analyzing 319 time points...
Processing: 005903b_.mid
Processing MIDI file: 66.92 seconds long
Analyzing 670 time points...
Processing: 039700b_.mid
Processing MIDI file: 57.27 seconds long
Analyzing 573 time points...
Processing: 076904b_.mid
Processing MIDI file: 168.00 seconds long
Analyzing 1681 time points...
Processed 1000/1681 time points
Processing: 040900b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 011106b_.mid
Processing MIDI file: 52.50 seconds long
Analyzing 525 time points...
Processing: 043400b_.mid
Processing MIDI file: 40.67 seconds long
Analyzing 407 time points...
Processing: 041000b_.mid

Processing MIDI file: 35.00 seconds long
 Analyzing 350 time points...
 Processing: 035900b_.mid
 Processing MIDI file: 40.00 seconds long
 Analyzing 400 time points...
 Processing: 019406b_.mid
 Processing MIDI file: 42.50 seconds long
 Analyzing 425 time points...
 Processing: 036900b_.mid
 Processing MIDI file: 42.50 seconds long
 Analyzing 425 time points...
 Processing: 041700b_.mid
 Processing MIDI file: 42.50 seconds long
 Analyzing 425 time points...
 Processing: 007614b_.mid
 Processing MIDI file: 113.33 seconds long
 Analyzing 1134 time points...
 Processed 1000/1134 time points
 Processing: 040000b_.mid
 Processing MIDI file: 33.75 seconds long
 Analyzing 338 time points...
 Processing: 031800b_.mid
 Processing MIDI file: 32.50 seconds long
 Analyzing 325 time points...
 Processing: 029900b_.mid
 Processing MIDI file: 46.88 seconds long
 Analyzing 469 time points...
 Processing: 037500b_.mid
 Processing MIDI file: 28.70 seconds long
 Analyzing 287 time points...
 Processing: 039200b_.mid
 Processing MIDI file: 32.50 seconds long
 Analyzing 325 time points...
 Processing: 008807b_.mid
 Processing MIDI file: 36.00 seconds long
 Analyzing 360 time points...
 Processing: 066000b_.mid
 Processing MIDI file: 229.09 seconds long
 Analyzing 2291 time points...
 Processed 1000/2291 time points
 Processed 2000/2291 time points
 Processing: Bwv001.mid
 Processing MIDI file: 490.34 seconds long
 Analyzing 4904 time points...
 Processed 1000/4904 time points
 Processed 2000/4904 time points
 Processed 3000/4904 time points
 Processed 4000/4904 time points

Processing: Bwv0306.mid
Processing MIDI file: 45.60 seconds long
Analyzing 456 time points...

Processing: Bwv0197.mid
Processing MIDI file: 40.50 seconds long
Analyzing 405 time points...

Processing: 029600b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 019705b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 012606b_.mid
Processing MIDI file: 71.49 seconds long
Analyzing 715 time points...

Processing: 042600b_.mid
Processing MIDI file: 42.67 seconds long
Analyzing 427 time points...

Processing: 043200b_.mid
Processing MIDI file: 23.48 seconds long
Analyzing 235 time points...

Processing: 005605b_.mid
Processing MIDI file: 55.00 seconds long
Analyzing 550 time points...

Processing: 012406b_.mid
Processing MIDI file: 31.84 seconds long
Analyzing 319 time points...

Processing: Bwv0256v1.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 024823bs.mid
Processing MIDI file: 27.00 seconds long
Analyzing 270 time points...

Processing: 028700b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 017206b_.mid
Processing MIDI file: 56.73 seconds long
Analyzing 568 time points...

Processing: 026000b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 014907b_.mid
Processing MIDI file: 67.50 seconds long
Analyzing 675 time points...

Processing: 024440b_.mid
Processing MIDI file: 40.31 seconds long
Analyzing 404 time points...

Processing: 064900b_.mid
Processing MIDI file: 131.11 seconds long
Analyzing 1312 time points...
Processed 1000/1312 time points
Processing: 042300b_.mid
Processing MIDI file: 43.64 seconds long
Analyzing 437 time points...
Processing: 008707b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...
Processing: 012008ba.mid
Processing MIDI file: 32.88 seconds long
Analyzing 329 time points...
Processing: 012206b_.mid
Processing MIDI file: 28.80 seconds long
Analyzing 288 time points...
Processing: Bwv0336.mid
Processing MIDI file: 57.50 seconds long
Analyzing 575 time points...
Processing: 039600b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 026500b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: Bwv0077.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...
Processing: 013705ch.mid
Processing MIDI file: 32.88 seconds long
Analyzing 329 time points...
Processing: 069000b_.mid
Processing MIDI file: 102.50 seconds long
Analyzing 1025 time points...
Processed 1000/1025 time points
Processing: 029100b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 006906bav.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 006402b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 007305b_.mid
Processing MIDI file: 39.23 seconds long
Analyzing 393 time points...
Processing: 019506b_.mid

Processing MIDI file: 26.88 seconds long
Analyzing 269 time points...
Processing: 031000b_.mid
Processing MIDI file: 27.27 seconds long
Analyzing 273 time points...
Processing: 018007bv.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...
Processing: 009106ch.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 014907ch.mid
Processing MIDI file: 67.50 seconds long
Analyzing 675 time points...
Processing: 006704b_.mid
Processing MIDI file: 28.50 seconds long
Analyzing 285 time points...
Processing: 035200b_.mid
Processing MIDI file: 43.64 seconds long
Analyzing 437 time points...
Processing: 042900b_.mid
Processing MIDI file: 41.74 seconds long
Analyzing 418 time points...
Processing: Bwv0306v.mid
Processing MIDI file: 45.60 seconds long
Analyzing 456 time points...
Processing: 018806b_.mid
Processing MIDI file: 31.88 seconds long
Analyzing 319 time points...
Processing: 031700b_.mid
Processing MIDI file: 70.00 seconds long
Analyzing 700 time points...
Processing: 005708b_.mid
Processing MIDI file: 34.69 seconds long
Analyzing 347 time points...
Processing: 004407b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 040300b_.mid
Processing MIDI file: 47.25 seconds long
Analyzing 473 time points...
Processing: 037800b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 109100b_.mid
Processing MIDI file: 81.60 seconds long
Analyzing 817 time points...
Processing: 030800b_.mid

Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 031400b_.mid
Processing MIDI file: 28.70 seconds long
Analyzing 287 time points...
Processing: 027900b_.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...
Processing: 017206ch.mid
Processing MIDI file: 83.20 seconds long
Analyzing 833 time points...
Processing: 024526b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: Bwv0266.mid
Processing MIDI file: 28.64 seconds long
Analyzing 287 time points...
Processing: 038400b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 024432b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 024835b3.mid
Processing MIDI file: 34.29 seconds long
Analyzing 343 time points...
Processing: 025300b_.mid
Processing MIDI file: 26.88 seconds long
Analyzing 269 time points...
Processing: 076903b_.mid
Processing MIDI file: 108.00 seconds long
Analyzing 1081 time points...
Processed 1000/1081 time points
Processing: Bwv0246s.mid
Processing MIDI file: 38.18 seconds long
Analyzing 382 time points...
Processing: 024454b_.mid
Processing MIDI file: 45.33 seconds long
Analyzing 454 time points...
Processing: 004606bs.mid
Processing MIDI file: 43.02 seconds long
Analyzing 431 time points...
Processing: 015403b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 032100b_.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...

Processing: 042800b_.mid
Processing MIDI file: 36.92 seconds long
Analyzing 370 time points...

Processing: 012306b_.mid
Processing MIDI file: 54.00 seconds long
Analyzing 540 time points...

Processing: 025800b_.mid
Processing MIDI file: 40.91 seconds long
Analyzing 410 time points...

Processing: 018405bv.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...

Processing: 009408b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 004003b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 060600b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...

Processing: 008305b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 011704v2.mid
Processing MIDI file: 38.71 seconds long
Analyzing 388 time points...

Processing: 006408b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...

Processing: 029200b_.mid
Processing MIDI file: 35.00 seconds long
Analyzing 350 time points...

Processing: 035600b_.mid
Processing MIDI file: 52.50 seconds long
Analyzing 525 time points...

Processing: 011308b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...

Processing: 043600b_.mid
Processing MIDI file: 59.32 seconds long
Analyzing 594 time points...

Processing: 016106b_.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...

Processing: 069100b_.mid
Processing MIDI file: 106.00 seconds long
Analyzing 1061 time points...

Processed 1000/1061 time points
Processing: 024540b_.mid
Processing MIDI file: 72.50 seconds long
Analyzing 725 time points...
Processing: 040500b_.mid
Processing MIDI file: 27.50 seconds long
Analyzing 275 time points...
Processing: 028400b_.mid
Processing MIDI file: 42.86 seconds long
Analyzing 429 time points...
Processing: 006502b_.mid
Processing MIDI file: 31.25 seconds long
Analyzing 313 time points...
Processing: 035800b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...
Processing: 029000b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 024429bb.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: Bwv0107.mid
Processing MIDI file: 56.17 seconds long
Analyzing 562 time points...
Processing: 022602b_.mid
Processing MIDI file: 65.22 seconds long
Analyzing 653 time points...
Processing: 007007b_.mid
Processing MIDI file: 41.35 seconds long
Analyzing 414 time points...
Processing: 035500b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 015505b_.mid
Processing MIDI file: 36.00 seconds long
Analyzing 360 time points...
Processing: Bwv0036.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 024817b2.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...
Processing: 064600b_.mid
Processing MIDI file: 111.67 seconds long
Analyzing 1117 time points...
Processed 1000/1117 time points
Processing: 065000b_.mid

Processing MIDI file: 212.14 seconds long
Analyzing 2122 time points...
 Processed 1000/2122 time points
 Processed 2000/2122 time points
Processing: 025700b_.mid
 Processing MIDI file: 40.00 seconds long
 Analyzing 400 time points...
Processing: 026900b_.mid
 Processing MIDI file: 58.64 seconds long
 Analyzing 587 time points...
Processing: 011506bv.mid
 Processing MIDI file: 35.00 seconds long
 Analyzing 350 time points...
Processing: 040200b_.mid
 Processing MIDI file: 62.50 seconds long
 Analyzing 625 time points...
Processing: 018506b_.mid
 Processing MIDI file: 45.00 seconds long
 Analyzing 450 time points...
Processing: 073300b_.mid
 Processing MIDI file: 250.00 seconds long
 Analyzing 2500 time points...
 Processed 1000/2500 time points
 Processed 2000/2500 time points
Processing: 035100b_.mid
 Processing MIDI file: 28.57 seconds long
 Analyzing 286 time points...
Processing: 035000b_.mid
 Processing MIDI file: 51.82 seconds long
 Analyzing 519 time points...
Processing: 065200b_.mid
 Processing MIDI file: 522.61 seconds long
 Analyzing 5227 time points...
 Processed 1000/5227 time points
 Processed 2000/5227 time points
 Processed 3000/5227 time points
 Processed 4000/5227 time points
 Processed 5000/5227 time points
Processing: 022902b_.mid
 Processing MIDI file: 52.50 seconds long
 Analyzing 525 time points...
Processing: 007011b_.mid
 Processing MIDI file: 35.45 seconds long
 Analyzing 355 time points...
Processing: 017106b_.mid
 Processing MIDI file: 100.80 seconds long
 Analyzing 1009 time points...
 Processed 1000/1009 time points

Processing: 009801b_.mid
Processing MIDI file: 263.51 seconds long
Analyzing 2636 time points...
Processed 1000/2636 time points
Processed 2000/2636 time points
Processing: Bwv0319.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 011909b_.mid
Processing MIDI file: 44.00 seconds long
Analyzing 440 time points...
Processing: 013807b_.mid
Processing MIDI file: 144.31 seconds long
Analyzing 1444 time points...
Processed 1000/1444 time points
Processing: 017906b_.mid
Processing MIDI file: 45.38 seconds long
Analyzing 454 time points...
Processing: 035700b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: Bwv0136.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 029300b_.mid
Processing MIDI file: 24.55 seconds long
Analyzing 246 time points...
Processing: 013306b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: Bwv0086.mid
Processing MIDI file: 54.55 seconds long
Analyzing 546 time points...
Processing: 033000b_.mid
Processing MIDI file: 38.25 seconds long
Analyzing 383 time points...
Processing: 041900b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 012106b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 024864bs.mid
Processing MIDI file: 41.88 seconds long
Analyzing 419 time points...
Processing: 007903bs.mid
Processing MIDI file: 36.00 seconds long
Analyzing 360 time points...

Processing: 029700b_.mid
Processing MIDI file: 31.30 seconds long
Analyzing 314 time points...

Processing: 017705b_.mid
Processing MIDI file: 49.09 seconds long
Analyzing 491 time points...

Processing: 024462bv.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 034400b_.mid
Processing MIDI file: 45.62 seconds long
Analyzing 457 time points...

Processing: Bwv03628.mid
Processing MIDI file: 22.86 seconds long
Analyzing 229 time points...

Processing: 009606b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 006906ba.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 025500b_.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...

Processing: 026100b_.mid
Processing MIDI file: 68.75 seconds long
Analyzing 688 time points...

Processing: 024805b1.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 015408b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 006106b_.mid
Processing MIDI file: 47.32 seconds long
Analyzing 474 time points...

Processing: 034200b_.mid
Processing MIDI file: 45.00 seconds long
Analyzing 450 time points...

Processing: 019710b_.mid
Processing MIDI file: 38.94 seconds long
Analyzing 390 time points...

Processing: 010207b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 060800b_.mid
Processing MIDI file: 75.68 seconds long
Analyzing 757 time points...

Processing: 010406bv.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 006005b_.mid
Processing MIDI file: 54.55 seconds long
Analyzing 546 time points...

Processing: 015804b_.mid
Processing MIDI file: 46.36 seconds long
Analyzing 464 time points...

Processing: 031900b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 065800b_.mid
Processing MIDI file: 195.00 seconds long
Analyzing 1951 time points...
Processed 1000/1951 time points

Processing: 027200b_.mid
Processing MIDI file: 41.88 seconds long
Analyzing 419 time points...

Processing: 008405b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 005206b_.mid
Processing MIDI file: 35.40 seconds long
Analyzing 354 time points...

Processing: 013702b_.mid
Processing MIDI file: 212.14 seconds long
Analyzing 2122 time points...
Processed 1000/2122 time points
Processed 2000/2122 time points

Processing: 011205b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 024415bv.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 007903b_.mid
Processing MIDI file: 148.80 seconds long
Analyzing 1489 time points...
Processed 1000/1489 time points

Processing: 066700b_.mid
Processing MIDI file: 132.00 seconds long
Analyzing 1321 time points...
Processed 1000/1321 time points

Processing: 022701b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...

Processing: 051000b_.mid

Processing MIDI file: 47.73 seconds long
Analyzing 478 time points...
Processing: Bwv0116.mid
Processing MIDI file: 56.25 seconds long
Analyzing 563 time points...
Processing: 004006b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 042100b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 024812b2.mid
Processing MIDI file: 48.57 seconds long
Analyzing 486 time points...
Processing: 025000b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 012506b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 073800b_.mid
Processing MIDI file: 69.82 seconds long
Analyzing 699 time points...
Processing: 036300b_.mid
Processing MIDI file: 32.73 seconds long
Analyzing 328 time points...
Processing: 038900b_.mid
Processing MIDI file: 71.25 seconds long
Analyzing 713 time points...
Processing: 009209b_.mid
Processing MIDI file: 54.55 seconds long
Analyzing 546 time points...
Processing: 032000b_.mid
Processing MIDI file: 71.25 seconds long
Analyzing 713 time points...
Processing: 042500b_.mid
Processing MIDI file: 70.91 seconds long
Analyzing 710 time points...
Processing: 039000b_.mid
Processing MIDI file: 73.64 seconds long
Analyzing 737 time points...
Processing: 064500b_.mid
Processing MIDI file: 236.84 seconds long
Analyzing 2369 time points...
Processed 1000/2369 time points
Processed 2000/2369 time points
Processing: 034300b_.mid
Processing MIDI file: 51.92 seconds long

Analyzing 520 time points...
Processing: Bwv0145.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 039800b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 040900bv.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 004311b_.mid
Processing MIDI file: 48.21 seconds long
Analyzing 483 time points...
Processing: 038100b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 012905b_.mid
Processing MIDI file: 138.00 seconds long
Analyzing 1381 time points...
Processed 1000/1381 time points
Processing: 022707b_.mid
Processing MIDI file: 60.00 seconds long
Analyzing 600 time points...
Processing: 039300b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 016206b_.mid
Processing MIDI file: 40.00 seconds long
Analyzing 400 time points...
Processing: 016506b_.mid
Processing MIDI file: 21.60 seconds long
Analyzing 216 time points...
Processing: 038600b_.mid
Processing MIDI file: 47.86 seconds long
Analyzing 479 time points...
Processing: 024511b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 024417bv.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 066200b_.mid
Processing MIDI file: 281.74 seconds long
Analyzing 2818 time points...
Processed 1000/2818 time points
Processed 2000/2818 time points
Processing: 022703b_.mid
Processing MIDI file: 47.50 seconds long

Analyzing 475 time points...
Processing: 015705b_.mid
Processing MIDI file: 30.59 seconds long
Analyzing 306 time points...
Processing: 007305bv.mid
Processing MIDI file: 39.23 seconds long
Analyzing 393 time points...
Processing: 009709b_.mid
Processing MIDI file: 33.75 seconds long
Analyzing 338 time points...
Processing: 018007b_.mid
Processing MIDI file: 50.00 seconds long
Analyzing 500 time points...
Processing: 024859b6.mid
Processing MIDI file: 38.30 seconds long
Analyzing 383 time points...
Processing: 006404b_.mid
Processing MIDI file: 40.80 seconds long
Analyzing 408 time points...
Processing: 029400b_.mid
Processing MIDI file: 52.50 seconds long
Analyzing 525 time points...
Processing: 008506b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...
Processing: 032700b_.mid
Processing MIDI file: 25.50 seconds long
Analyzing 255 time points...
Processing: 024522b_.mid
Processing MIDI file: 33.19 seconds long
Analyzing 332 time points...
Processing: 014500ba.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...
Processing: 024864qt.mid
Processing MIDI file: 231.67 seconds long
Analyzing 2317 time points...
Processed 1000/2317 time points
Processed 2000/2317 time points
Processing: 038000b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...
Processing: 024444b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...
Processing: 011007b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 030100b_.mid
Processing MIDI file: 47.50 seconds long
Analyzing 475 time points...

Processing: 014706b_.mid
Processing MIDI file: 142.00 seconds long
Analyzing 1420 time points...
Processed 1000/1420 time points

Processing: Bwv0036v.mid
Processing MIDI file: 22.50 seconds long
Analyzing 225 time points...

Processing: 036600b_.mid
Processing MIDI file: 46.25 seconds long
Analyzing 463 time points...

Processing: Bwv0298ch.mid
Processing MIDI file: 69.83 seconds long
Analyzing 699 time points...

Processing: 004106b_.mid
Processing MIDI file: 100.80 seconds long
Analyzing 1009 time points...
Processed 1000/1009 time points

Processing: Bwv0246.mid
Processing MIDI file: 81.00 seconds long
Analyzing 811 time points...

Processing: 038500b_.mid
Processing MIDI file: 37.50 seconds long
Analyzing 375 time points...

Processing: 009709ch.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 024403b_.mid
Processing MIDI file: 30.00 seconds long
Analyzing 300 time points...

Processing: 014710b_.mid
Processing MIDI file: 142.00 seconds long
Analyzing 1420 time points...
Processed 1000/1420 time points

Processing: 036000b_.mid
Processing MIDI file: 42.50 seconds long
Analyzing 425 time points...

Processing: 014806b_.mid
Processing MIDI file: 32.50 seconds long
Analyzing 325 time points...

Processing: 05Polonaise.mid
Processing MIDI file: 164.56 seconds long
Analyzing 1646 time points...
Processed 1000/1646 time points

Processing: 16Marche.mid
Processing MIDI file: 102.39 seconds long

Analyzing 1024 time points...
 Processed 1000/1024 time points
Processing: 13Marche.mid
 Processing MIDI file: 96.42 seconds long
 Analyzing 965 time points...
Processing: 12Polonaise.mid
 Processing MIDI file: 63.00 seconds long
 Analyzing 630 time points...
Processing: 02Menuet.mid
 Processing MIDI file: 89.35 seconds long
 Analyzing 894 time points...
Processing: 06Menuet.mid
 Processing MIDI file: 84.85 seconds long
 Analyzing 849 time points...
Processing: 10Menuet.mid
 Processing MIDI file: 74.21 seconds long
 Analyzing 743 time points...
Processing: 03Menuet.mid
 Processing MIDI file: 99.64 seconds long
 Analyzing 997 time points...
Processing: 14Polonaise.mid
 Processing MIDI file: 86.39 seconds long
 Analyzing 864 time points...
Processing: 15Musette.mid
 Processing MIDI file: 63.99 seconds long
 Analyzing 640 time points...
Processing: 17Polonaise.mid
 Processing MIDI file: 66.59 seconds long
 Analyzing 666 time points...
Processing: 09Menuet.mid
 Processing MIDI file: 87.92 seconds long
 Analyzing 880 time points...
Processing: 01Menuet.mid
 Processing MIDI file: 110.48 seconds long
 Analyzing 1105 time points...
 Processed 1000/1105 time points
Processing: 08Polonaise.mid
 Processing MIDI file: 59.40 seconds long
 Analyzing 594 time points...
Processing: 04Menuet.mid
 Processing MIDI file: 120.69 seconds long
 Analyzing 1207 time points...
 Processed 1000/1207 time points
Processing: 11Marche.mid
 Processing MIDI file: 56.52 seconds long
 Analyzing 566 time points...
Processing: 07Rondo.mid
 Processing MIDI file: 209.52 seconds long

```
Analyzing 2096 time points...
  Processed 1000/2096 time points
  Processed 2000/2096 time points
Successfully processed: 884 files
```

```
=== FEATURE EXTRACTION COMPLETE ===
```

```
Total files processed: 1450
```

```
  Mozart: 219 files
```

```
  Chopin: 136 files
```

```
  Beethoven: 211 files
```

```
  Bach: 884 files
```

```
[41]: # examine and analyze results
if len(all_extracted_features) > 0:
    # Look at first file as an example
    sample_features = all_extracted_features[0]

    print(f"\nExample: Features from '{sample_features['filename']}'")
    print(f"Composer: {sample_features['composer']}")
    print(f"Duration: {sample_features['total_duration']:.2f} seconds")
    print(f"Sequence length: {sample_features['sequence_length']} time steps")
    print(f"Total notes: {sample_features['total_notes']}")
    print(f"Average tempo: {sample_features['average_tempo']:.1f} BPM")
    print(f"Average pitch: {sample_features['average_pitch']:.1f}")
    print(f"Max simultaneous notes: {sample_features['max_simultaneous_notes']:.1f}")

    # Show first few values of the sequences
    print(f"\nFirst 10 pitch values: {sample_features['pitch_sequence'][:10]}")
    print(f"First 10 note density values: {sample_features['note_density_sequence'][:10]}")

    # Calculate some statistics across all files
    print("DATASET STATISTICS")

    # Sequence lengths
    sequence_lengths = [f['sequence_length'] for f in all_extracted_features]
    print(f"Sequence lengths - Min: {min(sequence_lengths)}, Max: {max(sequence_lengths)}, Average: {np.mean(sequence_lengths):.1f}")

    # Duration statistics
    durations = [f['total_duration'] for f in all_extracted_features]
    print(f"File durations - Min: {min(durations):.1f}s, Max: {max(durations):.1f}s, Average: {np.mean(durations):.1f}s")

    # Note density by composer
    print(f"\nAverage note density by composer:")
```

```

    for composer in ["Mozart", "Chopin", "Beethoven", "Bach"]:
        composer_files = [f for f in all_extracted_features if f['composer'] ==
↪ composer]
        if composer_files:
            avg_density = np.mean([f['average_note_density'] for f in
↪ composer_files])
            print(f" {composer}: {avg_density:.2f} notes/time")

print(f"\n Feature extraction complete!")
print(f"Features are stored in 'all_extracted_features' variable.")

```

Example: Features from 'K626Requiem04DiesIrae.mid'

Composer: Mozart

Duration: 111.08 seconds

Sequence length: 1111 time steps

Total notes: 5458

Average tempo: 151.0 BPM

Average pitch: 74.0

Max simultaneous notes: 18.0

First 10 pitch values: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

First 10 note density values: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

DATASET STATISTICS

Sequence lengths - Min: 176, Max: 52094, Average: 2438.7

File durations - Min: 17.5s, Max: 5209.3s, Average: 243.8s

Average note density by composer:

Mozart: 4.52 notes/time

Chopin: 3.03 notes/time

Beethoven: 3.92 notes/time

Bach: 4.04 notes/time

Feature extraction complete!

Features are stored in 'all_extracted_features' variable.

3 Additional Feature Engineering

```

[42]: # Balance the dataset
def time_window_augmentation(features, window_size=100, overlap=0.5):
    """
    Create multiple samples by sliding a window over long sequences.

    WHY: This is the most effective augmentation technique because:
    - Creates many samples from one long piece
    - Preserves musical structure completely
    - Works perfectly with any composer's style
    """

```

- Increases dataset size dramatically

Args:

features: Dictionary containing the extracted features
window_size: Number of time steps in each window (100 = 10 seconds)
overlap: How much windows overlap (0.5 = 50% overlap)

Returns:

List of new feature dictionaries, each with a shorter sequence
"""

```
# Get the main sequences from the features
pitch_sequence = features['pitch_sequence']
note_density_sequence = features['note_density_sequence']
pitch_range_sequence = features['pitch_range_sequence']

# Only process if sequence is long enough
if len(pitch_sequence) < window_size:
    return [features] # Return original if too short

augmented_samples = []
step_size = int(window_size * (1 - overlap)) # How far to move window each
time

# Slide the window across the sequence
for start_idx in range(0, len(pitch_sequence) - window_size + 1, step_size):
    end_idx = start_idx + window_size

    # Create new sample with windowed sequences
    new_sample = copy.deepcopy(features) # Copy all the original data

    # Replace sequences with windowed versions
    new_sample['pitch_sequence'] = pitch_sequence[start_idx:end_idx]
    new_sample['note_density_sequence'] = note_density_sequence[start_idx:
end_idx]
    new_sample['pitch_range_sequence'] = pitch_range_sequence[start_idx:
end_idx]

    # Update metadata
    new_sample['sequence_length'] = window_size
    new_sample['total_duration'] = float(window_size * 0.1) # 0.1 seconds
per time step
    new_sample['filename'] = f"{features['filename']}_window_{start_idx}"

    augmented_samples.append(new_sample)

return augmented_samples
```



```
[43]: def pitch_shift_augmentation(features, shift_amount):
    """
    Transpose all pitches up or down by a fixed amount.

    WHY: Musical pieces sound the same in different keys:
    - Preserves the relative relationships between notes
    - Very common in music (performers play in different keys)
    - Doesn't change the composer's style

    Args:
        features: Dictionary containing the extracted features
        shift_amount: Number of semitones to shift (positive = higher, negative =
↳ lower)

    Returns:
        New feature dictionary with shifted pitches
    """
    new_sample = copy.deepcopy(features)

    # Shift all pitches (but not the zeros, which represent silence)
    new_pitch_sequence = []
    for pitch in features['pitch_sequence']:
        if pitch == 0: # Silence stays silence
            new_pitch_sequence.append(0)
        else:
            # Shift the pitch, but keep it in reasonable range (21-108 = piano
↳ range)
            new_pitch = pitch + shift_amount
            if 21 <= new_pitch <= 108: # Valid piano range
                new_pitch_sequence.append(new_pitch)
            else:
                new_pitch_sequence.append(pitch) # Keep original if out of
↳ range

    new_sample['pitch_sequence'] = new_pitch_sequence
    new_sample['filename'] =
↳ f"{features['filename']}_pitch_shift_{shift_amount}"

    # Update average pitch
    non_zero_pitches = [p for p in new_pitch_sequence if p > 0]
    if non_zero_pitches:
        new_sample['average_pitch'] = float(np.mean(non_zero_pitches))

    return new_sample
```

```

[44]: def tempo_scaling_augmentation(features, scale_factor):
    """
    Change the speed of the music by resampling the sequences.

    WHY: Same piece can be played at different tempos:
    - Faster tempo = compress the sequence
    - Slower tempo = stretch the sequence
    - Preserves musical patterns at different speeds

    Args:
        features: Dictionary containing the extracted features
        scale_factor: Speed multiplier (2.0 = twice as fast, 0.5 = half speed)

    Returns:
        New feature dictionary with tempo-scaled sequences
    """
    new_sample = copy.deepcopy(features)

    # Get original sequences
    pitch_seq = features['pitch_sequence']
    density_seq = features['note_density_sequence']
    range_seq = features['pitch_range_sequence']

    original_length = len(pitch_seq)
    new_length = int(original_length / scale_factor)

    # Don't make sequences too short
    if new_length < 10:
        return features # Return original if would be too short

    # Resample sequences to new length
    # Create indices for resampling
    original_indices = np.linspace(0, original_length - 1, original_length)
    new_indices = np.linspace(0, original_length - 1, new_length)

    # Simple nearest-neighbor resampling
    new_pitch_sequence = []
    new_density_sequence = []
    new_range_sequence = []

    for new_idx in new_indices:
        # Find closest original index
        closest_original_idx = int(round(new_idx))
        if closest_original_idx >= original_length:
            closest_original_idx = original_length - 1

        new_pitch_sequence.append(pitch_seq[closest_original_idx])

```

```

new_density_sequence.append(density_seq[closest_original_idx])
new_range_sequence.append(range_seq[closest_original_idx])

# Update the sample
new_sample['pitch_sequence'] = new_pitch_sequence
new_sample['note_density_sequence'] = new_density_sequence
new_sample['pitch_range_sequence'] = new_range_sequence
new_sample['sequence_length'] = new_length
new_sample['total_duration'] = float(new_length * 0.1)
new_sample['filename'] = f"{features['filename']}_tempo_{scale_factor}"

# Update tempo-related features
new_sample['average_tempo'] = features['average_tempo'] * scale_factor
new_sample['initial_tempo'] = features['initial_tempo'] * scale_factor

return new_sample

```

```

[46]: def velocity_scaling_augmentation(features, scale_factor):
    """
    Scale the note density (volume/intensity) by a constant factor.

    WHY: Same piece can be played at different volumes:
    - Softer playing vs louder playing
    - Different performance interpretations
    - Preserves relative dynamics

    Args:
        features: Dictionary containing the extracted features
        scale_factor: Volume multiplier (1.5 = louder, 0.7 = softer)

    Returns:
        New feature dictionary with scaled note densities
    """
    new_sample = copy.deepcopy(features)

    # Scale note density sequence (represents how many notes playing)
    scaled_density = [density * scale_factor for density in
    ↪ features['note_density_sequence']]

    new_sample['note_density_sequence'] = scaled_density
    new_sample['average_note_density'] = features['average_note_density'] *
    ↪ scale_factor
    new_sample['max_simultaneous_notes'] = features['max_simultaneous_notes'] *
    ↪ scale_factor
    new_sample['filename'] = f"{features['filename']}_velocity_{scale_factor}"

    return new_sample

```

```

[47]: def augment_composer_data(composer_features, target_count, composer_name):
    """
    Augment a single composer's data to reach target count.

    Args:
        composer_features: List of feature dictionaries for one composer
        target_count: How many samples we want total
        composer_name: Name of composer (for progress updates)

    Returns:
        List of augmented features (original + generated)
    """
    current_count = len(composer_features)

    if current_count >= target_count:
        print(f" {composer_name}: Already has {current_count} files, no_
↪augmentation needed")
        return composer_features[:target_count] # Just return the target amount

    needed_count = target_count - current_count
    print(f" {composer_name}: Augmenting from {current_count} to_
↪{target_count} files ({needed_count} new samples needed)")

    augmented_data = composer_features.copy() # Start with originals

    # Define augmentation strategies in order of preference
    augmentation_techniques = [
        # Technique, probability of use, parameters
        ('time_window', 0.4, {'window_size': 150, 'overlap': 0.3}), # Most_
↪samples
        ('time_window', 0.3, {'window_size': 100, 'overlap': 0.5}), #_
↪Different window size
        ('pitch_shift', 0.1, {'shift_amounts': [2, 3, 4, -2, -3, -4]}), #_
↪Different keys
        ('tempo_scaling', 0.1, {'scale_factors': [1.2, 1.3, 0.8, 0.9]}), #_
↪Different speeds
        ('velocity_scaling', 0.1, {'scale_factors': [1.3, 1.5, 0.7, 0.8]}) #_
↪Different volumes
    ]

    # Keep generating until we have enough samples
    attempts = 0
    max_attempts = needed_count * 3 # Prevent infinite loops

    while len(augmented_data) < target_count and attempts < max_attempts:
        # Pick a random original sample to augment

```

```

original_sample = random.choice(composer_features)

# Pick augmentation technique based on probabilities
rand_val = random.random()
cumulative_prob = 0

for technique, prob, params in augmentation_techniques:
    cumulative_prob += prob
    if rand_val <= cumulative_prob:

        if technique == 'time_window':
            new_samples = time_window_augmentation(original_sample, ↵
↵**params)

            # Add all windowed samples
            for new_sample in new_samples:
                if len(augmented_data) < target_count:
                    augmented_data.append(new_sample)

        elif technique == 'pitch_shift':
            shift_amount = random.choice(params['shift_amounts'])
            new_sample = pitch_shift_augmentation(original_sample, ↵
↵shift_amount)

            augmented_data.append(new_sample)

        elif technique == 'tempo_scaling':
            scale_factor = random.choice(params['scale_factors'])
            new_sample = tempo_scaling_augmentation(original_sample, ↵
↵scale_factor)

            augmented_data.append(new_sample)

        elif technique == 'velocity_scaling':
            scale_factor = random.choice(params['scale_factors'])
            new_sample = velocity_scaling_augmentation(original_sample, ↵
↵scale_factor)

            augmented_data.append(new_sample)

        break

    attempts += 1

# Trim to exact target count if we generated too many
final_data = augmented_data[:target_count]

print(f"    Generated {len(final_data) - current_count} new samples")
return final_data

```

```
[48]: def balance_dataset(all_extracted_features, target_samples_per_composer=450):
    """
    Balance the entire dataset by augmenting underrepresented composers.

    Args:
        all_extracted_features: List of all feature dictionaries
        target_samples_per_composer: How many samples each composer should have

    Returns:
        Balanced list of feature dictionaries
    """
    print("BALANCING DATASET WITH FEATURE ENGINEERING")
    print(f"Target: {target_samples_per_composer} samples per composer")
    print()

    # Separate features by composer
    composers_data = {
        'Mozart': [],
        'Chopin': [],
        'Beethoven': [],
        'Bach': []
    }

    for features in all_extracted_features:
        composer = features['composer']
        composers_data[composer].append(features)

    # Show current distribution
    print("Current distribution:")
    for composer, features_list in composers_data.items():
        print(f" {composer}: {len(features_list)} files")
    print()

    # Augment each composer's data
    balanced_data = []

    for composer, features_list in composers_data.items():
        augmented_features = augment_composer_data(
            features_list,
            target_samples_per_composer,
            composer
        )
        balanced_data.extend(augmented_features)

    # Shuffle the balanced dataset
    random.shuffle(balanced_data)
```

```

# Show final distribution
print(f"AUGMENTATION COMPLETE")
print(f"Total samples: {len(balanced_data)}")
print("Final distribution:")

final_counts = {'Mozart': 0, 'Chopin': 0, 'Beethoven': 0, 'Bach': 0}
for features in balanced_data:
    final_counts[features['composer']] += 1

for composer, count in final_counts.items():
    print(f" {composer}: {count} files ({count/len(balanced_data)*100:.
↪1f}%)")

return balanced_data

```

```

[49]: import numpy as np
import random
import copy

```

```

[50]: # Run all the feature engineering functions
print("Starting feature engineering to balance the dataset...")
print("This will create additional training samples to improve LSTM performance.
↪")
print()

# Balance the dataset (using your extracted features)
balanced_features = balance_dataset(all_extracted_features,
↪target_samples_per_composer=400)

```

Starting feature engineering to balance the dataset...

This will create additional training samples to improve LSTM performance.

BALANCING DATASET WITH FEATURE ENGINEERING

Target: 400 samples per composer

Current distribution:

Mozart: 219 files
 Chopin: 136 files
 Beethoven: 211 files
 Bach: 884 files

Mozart: Augmenting from 219 to 400 files (181 new samples needed)
 Generated 181 new samples
 Chopin: Augmenting from 136 to 400 files (264 new samples needed)
 Generated 264 new samples
 Beethoven: Augmenting from 211 to 400 files (189 new samples needed)
 Generated 189 new samples
 Bach: Already has 884 files, no augmentation needed

AUGMENTATION COMPLETE

Total samples: 1600

Final distribution:

Mozart: 400 files (25.0%)

Chopin: 400 files (25.0%)

Beethoven: 400 files (25.0%)

Bach: 400 files (25.0%)

```
[51]: # See results
# Show a few examples of augmented data
print(f"\nExample augmented filenames:")
example_count = 0
for features in balanced_features:
    if 'window_' in features['filename'] or 'pitch_shift_' in_
    features['filename'] or 'tempo_' in features['filename']:
        print(f"  Original: {features['filename'].split('_window_')[0].
        split('_pitch_shift_')[0].split('_tempo_')[0]}")
        print(f"  Augmented: {features['filename']}")
        print(f"  Composer: {features['composer']}")
        print()
        example_count += 1
        if example_count >= 3:
            break

# Check sequence length distribution
sequence_lengths = [len(f['pitch_sequence']) for f in balanced_features]
print(f"Sequence length statistics:")
print(f"  Min: {min(sequence_lengths)} time steps")
print(f"  Max: {max(sequence_lengths)} time steps")
print(f"  Average: {np.mean(sequence_lengths):.1f} time steps")
print(f"  Most common: {max(set(sequence_lengths), key=sequence_lengths.count)}_
    time steps")

print(f"\n Dataset is now balanced and ready for LSTM training!")
print(f"There are now {len(balanced_features)} total training samples.")
```

Example augmented filenames:

Original: Symphonyop125n92mov_Choral_.mid

Augmented: Symphonyop125n92mov_Choral_.mid_window_5150

Composer: Beethoven

Original: Symphonyn25K1832mov.mid

Augmented: Symphonyn25K1832mov.mid_window_315

Composer: Mozart

Original: Preluden02op28_PresentimentofDeath_.mid

Augmented: Preluden02op28_PresentimentofDeath_.mid_window_100

Composer: Chopin

Sequence length statistics:

Min: 100 time steps

Max: 52094 time steps

Average: 2067.3 time steps

Most common: 100 time steps

Dataset is now balanced and ready for LSTM training!
There are now 1600 total training samples.

4 LSTM Model Training & Evaluation

```
[52]: from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, LabelEncoder
from sklearn.metrics import classification_report, confusion_matrix, \
    accuracy_score
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense, Dropout, BatchNormalization
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau
from tensorflow.keras.utils import to_categorical
import matplotlib.pyplot as plt
import seaborn as sns
```

Why is an LSTM model good for composer classification?

1. Music is sequential - notes depend on what came before
2. Temporal patterns - composers have signature rhythmic/melodic patterns
3. Long-term memory - musical phrases span many time steps
4. Context matters - the same note sequence means different things in different contexts

```
[53]: def prepare_sequences_for_lstm(balanced_features, max_sequence_length=150):
    """
    Convert our extracted features into sequences suitable for LSTM training.

    WHY PADDING IS NEEDED:
    - LSTM requires all input sequences to be the same length
    - Pad shorter sequences with zeros
    - Truncate longer sequences to max_length

    Args:
        balanced_features: List of feature dictionaries from augmentation
        max_sequence_length: Maximum length for all sequences

    Returns:
        X: Input sequences for LSTM (samples, time_steps, features)
```

```

        y: Target labels (composer names)
        feature_names: Names of the features we're using
    """
    print("PREPARING DATA FOR LSTM")
    print(f"Converting {len(balanced_features)} samples into LSTM-ready format..")
    ↪.")

    # Use these 3 time-series features as input to LSTM
    feature_names = ['pitch_sequence', 'note_density_sequence', ↪
    ↪'pitch_range_sequence']

    X = [] # Input sequences
    y = [] # Composer labels

    for i, features in enumerate(balanced_features):
        if i % 200 == 0:
            print(f" Processing sample {i}/{len(balanced_features)}...")

        # Get the three sequences
        pitch_seq = features['pitch_sequence']
        density_seq = features['note_density_sequence']
        range_seq = features['pitch_range_sequence']

        # Make sure all sequences are the same length
        seq_length = len(pitch_seq)

        # Truncate if too long
        if seq_length > max_sequence_length:
            pitch_seq = pitch_seq[:max_sequence_length]
            density_seq = density_seq[:max_sequence_length]
            range_seq = range_seq[:max_sequence_length]
            seq_length = max_sequence_length

        # Pad if too short
        if seq_length < max_sequence_length:
            padding_needed = max_sequence_length - seq_length
            pitch_seq.extend([0] * padding_needed)
            density_seq.extend([0] * padding_needed)
            range_seq.extend([0] * padding_needed)

        # Combine the three sequences into one multi-feature sequence
        # Shape will be (time_steps, num_features) = (max_sequence_length, 3)
        combined_sequence = []
        for t in range(max_sequence_length):
            time_step_features = [
                pitch_seq[t], # Feature 1: Pitch at time t
                density_seq[t], # Feature 2: Note density at time t

```

```

        range_seq[t]          # Feature 3: Pitch range at time t
    ]
    combined_sequence.append(time_step_features)

    X.append(combined_sequence)
    y.append(features['composer'])

# Convert to numpy arrays
X = np.array(X) # Shape: (num_samples, max_sequence_length, 3)
y = np.array(y) # Shape: (num_samples,)

print(f"    Prepared {len(X)} sequences")
print(f"    Input shape: {X.shape} (samples, time_steps, features)")
print(f"    Each sequence has {X.shape[1]} time steps with {X.shape[2]}_
↪features")

return X, y, feature_names

```

```

[54]: def normalize_features(X_train, X_val, X_test):
    """
    Normalize the input features for better LSTM training.

    WHY NORMALIZATION IS IMPORTANT:
    - Pitch values (0-127) are much larger than density values (0-10)
    - LSTM trains better when all features are on similar scales
    - Prevents one feature from dominating the learning

    Args:
        X_train, X_val, X_test: Training, validation, and test sequences

    Returns:
        Normalized versions of the input arrays + the scaler
    """
    print("NORMALIZING FEATURES")

    # Reshape for scaling: (samples * time_steps, features)
    original_shape_train = X_train.shape
    original_shape_val = X_val.shape
    original_shape_test = X_test.shape

    X_train_reshaped = X_train.reshape(-1, X_train.shape[-1])
    X_val_reshaped = X_val.reshape(-1, X_val.shape[-1])
    X_test_reshaped = X_test.reshape(-1, X_test.shape[-1])

    # Fit scaler on training data only
    scaler = StandardScaler()
    X_train_scaled = scaler.fit_transform(X_train_reshaped)

```

```

X_val_scaled = scaler.transform(X_val_reshaped)
X_test_scaled = scaler.transform(X_test_reshaped)

# Reshape back to original sequence format
X_train_normalized = X_train_scaled.reshape(original_shape_train)
X_val_normalized = X_val_scaled.reshape(original_shape_val)
X_test_normalized = X_test_scaled.reshape(original_shape_test)

print(f"    Normalized features using StandardScaler")
print(f"    Training data shape: {X_train_normalized.shape}")

return X_train_normalized, X_val_normalized, X_test_normalized, scaler

```

```

[55]: def prepare_labels(y_train, y_val, y_test):
    """
    Convert composer names to numbers that model can use.

    WHY THIS IS NEEDED:
    - Neural networks need numerical labels, not text
    - We convert: 'Mozart' -> 0, 'Chopin' -> 1, etc.
    - Then convert to one-hot encoding for multi-class classification

    Args:
        y_train, y_val, y_test: Arrays of composer names

    Returns:
        One-hot encoded labels + label encoder for later use
    """
    print("PREPARING LABELS")

    # Convert composer names to numbers
    label_encoder = LabelEncoder()
    y_train_encoded = label_encoder.fit_transform(y_train)
    y_val_encoded = label_encoder.transform(y_val)
    y_test_encoded = label_encoder.transform(y_test)

    # Convert to one-hot encoding
    num_classes = len(label_encoder.classes_)
    y_train_onehot = to_categorical(y_train_encoded, num_classes)
    y_val_onehot = to_categorical(y_val_encoded, num_classes)
    y_test_onehot = to_categorical(y_test_encoded, num_classes)

    print(f"    Encoded {num_classes} composers: {list(label_encoder.
↪classes_)})")
    print(f"    Label encoding: {dict(zip(label_encoder.classes_,
↪range(num_classes)))}")
    print(f"    One-hot shape: {y_train_onehot.shape}")

```

```
return y_train_onehot, y_val_onehot, y_test_onehot, label_encoder
```

```
[56]: def build_lstm_model(input_shape, num_classes):
    """
    Build the LSTM architecture:
    1. LSTM Layer 1: Learns temporal patterns in music (128 units)
    2. Dropout: Prevents overfitting (20% of neurons randomly turned off)
    3. LSTM Layer 2: Learns higher-level patterns (64 units)
    4. Dropout: More regularization
    5. Dense Layer: Combines patterns for classification (32 units)
    6. Output Layer: Final prediction (4 units for 4 composers)

    WHY THIS ARCHITECTURE:
    - Two LSTM layers capture both short and long-term patterns
    - Dropout prevents the model from memorizing training data
    - Dense layer allows complex decision boundaries
    - return_sequences=True passes all time steps to next layer

    Args:
        input_shape: Shape of input sequences (time_steps, features)
        num_classes: Number of composers to classify

    Returns:
        Compiled Keras model ready for training
    """
    print(f"BUILDING LSTM MODEL")
    print(f"Input shape: {input_shape}")
    print(f"Number of classes: {num_classes}")

    model = Sequential()

    # First LSTM layer - learns basic temporal patterns
    model.add(LSTM(128,
                   return_sequences=True, # Pass sequences to next layer
                   input_shape=input_shape,
                   dropout=0.2,           # Dropout within LSTM
                   recurrent_dropout=0.2)) # Dropout on recurrent connections

    # Batch normalization - helps training stability
    model.add(BatchNormalization())

    # Second LSTM layer - learns higher-level patterns
    model.add(LSTM(64,
                   return_sequences=False, # Only output final state
                   dropout=0.2,
                   recurrent_dropout=0.2))
```

```

# Dropout for regularization
model.add(Dropout(0.3))

# Dense layer for learning complex combinations
model.add(Dense(32, activation='relu'))
model.add(Dropout(0.2))

# Output layer - one neuron per composer
model.add(Dense(num_classes, activation='softmax'))

# Compile the model
model.compile(
    optimizer=Adam(learning_rate=0.001), # Good default learning rate
    loss='categorical_crossentropy',      # Standard for multi-class
    metrics=['accuracy']                  # Track accuracy during training
)

print("    Model architecture:")
model.summary()

return model

```

```

[57]: def train_lstm_model(model, X_train, y_train, X_val, y_val):
    """
    Train the LSTM model with monitoring and early stopping.

    TRAINING STRATEGY:
    - Early Stopping: Stop if validation accuracy doesn't improve
    - Learning Rate Reduction: Lower learning rate if stuck
    - Validation Split: Monitor performance on unseen data

    Args:
        model: Compiled Keras model
        X_train, y_train: Training data and labels
        X_val, y_val: Validation data and labels

    Returns:
        Trained model + training history for plotting
    """
    print(f"TRAINING LSTM MODEL")

    # Define callbacks for better training
    callbacks = [
        # Stop training if validation accuracy doesn't improve for 30 epochs
        EarlyStopping(
            monitor='val_accuracy',

```

```

        patience=30,
        restore_best_weights=True,
        verbose=1
    ),

    # Reduce learning rate if validation loss plateaus
    ReduceLROnPlateau(
        monitor='val_loss',
        factor=0.5,
        patience=5,
        min_lr=0.0001,
        verbose=1
    )
]

print(f" Training on {len(X_train)} samples")
print(f" Validating on {len(X_val)} samples")
print(f" Using early stopping and learning rate reduction")

# Train the model
history = model.fit(
    X_train, y_train,
    batch_size=32, # Process 32 samples at a time
    epochs=100, # Maximum 100 epochs
    validation_data=(X_val, y_val),
    callbacks=callbacks,
    verbose=1 # Show training progress
)

print(f" Training completed!")
return model, history

```

```

[58]: def evaluate_model(model, X_test, y_test, label_encoder):
    """
    Evaluate the trained model and show detailed performance metrics.

    Args:
        model: Trained model
        X_test, y_test: Test data and labels
        label_encoder: For converting predictions back to composer names

    Returns:
        Test accuracy and detailed classification report
    """
    print(f"EVALUATING MODEL PERFORMANCE")

    # Make predictions

```

```

predictions = model.predict(X_test)
predicted_classes = np.argmax(predictions, axis=1)
true_classes = np.argmax(y_test, axis=1)

# Calculate accuracy
test_accuracy = accuracy_score(true_classes, predicted_classes)

print(f"    Test Accuracy: {test_accuracy:.4f} ({test_accuracy*100:.2f}%)")

# Detailed classification report
composer_names = label_encoder.classes_
print(f"\n Detailed Performance by Composer:")
print(classification_report(true_classes, predicted_classes,
                           target_names=composer_names, digits=4))

# Confusion Matrix
cm = confusion_matrix(true_classes, predicted_classes)

plt.figure(figsize=(8, 6))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
            xticklabels=composer_names, yticklabels=composer_names)
plt.title('Confusion Matrix - Composer Classification')
plt.xlabel('Predicted Composer')
plt.ylabel('True Composer')
plt.tight_layout()
plt.show()

return test_accuracy

```

```

[59]: def plot_training_history(history):
    """
    Plot training and validation accuracy/loss over time.

    Args:
        history: Training history from model.fit()
    """
    print(f"TRAINING HISTORY")

    fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12, 4))

    # Plot accuracy
    ax1.plot(history.history['accuracy'], label='Training Accuracy')
    ax1.plot(history.history['val_accuracy'], label='Validation Accuracy')
    ax1.set_title('Model Accuracy Over Time')
    ax1.set_xlabel('Epoch')
    ax1.set_ylabel('Accuracy')
    ax1.legend()

```



```

ax1.grid(True)

# Plot loss
ax2.plot(history.history['loss'], label='Training Loss')
ax2.plot(history.history['val_loss'], label='Validation Loss')
ax2.set_title('Model Loss Over Time')
ax2.set_xlabel('Epoch')
ax2.set_ylabel('Loss')
ax2.legend()
ax2.grid(True)

plt.tight_layout()
plt.show()

```

```

[60]: # Run the training pipeline built above

print("=== STARTING LSTM MODEL TRAINING ===")
print("This will build and train a LSTM model to classify composers")
print()

# Step 1: Prepare sequences for LSTM
print("Step 1: Converting features to LSTM format...")
X, y, feature_names = prepare_sequences_for_lstm(balanced_features,
    ↪max_sequence_length=150)

# Step 2: Split into train/validation/test sets
print(f"\nStep 2: Splitting data...")
# First split: 80% train+val, 20% test
X_temp, X_test, y_temp, y_test = train_test_split(X, y, test_size=0.2,
    stratify=y, random_state=42)
# Second split: 75% train, 25% validation (of the 80%)
X_train, X_val, y_train, y_val = train_test_split(X_temp, y_temp, test_size=0.
    ↪25,
    stratify=y_temp,
    ↪random_state=42)

print(f"    Training set: {len(X_train)} samples")
print(f"    Validation set: {len(X_val)} samples")
print(f"    Test set: {len(X_test)} samples")

# Step 3: Normalize features
X_train_norm, X_val_norm, X_test_norm, scaler = normalize_features(X_train,
    ↪X_val, X_test)

# Step 4: Prepare labels
y_train_encoded, y_val_encoded, y_test_encoded, label_encoder =
    ↪prepare_labels(y_train, y_val, y_test)

```

```

# Step 5: Build model
input_shape = (X_train_norm.shape[1], X_train_norm.shape[2]) # (time_steps,
    ↳features)
num_classes = len(label_encoder.classes_)
model = build_lstm_model(input_shape, num_classes)

# Step 6: Train model
trained_model, training_history = train_lstm_model(
    model, X_train_norm, y_train_encoded, X_val_norm, y_val_encoded
)

# Step 7: Evaluate performance
test_accuracy = evaluate_model(trained_model, X_test_norm, y_test_encoded,
    ↳label_encoder)

# Step 8: Plot training progress
plot_training_history(training_history)

```

=== STARTING LSTM MODEL TRAINING ===

This will build and train a LSTM model to classify composers

Step 1: Converting features to LSTM format...

PREPARING DATA FOR LSTM

Converting 1600 samples into LSTM-ready format...

Processing sample 0/1600...

Processing sample 200/1600...

Processing sample 400/1600...

Processing sample 600/1600...

Processing sample 800/1600...

Processing sample 1000/1600...

Processing sample 1200/1600...

Processing sample 1400/1600...

Prepared 1600 sequences

Input shape: (1600, 150, 3) (samples, time_steps, features)

Each sequence has 150 time steps with 3 features

Step 2: Splitting data...

Training set: 960 samples

Validation set: 320 samples

Test set: 320 samples

NORMALIZING FEATURES

Normalized features using StandardScaler

Training data shape: (960, 150, 3)

PREPARING LABELS

Encoded 4 composers: [np.str_('Bach'), np.str_('Beethoven'),
np.str_('Chopin'), np.str_('Mozart')]

```
Label encoding: {np.str_('Bach'): 0, np.str_('Beethoven'): 1,
np.str_('Chopin'): 2, np.str_('Mozart'): 3}
```

```
One-hot shape: (960, 4)
```

```
BUILDING LSTM MODEL
```

```
Input shape: (150, 3)
```

```
Number of classes: 4
```

```
Model architecture:
```

```
Model: "sequential_2"
```

Layer (type)	Output Shape	Param #
lstm (LSTM)	(None, 150, 128)	67,584
batch_normalization (BatchNormalization)	(None, 150, 128)	512
lstm_1 (LSTM)	(None, 64)	49,408
dropout_3 (Dropout)	(None, 64)	0
dense_6 (Dense)	(None, 32)	2,080
dropout_4 (Dropout)	(None, 32)	0
dense_7 (Dense)	(None, 4)	132

```
Total params: 119,716 (467.64 KB)
```

```
Trainable params: 119,460 (466.64 KB)
```

```
Non-trainable params: 256 (1.00 KB)
```

```
TRAINING LSTM MODEL
```

```
Training on 960 samples
```

```
Validating on 320 samples
```

```
Using early stopping and learning rate reduction
```

```
Epoch 1/100
```

```
30/30 27s 588ms/step -
```

```
accuracy: 0.3026 - loss: 1.4094 - val_accuracy: 0.3625 - val_loss: 1.3201 -
```

```
learning_rate: 0.0010
```

```
Epoch 2/100
```

```
30/30 38s 616ms/step -
```

```
accuracy: 0.3703 - loss: 1.3144 - val_accuracy: 0.3500 - val_loss: 1.2987 -
```

```

learning_rate: 0.0010
Epoch 3/100
30/30          20s 602ms/step -
accuracy: 0.3440 - loss: 1.3285 - val_accuracy: 0.3625 - val_loss: 1.2898 -
learning_rate: 0.0010
Epoch 4/100
30/30          19s 638ms/step -
accuracy: 0.3640 - loss: 1.3090 - val_accuracy: 0.3562 - val_loss: 1.2792 -
learning_rate: 0.0010
Epoch 5/100
30/30          18s 565ms/step -
accuracy: 0.3707 - loss: 1.2718 - val_accuracy: 0.3531 - val_loss: 1.2688 -
learning_rate: 0.0010
Epoch 6/100
30/30          18s 602ms/step -
accuracy: 0.3297 - loss: 1.3069 - val_accuracy: 0.3844 - val_loss: 1.2742 -
learning_rate: 0.0010
Epoch 7/100
30/30          21s 609ms/step -
accuracy: 0.3523 - loss: 1.2958 - val_accuracy: 0.3500 - val_loss: 1.2756 -
learning_rate: 0.0010
Epoch 8/100
30/30          20s 602ms/step -
accuracy: 0.3908 - loss: 1.2709 - val_accuracy: 0.3531 - val_loss: 1.2659 -
learning_rate: 0.0010
Epoch 9/100
30/30          20s 602ms/step -
accuracy: 0.3772 - loss: 1.2667 - val_accuracy: 0.3906 - val_loss: 1.2503 -
learning_rate: 0.0010
Epoch 10/100
30/30          21s 615ms/step -
accuracy: 0.3782 - loss: 1.2579 - val_accuracy: 0.3969 - val_loss: 1.2471 -
learning_rate: 0.0010
Epoch 11/100
30/30          19s 567ms/step -
accuracy: 0.3902 - loss: 1.2762 - val_accuracy: 0.4094 - val_loss: 1.2395 -
learning_rate: 0.0010
Epoch 12/100
30/30          18s 604ms/step -
accuracy: 0.3616 - loss: 1.2736 - val_accuracy: 0.3562 - val_loss: 1.2952 -
learning_rate: 0.0010
Epoch 13/100
30/30          21s 609ms/step -
accuracy: 0.3719 - loss: 1.2701 - val_accuracy: 0.3906 - val_loss: 1.2572 -
learning_rate: 0.0010
Epoch 14/100
30/30          18s 602ms/step -
accuracy: 0.3906 - loss: 1.2531 - val_accuracy: 0.3656 - val_loss: 1.2502 -

```

learning_rate: 0.0010
Epoch 15/100
30/30 20s 602ms/step -
accuracy: 0.3806 - loss: 1.2537 - val_accuracy: 0.3625 - val_loss: 1.2548 -
learning_rate: 0.0010
Epoch 16/100
30/30 0s 522ms/step -
accuracy: 0.3900 - loss: 1.2396
Epoch 16: ReduceLROnPlateau reducing learning rate to 0.0005000000237487257.
30/30 21s 612ms/step -
accuracy: 0.3901 - loss: 1.2397 - val_accuracy: 0.3781 - val_loss: 1.2448 -
learning_rate: 0.0010
Epoch 17/100
30/30 17s 567ms/step -
accuracy: 0.3789 - loss: 1.2707 - val_accuracy: 0.3594 - val_loss: 1.2560 -
learning_rate: 5.0000e-04
Epoch 18/100
30/30 22s 606ms/step -
accuracy: 0.4080 - loss: 1.2598 - val_accuracy: 0.3969 - val_loss: 1.2504 -
learning_rate: 5.0000e-04
Epoch 19/100
30/30 20s 598ms/step -
accuracy: 0.4211 - loss: 1.2324 - val_accuracy: 0.3906 - val_loss: 1.2406 -
learning_rate: 5.0000e-04
Epoch 20/100
30/30 21s 608ms/step -
accuracy: 0.3693 - loss: 1.2581 - val_accuracy: 0.3812 - val_loss: 1.2355 -
learning_rate: 5.0000e-04
Epoch 21/100
30/30 20s 602ms/step -
accuracy: 0.3836 - loss: 1.2750 - val_accuracy: 0.3719 - val_loss: 1.2446 -
learning_rate: 5.0000e-04
Epoch 22/100
30/30 21s 622ms/step -
accuracy: 0.4193 - loss: 1.2211 - val_accuracy: 0.3938 - val_loss: 1.2362 -
learning_rate: 5.0000e-04
Epoch 23/100
30/30 20s 602ms/step -
accuracy: 0.4172 - loss: 1.2281 - val_accuracy: 0.3688 - val_loss: 1.2449 -
learning_rate: 5.0000e-04
Epoch 24/100
30/30 20s 601ms/step -
accuracy: 0.3997 - loss: 1.2292 - val_accuracy: 0.4125 - val_loss: 1.2232 -
learning_rate: 5.0000e-04
Epoch 25/100
30/30 21s 609ms/step -
accuracy: 0.4438 - loss: 1.1882 - val_accuracy: 0.3906 - val_loss: 1.2303 -
learning_rate: 5.0000e-04

Epoch 26/100
 30/30 20s 606ms/step -
 accuracy: 0.4305 - loss: 1.2104 - val_accuracy: 0.3781 - val_loss: 1.2338 -
 learning_rate: 5.0000e-04

Epoch 27/100
 30/30 20s 603ms/step -
 accuracy: 0.4175 - loss: 1.1829 - val_accuracy: 0.3938 - val_loss: 1.2306 -
 learning_rate: 5.0000e-04

Epoch 28/100
 30/30 20s 606ms/step -
 accuracy: 0.4615 - loss: 1.1861 - val_accuracy: 0.4094 - val_loss: 1.2302 -
 learning_rate: 5.0000e-04

Epoch 29/100
 30/30 0s 528ms/step -
 accuracy: 0.4103 - loss: 1.2370

Epoch 29: ReduceLROnPlateau reducing learning rate to 0.0002500000118743628.

30/30 21s 617ms/step -
 accuracy: 0.4110 - loss: 1.2362 - val_accuracy: 0.4156 - val_loss: 1.2406 -
 learning_rate: 5.0000e-04

Epoch 30/100
 30/30 20s 621ms/step -
 accuracy: 0.4575 - loss: 1.1863 - val_accuracy: 0.4125 - val_loss: 1.2377 -
 learning_rate: 2.5000e-04

Epoch 31/100
 30/30 20s 609ms/step -
 accuracy: 0.4659 - loss: 1.1922 - val_accuracy: 0.4125 - val_loss: 1.2312 -
 learning_rate: 2.5000e-04

Epoch 32/100
 30/30 21s 617ms/step -
 accuracy: 0.4020 - loss: 1.2222 - val_accuracy: 0.4031 - val_loss: 1.2278 -
 learning_rate: 2.5000e-04

Epoch 33/100
 30/30 20s 602ms/step -
 accuracy: 0.4098 - loss: 1.2079 - val_accuracy: 0.4031 - val_loss: 1.2331 -
 learning_rate: 2.5000e-04

Epoch 34/100
 30/30 0s 523ms/step -
 accuracy: 0.4839 - loss: 1.1552

Epoch 34: ReduceLROnPlateau reducing learning rate to 0.0001250000059371814.

30/30 21s 612ms/step -
 accuracy: 0.4823 - loss: 1.1564 - val_accuracy: 0.3906 - val_loss: 1.2357 -
 learning_rate: 2.5000e-04

Epoch 35/100
 30/30 16s 548ms/step -
 accuracy: 0.4429 - loss: 1.1775 - val_accuracy: 0.3875 - val_loss: 1.2332 -
 learning_rate: 1.2500e-04

Epoch 36/100
 30/30 24s 682ms/step -

```

accuracy: 0.4266 - loss: 1.2055 - val_accuracy: 0.3938 - val_loss: 1.2331 -
learning_rate: 1.2500e-04
Epoch 37/100
30/30          16s 547ms/step -
accuracy: 0.4555 - loss: 1.1762 - val_accuracy: 0.3969 - val_loss: 1.2314 -
learning_rate: 1.2500e-04
Epoch 38/100
30/30          22s 611ms/step -
accuracy: 0.4765 - loss: 1.1781 - val_accuracy: 0.4094 - val_loss: 1.2332 -
learning_rate: 1.2500e-04
Epoch 39/100
30/30          0s 494ms/step -
accuracy: 0.4367 - loss: 1.1715
Epoch 39: ReduceLROnPlateau reducing learning rate to 0.0001.
30/30          17s 583ms/step -
accuracy: 0.4365 - loss: 1.1723 - val_accuracy: 0.4125 - val_loss: 1.2319 -
learning_rate: 1.2500e-04
Epoch 40/100
30/30          21s 586ms/step -
accuracy: 0.4212 - loss: 1.1966 - val_accuracy: 0.4094 - val_loss: 1.2320 -
learning_rate: 1.0000e-04
Epoch 41/100
30/30          22s 627ms/step -
accuracy: 0.4341 - loss: 1.1804 - val_accuracy: 0.4125 - val_loss: 1.2326 -
learning_rate: 1.0000e-04
Epoch 42/100
30/30          17s 581ms/step -
accuracy: 0.4572 - loss: 1.1956 - val_accuracy: 0.4031 - val_loss: 1.2300 -
learning_rate: 1.0000e-04
Epoch 43/100
30/30          20s 581ms/step -
accuracy: 0.4316 - loss: 1.1920 - val_accuracy: 0.4094 - val_loss: 1.2281 -
learning_rate: 1.0000e-04
Epoch 44/100
30/30          18s 587ms/step -
accuracy: 0.4534 - loss: 1.1650 - val_accuracy: 0.4062 - val_loss: 1.2288 -
learning_rate: 1.0000e-04
Epoch 45/100
30/30          19s 548ms/step -
accuracy: 0.4352 - loss: 1.1932 - val_accuracy: 0.4094 - val_loss: 1.2263 -
learning_rate: 1.0000e-04
Epoch 46/100
30/30          17s 580ms/step -
accuracy: 0.4568 - loss: 1.1864 - val_accuracy: 0.4094 - val_loss: 1.2266 -
learning_rate: 1.0000e-04
Epoch 47/100
30/30          18s 593ms/step -
accuracy: 0.4965 - loss: 1.1469 - val_accuracy: 0.4094 - val_loss: 1.2240 -

```

```

learning_rate: 1.0000e-04
Epoch 48/100
30/30          19s 542ms/step -
accuracy: 0.4483 - loss: 1.1915 - val_accuracy: 0.4031 - val_loss: 1.2269 -
learning_rate: 1.0000e-04
Epoch 49/100
30/30          16s 543ms/step -
accuracy: 0.4800 - loss: 1.1779 - val_accuracy: 0.4031 - val_loss: 1.2264 -
learning_rate: 1.0000e-04
Epoch 50/100
30/30          20s 544ms/step -
accuracy: 0.4490 - loss: 1.1997 - val_accuracy: 0.4062 - val_loss: 1.2219 -
learning_rate: 1.0000e-04
Epoch 51/100
30/30          19s 622ms/step -
accuracy: 0.4172 - loss: 1.1899 - val_accuracy: 0.4000 - val_loss: 1.2213 -
learning_rate: 1.0000e-04
Epoch 52/100
30/30          19s 578ms/step -
accuracy: 0.4778 - loss: 1.1709 - val_accuracy: 0.4062 - val_loss: 1.2242 -
learning_rate: 1.0000e-04
Epoch 53/100
30/30          20s 556ms/step -
accuracy: 0.4578 - loss: 1.2094 - val_accuracy: 0.4062 - val_loss: 1.2256 -
learning_rate: 1.0000e-04
Epoch 54/100
30/30          21s 580ms/step -
accuracy: 0.4663 - loss: 1.1683 - val_accuracy: 0.4031 - val_loss: 1.2259 -
learning_rate: 1.0000e-04
Epoch 55/100
30/30          21s 601ms/step -
accuracy: 0.4677 - loss: 1.1698 - val_accuracy: 0.3969 - val_loss: 1.2262 -
learning_rate: 1.0000e-04
Epoch 56/100
30/30          19s 549ms/step -
accuracy: 0.4571 - loss: 1.1749 - val_accuracy: 0.4000 - val_loss: 1.2242 -
learning_rate: 1.0000e-04
Epoch 57/100
30/30          16s 548ms/step -
accuracy: 0.4479 - loss: 1.1942 - val_accuracy: 0.3938 - val_loss: 1.2249 -
learning_rate: 1.0000e-04
Epoch 58/100
30/30          20s 547ms/step -
accuracy: 0.4234 - loss: 1.1818 - val_accuracy: 0.3969 - val_loss: 1.2239 -
learning_rate: 1.0000e-04
Epoch 59/100
30/30          17s 578ms/step -
accuracy: 0.4296 - loss: 1.1924 - val_accuracy: 0.4156 - val_loss: 1.2241 -

```



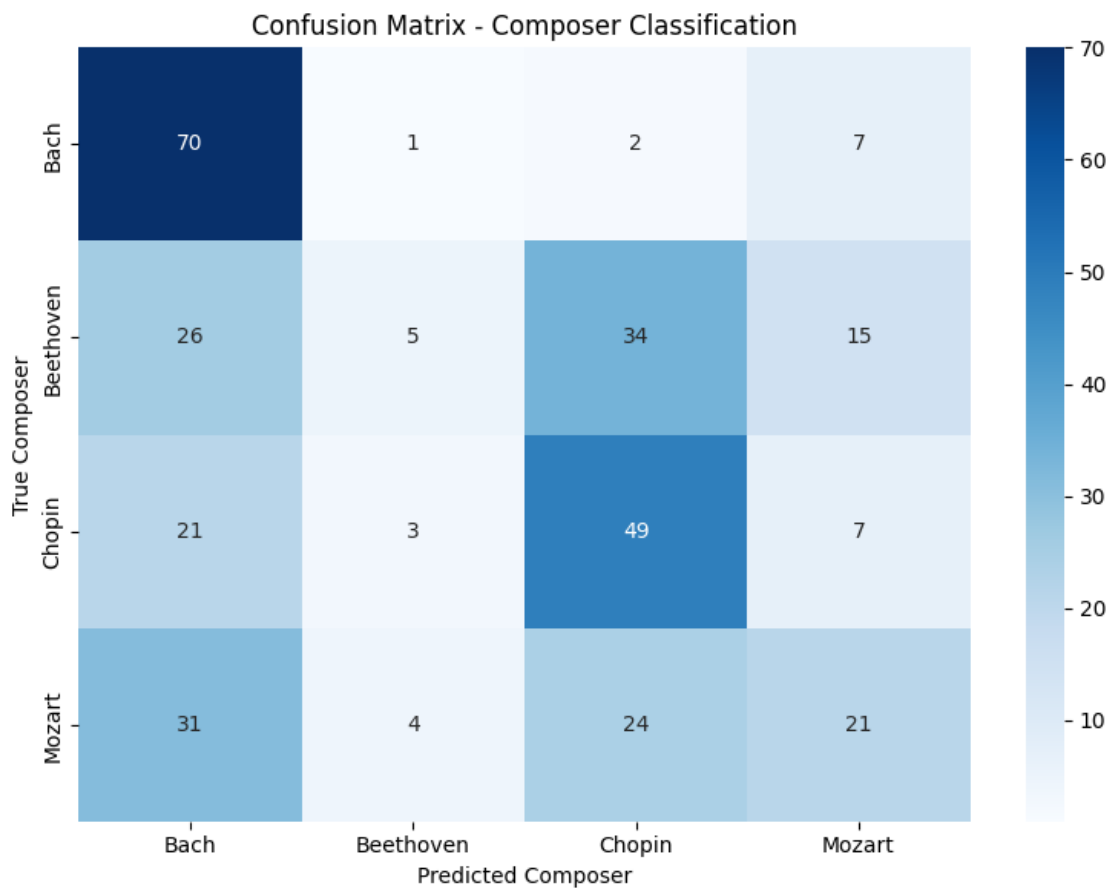
```

learning_rate: 1.0000e-04
Epoch 59: early stopping
Restoring model weights from the end of the best epoch: 29.
Training completed!
EVALUATING MODEL PERFORMANCE
10/10          3s 255ms/step
Test Accuracy: 0.4531 (45.31%)

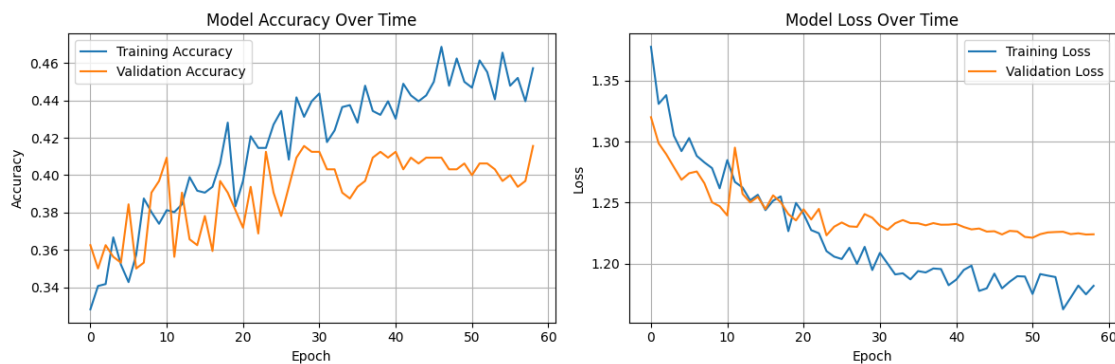
```

Detailed Performance by Composer:

	precision	recall	f1-score	support
Bach	0.4730	0.8750	0.6140	80
Beethoven	0.3846	0.0625	0.1075	80
Chopin	0.4495	0.6125	0.5185	80
Mozart	0.4200	0.2625	0.3231	80
accuracy			0.4531	320
macro avg	0.4318	0.4531	0.3908	320
weighted avg	0.4318	0.4531	0.3908	320



TRAINING HISTORY



```
[ ]: # Trying different optimization / enhancements to improve model performance:
# 1. Longer sequences: 150 → 200 time steps (more musical context)
# 2. Bidirectional LSTM: Reads music forward AND backward
# 3. Deeper architecture: More layers to learn complex patterns
# 4. Wider layers: More neurons to capture subtle differences
# 5. Better regularization: L2 regularization + optimized dropout
# 6. Class weights: Handle any remaining imbalance
# 7. Improved training: Better callbacks and monitoring
```

```
[70]: def extract_enhanced_musical_features(balanced_features,
      ↪max_sequence_length=200):
    print("ENHANCED FEATURE PREPARATION")
    print(f"Using extended sequence length: {max_sequence_length} time steps")
    print(f"Processing {len(balanced_features)} samples...")

    # Enhanced feature set - adding pitch direction
    feature_names = [
        'pitch_sequence',
        'note_density_sequence',
        'pitch_range_sequence',
        'pitch_direction' # NEW: melodic movement (+1 up, 0 same, -1 down)
    ]

    X = []
    y = []

    for i, features in enumerate(balanced_features):
        if i % 200 == 0:
            print(f" Processing sample {i}/{len(balanced_features)}...")
```

```

# Get original sequences
pitch_seq = features['pitch_sequence'].copy()
density_seq = features['note_density_sequence'].copy()
range_seq = features['pitch_range_sequence'].copy()

# NEW: Calculate pitch direction (melodic movement)
pitch_direction = []
for j in range(len(pitch_seq)):
    if j == 0 or pitch_seq[j] == 0 or pitch_seq[j-1] == 0:
        direction = 0 # No direction for first note or silence
    elif pitch_seq[j] > pitch_seq[j-1]:
        direction = 1 # Melody goes up
    elif pitch_seq[j] < pitch_seq[j-1]:
        direction = -1 # Melody goes down
    else:
        direction = 0 # Melody stays same
    pitch_direction.append(direction)

# Handle sequence length
current_length = len(pitch_seq)

# Truncate if too long
if current_length > max_sequence_length:
    pitch_seq = pitch_seq[:max_sequence_length]
    density_seq = density_seq[:max_sequence_length]
    range_seq = range_seq[:max_sequence_length]
    pitch_direction = pitch_direction[:max_sequence_length]
    current_length = max_sequence_length

# Improved padding strategy - pad with zeros but track where real data
→ends
if current_length < max_sequence_length:
    padding_needed = max_sequence_length - current_length
    pitch_seq.extend([0] * padding_needed)
    density_seq.extend([0] * padding_needed)
    range_seq.extend([0] * padding_needed)
    pitch_direction.extend([0] * padding_needed)

# Combine all features into multi-dimensional sequence
combined_sequence = []
for t in range(max_sequence_length):
    time_step_features = [
        pitch_seq[t],
        density_seq[t],
        range_seq[t],
        pitch_direction[t] # NEW FEATURE
    ]

```

```

        combined_sequence.append(time_step_features)

    X.append(combined_sequence)
    y.append(features['composer'])

X = np.array(X)  # Shape: (samples, max_sequence_length, 4)
y = np.array(y)

print(f"    Enhanced feature shape: {X.shape}")
print(f"    Features per time step: {len(feature_names)}")
print(f"    Total temporal context: {max_sequence_length * 0.1:.1f}␣
↪seconds")

return X, y, feature_names

```

```

[80]: from tensorflow.keras import Sequential, Input
from tensorflow.keras.layers import LSTM, Bidirectional, Dense, Dropout,␣
↪BatchNormalization
from tensorflow.keras.regularizers import l2
from tensorflow.keras.optimizers import Adam

def build_enhanced_lstm_model(input_shape, num_classes):
    print("BUILDING ENHANCED LSTM ARCHITECTURE")
    print(f"Input shape: {input_shape}")
    print("Architecture: Bidirectional + Deep + Wide")

    model = Sequential()
    # Explicit Input fixes the "unbuilt" summary issue
    model.add(Input(shape=input_shape))

    model.add(Bidirectional(LSTM(256, return_sequences=True,
                                dropout=0.2, recurrent_dropout=0.2,
                                kernel_regularizer=l2(0.001)),
                            name='bidirectional_lstm_1'))
    model.add(BatchNormalization())
    model.add(Dropout(0.3))

    model.add(Bidirectional(LSTM(128, return_sequences=True,
                                dropout=0.2, recurrent_dropout=0.2,
                                kernel_regularizer=l2(0.001)),
                            name='bidirectional_lstm_2'))
    model.add(BatchNormalization())
    model.add(Dropout(0.3))

    model.add(LSTM(64, return_sequences=False,
                   dropout=0.3, recurrent_dropout=0.3,
                   kernel_regularizer=l2(0.001), name='final_lstm'))

```

```

model.add(Dropout(0.4))

model.add(Dense(128, activation='relu', kernel_regularizer=l2(0.001),
↳name='dense_1'))
model.add(BatchNormalization())
model.add(Dropout(0.3))

model.add(Dense(64, activation='relu', kernel_regularizer=l2(0.001),
↳name='dense_2'))
model.add(Dropout(0.2))

model.add(Dense(num_classes, activation='softmax', name='composer_output'))

optimizer = Adam(learning_rate=0.001, beta_1=0.9, beta_2=0.999,
↳epsilon=1e-07)
model.compile(optimizer=optimizer, loss='categorical_crossentropy',
↳metrics=['accuracy'])

model.build(input_shape=(None, *input_shape)) # Optional, but makes
↳summary deterministic
model.summary()
return model

```

[81]: `def setup_enhanced_training_callbacks(model_name="best_composer_model.h5"):`

```

callbacks = [
    # Save the best model during training
    ModelCheckpoint(
        filepath=model_name,
        monitor='val_accuracy',
        save_best_only=True,
        save_weights_only=False,
        mode='max',
        verbose=1
    ),

    # More sophisticated early stopping
    EarlyStopping(
        monitor='val_accuracy',
        patience=30,
        restore_best_weights=True,
        mode='max',
        min_delta=0.001, # Minimum improvement threshold
        verbose=1
    ),

    # Enhanced learning rate reduction

```

```

        ReduceLROnPlateau(
            monitor='val_loss',
            factor=0.3,          # More aggressive reduction
            patience=7,          # Reduce patience
            min_lr=1e-6,         # Lower minimum
            cooldown=3,          # Cooldown period
            verbose=1
        )
    ]

    return callbacks

```

```

[82]: def calculate_class_weights(y_encoded):
    """
    Calculate class weights to handle any remaining imbalance.

    WHY: Even with augmentation, subtle imbalances can hurt performance

    Args:
        y_encoded: Encoded labels (not one-hot)

    Returns:
        Dictionary of class weights
    """
    class_weights = compute_class_weight(
        'balanced',
        classes=np.unique(y_encoded),
        y=y_encoded
    )

    class_weight_dict = dict(enumerate(class_weights))

    print(f"CLASS WEIGHTS")
    for class_idx, weight in class_weight_dict.items():
        print(f"  Class {class_idx}: {weight:.3f}")

    return class_weight_dict

```

```

[83]: def train_enhanced_model(model, X_train, y_train, X_val, y_val,
    ↪class_weights=None):
    print(f"ENHANCED TRAINING PROTOCOL")
    print(f"Training samples: {len(X_train)}")
    print(f"Validation samples: {len(X_val)}")
    print(f"Enhanced callbacks: Early stopping + LR reduction + Model
    ↪checkpointing")

    # Enhanced callbacks

```

```

callbacks = setup_enhanced_training_callbacks()

# Train with enhanced parameters
history = model.fit(
    X_train, y_train,
    batch_size=64, # Larger batch size for stability
    epochs=20, # More epochs with early stopping
    validation_data=(X_val, y_val),
    callbacks=callbacks,
    class_weight=class_weights, # Handle any remaining imbalance
    verbose=1,
    shuffle=True # Shuffle each epoch
)

print(f"    Training completed!")
print(f"    Best validation accuracy: {max(history.history['val_accuracy']):
↪.4f}")

return model, history

```

```

[84]: def enhanced_evaluation(model, X_test, y_test, label_encoder):
    print(f"ENHANCED MODEL EVALUATION")

    # Make predictions with probabilities
    predictions_proba = model.predict(X_test)
    predicted_classes = np.argmax(predictions_proba, axis=1)
    true_classes = np.argmax(y_test, axis=1)

    # Calculate accuracy
    test_accuracy = accuracy_score(true_classes, predicted_classes)

    print(f"    Test Accuracy: {test_accuracy:.4f} ({test_accuracy*100:.2f}%)")

    # Detailed classification report
    composer_names = label_encoder.classes_
    print(f"\n    Detailed Performance by Composer:")
    print(classification_report(true_classes, predicted_classes,
                                target_names=composer_names, digits=4))

    # Enhanced confusion matrix with percentages
    cm = confusion_matrix(true_classes, predicted_classes)
    cm_percentage = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis] * 100

    fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(15, 6))

    # Raw confusion matrix
    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',

```

```

        xticklabels=composer_names, yticklabels=composer_names, ax=ax1)
ax1.set_title('Confusion Matrix (Counts)')
ax1.set_xlabel('Predicted Composer')
ax1.set_ylabel('True Composer')

# Percentage confusion matrix
sns.heatmap(cm_percentage, annot=True, fmt='.1f', cmap='Blues',
            xticklabels=composer_names, yticklabels=composer_names, ax=ax2)
ax2.set_title('Confusion Matrix (Percentages)')
ax2.set_xlabel('Predicted Composer')
ax2.set_ylabel('True Composer')

plt.tight_layout()
plt.show()

# Confidence analysis
print(f"\n    Prediction Confidence Analysis:")
for i, composer in enumerate(composer_names):
    composer_mask = true_classes == i
    if np.any(composer_mask):
        composer_confidences = np.max(predictions_proba[composer_mask],
↪axis=1)
        print(f"        {composer}: Mean confidence = {np.
↪mean(composer_confidences):.3f}")

return test_accuracy

```

```

[85]: from sklearn.utils.class_weight import compute_class_weight
from tensorflow.keras.layers import LSTM, Dense, Dropout, BatchNormalization,
↪Bidirectional
from tensorflow.keras.regularizers import l2
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau,
↪ModelCheckpoint

```

```

[86]: print("Improvements: Longer sequences + Bidirectional + Deeper architecture")
print()

# Step 1: Enhanced feature extraction (200 time steps + new features)
print("Step 1: Enhanced feature extraction...")
X_enhanced, y_enhanced, enhanced_feature_names =
↪extract_enhanced_musical_features(
    balanced_features, max_sequence_length=200
)

# Step 2: Split data (same strategy but with enhanced features)
print(f"\nStep 2: Splitting enhanced dataset...")
X_temp, X_test, y_temp, y_test = train_test_split(

```



```

    X_enhanced, y_enhanced, test_size=0.2, stratify=y_enhanced, random_state=42
)
X_train, X_val, y_train, y_val = train_test_split(
    X_temp, y_temp, test_size=0.25, stratify=y_temp, random_state=42
)

print(f" Training set: {len(X_train)} samples")
print(f" Validation set: {len(X_val)} samples")
print(f" Test set: {len(X_test)} samples")

```

Improvements: Longer sequences + Bidirectional + Deeper architecture

Step 1: Enhanced feature extraction...

ENHANCED FEATURE PREPARATION

Using extended sequence length: 200 time steps

Processing 1600 samples...

Processing sample 0/1600...

Processing sample 200/1600...

Processing sample 400/1600...

Processing sample 600/1600...

Processing sample 800/1600...

Processing sample 1000/1600...

Processing sample 1200/1600...

Processing sample 1400/1600...

Enhanced feature shape: (1600, 200, 4)

Features per time step: 4

Total temporal context: 20.0 seconds

Step 2: Splitting enhanced dataset...

Training set: 960 samples

Validation set: 320 samples

Test set: 320 samples

```

[87]: # Step 3: Normalize features
print(f"\nStep 3: Feature normalization...")
# Reshape for scaling
original_shape_train = X_train.shape
X_train_reshaped = X_train.reshape(-1, X_train.shape[-1])
X_val_reshaped = X_val.reshape(-1, X_val.shape[-1])
X_test_reshaped = X_test.reshape(-1, X_test.shape[-1])

scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train_reshaped)
X_val_scaled = scaler.transform(X_val_reshaped)
X_test_scaled = scaler.transform(X_test_reshaped)

X_train_norm = X_train_scaled.reshape(original_shape_train)

```

```

X_val_norm = X_val_scaled.reshape(X_val.shape)
X_test_norm = X_test_scaled.reshape(X_test.shape)

print(f" Normalized {X_train_norm.shape[-1]} features")

# Step 4: Prepare labels
print(f"\nStep 4: Label preparation...")
label_encoder = LabelEncoder()
y_train_encoded = label_encoder.fit_transform(y_train)
y_val_encoded = label_encoder.transform(y_val)
y_test_encoded = label_encoder.transform(y_test)

num_classes = len(label_encoder.classes_)
y_train_onehot = to_categorical(y_train_encoded, num_classes)
y_val_onehot = to_categorical(y_val_encoded, num_classes)
y_test_onehot = to_categorical(y_test_encoded, num_classes)

print(f" Encoded {num_classes} composers: {list(label_encoder.classes_)}")

# Step 5: Calculate class weights
class_weights = calculate_class_weights(y_train_encoded)

```

Step 3: Feature normalization...
 Normalized 4 features

Step 4: Label preparation...
 Encoded 4 composers: [np.str_('Bach'), np.str_('Beethoven'), np.str_('Chopin'),
 np.str_('Mozart')]
 CLASS WEIGHTS
 Class 0: 1.000
 Class 1: 1.000
 Class 2: 1.000
 Class 3: 1.000

```

[88]: input_shape = (X_train_norm.shape[1], X_train_norm.shape[2]) # (200, 4)
      enhanced_model = build_enhanced_lstm_model(input_shape, num_classes)

```

BUILDING ENHANCED LSTM ARCHITECTURE
 Input shape: (200, 4)
 Architecture: Bidirectional + Deep + Wide
 Model: "sequential_5"

Layer (type)	Output Shape	Param #
bidirectional_lstm_1	(None, 200, 512)	534,528

(Bidirectional)		
batch_normalization_7 (BatchNormalization)	(None , 200, 512)	2,048
dropout_15 (Dropout)	(None , 200, 512)	0
bidirectional_lstm_2 (Bidirectional)	(None , 200, 256)	656,384
batch_normalization_8 (BatchNormalization)	(None , 200, 256)	1,024
dropout_16 (Dropout)	(None , 200, 256)	0
final_lstm (LSTM)	(None , 64)	82,176
dropout_17 (Dropout)	(None , 64)	0
dense_1 (Dense)	(None , 128)	8,320
batch_normalization_9 (BatchNormalization)	(None , 128)	512
dropout_18 (Dropout)	(None , 128)	0
dense_2 (Dense)	(None , 64)	8,256
dropout_19 (Dropout)	(None , 64)	0
composer_output (Dense)	(None , 4)	260

Total params: 1,293,508 (4.93 MB)

Trainable params: 1,291,716 (4.93 MB)

Non-trainable params: 1,792 (7.00 KB)

```
[89]: # Step 7: Train enhanced model
print(f"\nStep 7: Training enhanced model...")
trained_model, training_history = train_enhanced_model(
    enhanced_model, X_train_norm, y_train_onehot,
    X_val_norm, y_val_onehot, class_weights
)
```

```

# Step 8: Enhanced evaluation
test_accuracy = enhanced_evaluation(
    trained_model, X_test_norm, y_test_onehot, label_encoder
)

# Step 9: Plot training history
print(f"\nStep 9: Training analysis...")
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12, 4))

ax1.plot(training_history.history['accuracy'], label='Training Accuracy',
         ↪alpha=0.8)
ax1.plot(training_history.history['val_accuracy'], label='Validation Accuracy',
         ↪alpha=0.8)
ax1.set_title('Enhanced Model Accuracy')
ax1.set_xlabel('Epoch')
ax1.set_ylabel('Accuracy')
ax1.legend()
ax1.grid(True, alpha=0.3)

ax2.plot(training_history.history['loss'], label='Training Loss', alpha=0.8)
ax2.plot(training_history.history['val_loss'], label='Validation Loss', alpha=0.
         ↪8)
ax2.set_title('Enhanced Model Loss')
ax2.set_xlabel('Epoch')
ax2.set_ylabel('Loss')
ax2.legend()
ax2.grid(True, alpha=0.3)

plt.tight_layout()
plt.show()

```

Step 7: Training enhanced model...

ENHANCED TRAINING PROTOCOL

Training samples: 960

Validation samples: 320

Enhanced callbacks: Early stopping + LR reduction + Model checkpointing

Epoch 1/20

15/15 0s 2s/step -

accuracy: 0.2668 - loss: 3.2385

Epoch 1: val_accuracy improved from -inf to 0.40625, saving model to
best_composer_model.h5

WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or
`keras.saving.save_model(model)`. This file format is considered legacy. We
recommend using instead the native Keras format, e.g.

`model.save('my_model.keras')` or `keras.saving.save_model(model,

'my_model.keras'))`.

```
15/15          48s 2s/step -
accuracy: 0.2683 - loss: 3.2352 - val_accuracy: 0.4062 - val_loss: 2.8122 -
learning_rate: 0.0010
Epoch 2/20
15/15          0s 2s/step -
accuracy: 0.3441 - loss: 3.0477
Epoch 2: val_accuracy did not improve from 0.40625
15/15          38s 2s/step -
accuracy: 0.3429 - loss: 3.0486 - val_accuracy: 0.3625 - val_loss: 2.7966 -
learning_rate: 0.0010
Epoch 3/20
15/15          0s 2s/step -
accuracy: 0.3223 - loss: 2.9986
Epoch 3: val_accuracy did not improve from 0.40625
15/15          39s 2s/step -
accuracy: 0.3223 - loss: 2.9983 - val_accuracy: 0.3438 - val_loss: 2.7718 -
learning_rate: 0.0010
Epoch 4/20
15/15          0s 2s/step -
accuracy: 0.3222 - loss: 3.0071
Epoch 4: val_accuracy did not improve from 0.40625
15/15          41s 2s/step -
accuracy: 0.3226 - loss: 3.0045 - val_accuracy: 0.3812 - val_loss: 2.7440 -
learning_rate: 0.0010
Epoch 5/20
15/15          0s 2s/step -
accuracy: 0.3546 - loss: 2.8737
Epoch 5: val_accuracy did not improve from 0.40625
15/15          43s 2s/step -
accuracy: 0.3538 - loss: 2.8746 - val_accuracy: 0.3187 - val_loss: 2.7397 -
learning_rate: 0.0010
Epoch 6/20
15/15          0s 2s/step -
accuracy: 0.3081 - loss: 2.9277
Epoch 6: val_accuracy did not improve from 0.40625
15/15          40s 2s/step -
accuracy: 0.3092 - loss: 2.9246 - val_accuracy: 0.3781 - val_loss: 2.7167 -
learning_rate: 0.0010
Epoch 7/20
15/15          0s 2s/step -
accuracy: 0.3287 - loss: 2.8821
Epoch 7: val_accuracy did not improve from 0.40625
15/15          31s 2s/step -
accuracy: 0.3287 - loss: 2.8813 - val_accuracy: 0.3875 - val_loss: 2.6908 -
learning_rate: 0.0010
Epoch 8/20
```

```

15/15          0s 2s/step -
accuracy: 0.3438 - loss: 2.7882
Epoch 8: val_accuracy did not improve from 0.40625
15/15          40s 2s/step -
accuracy: 0.3431 - loss: 2.7885 - val_accuracy: 0.3906 - val_loss: 2.6682 -
learning_rate: 0.0010
Epoch 9/20
15/15          0s 2s/step -
accuracy: 0.3536 - loss: 2.7663
Epoch 9: val_accuracy did not improve from 0.40625
15/15          30s 2s/step -
accuracy: 0.3529 - loss: 2.7659 - val_accuracy: 0.3781 - val_loss: 2.6827 -
learning_rate: 0.0010
Epoch 10/20
15/15          0s 2s/step -
accuracy: 0.3588 - loss: 2.7170
Epoch 10: val_accuracy did not improve from 0.40625
15/15          41s 2s/step -
accuracy: 0.3580 - loss: 2.7172 - val_accuracy: 0.2875 - val_loss: 2.7589 -
learning_rate: 0.0010
Epoch 11/20
15/15          0s 2s/step -
accuracy: 0.3603 - loss: 2.7164
Epoch 11: val_accuracy did not improve from 0.40625
15/15          42s 2s/step -
accuracy: 0.3594 - loss: 2.7164 - val_accuracy: 0.2688 - val_loss: 2.7421 -
learning_rate: 0.0010
Epoch 12/20
15/15          0s 2s/step -
accuracy: 0.3448 - loss: 2.6867
Epoch 12: val_accuracy did not improve from 0.40625
15/15          40s 2s/step -
accuracy: 0.3451 - loss: 2.6852 - val_accuracy: 0.3250 - val_loss: 2.5802 -
learning_rate: 0.0010
Epoch 13/20
15/15          0s 2s/step -
accuracy: 0.3631 - loss: 2.6613
Epoch 13: val_accuracy did not improve from 0.40625
15/15          41s 2s/step -
accuracy: 0.3637 - loss: 2.6611 - val_accuracy: 0.3562 - val_loss: 2.5567 -
learning_rate: 0.0010
Epoch 14/20
15/15          0s 2s/step -
accuracy: 0.3341 - loss: 2.6270
Epoch 14: val_accuracy did not improve from 0.40625
15/15          41s 2s/step -
accuracy: 0.3340 - loss: 2.6269 - val_accuracy: 0.3969 - val_loss: 2.5328 -
learning_rate: 0.0010

```

```

Epoch 15/20
15/15          0s 2s/step -
accuracy: 0.4054 - loss: 2.5637
Epoch 15: val_accuracy did not improve from 0.40625
15/15          42s 2s/step -
accuracy: 0.4045 - loss: 2.5645 - val_accuracy: 0.4031 - val_loss: 2.5112 -
learning_rate: 0.0010
Epoch 16/20
15/15          0s 2s/step -
accuracy: 0.3876 - loss: 2.5795
Epoch 16: val_accuracy did not improve from 0.40625
15/15          38s 2s/step -
accuracy: 0.3860 - loss: 2.5812 - val_accuracy: 0.3344 - val_loss: 2.5467 -
learning_rate: 0.0010
Epoch 17/20
15/15          0s 2s/step -
accuracy: 0.3203 - loss: 2.6005
Epoch 17: val_accuracy did not improve from 0.40625
15/15          31s 2s/step -
accuracy: 0.3205 - loss: 2.5996 - val_accuracy: 0.3656 - val_loss: 2.4857 -
learning_rate: 0.0010
Epoch 18/20
15/15          0s 2s/step -
accuracy: 0.3388 - loss: 2.5841
Epoch 18: val_accuracy improved from 0.40625 to 0.42500, saving model to
best_composer_model.h5

WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or
`keras.saving.save_model(model)`. This file format is considered legacy. We
recommend using instead the native Keras format, e.g.
`model.save('my_model.keras')` or `keras.saving.save_model(model,
'my_model.keras')`.

15/15          28s 2s/step -
accuracy: 0.3393 - loss: 2.5818 - val_accuracy: 0.4250 - val_loss: 2.4389 -
learning_rate: 0.0010
Epoch 19/20
15/15          0s 2s/step -
accuracy: 0.3594 - loss: 2.5199
Epoch 19: val_accuracy improved from 0.42500 to 0.43750, saving model to
best_composer_model.h5

WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or
`keras.saving.save_model(model)`. This file format is considered legacy. We
recommend using instead the native Keras format, e.g.
`model.save('my_model.keras')` or `keras.saving.save_model(model,
'my_model.keras')`.

15/15          28s 2s/step -
accuracy: 0.3587 - loss: 2.5206 - val_accuracy: 0.4375 - val_loss: 2.4353 -

```

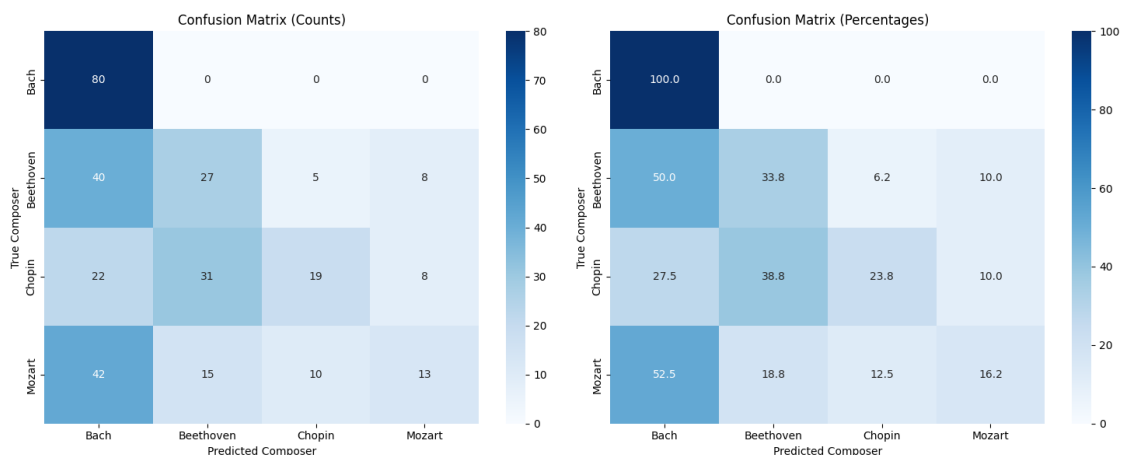
```

learning_rate: 0.0010
Epoch 20/20
15/15          0s 2s/step -
accuracy: 0.3375 - loss: 2.4985
Epoch 20: val_accuracy did not improve from 0.43750
15/15          42s 2s/step -
accuracy: 0.3374 - loss: 2.5000 - val_accuracy: 0.4281 - val_loss: 2.3943 -
learning_rate: 0.0010
Restoring model weights from the end of the best epoch: 19.
Training completed!
Best validation accuracy: 0.4375
ENHANCED MODEL EVALUATION
10/10          8s 608ms/step
Test Accuracy: 0.4344 (43.44%)

```

Detailed Performance by Composer:

	precision	recall	f1-score	support
Bach	0.4348	1.0000	0.6061	80
Beethoven	0.3699	0.3375	0.3529	80
Chopin	0.5588	0.2375	0.3333	80
Mozart	0.4483	0.1625	0.2385	80
accuracy			0.4344	320
macro avg	0.4529	0.4344	0.3827	320
weighted avg	0.4529	0.4344	0.3827	320



Prediction Confidence Analysis:

```

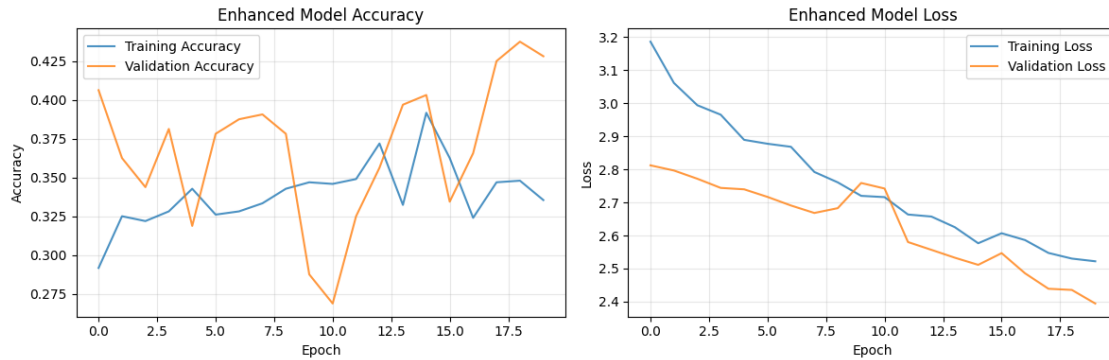
Bach: Mean confidence = 0.422
Beethoven: Mean confidence = 0.381

```


Chopin: Mean confidence = 0.378

Mozart: Mean confidence = 0.367

Step 9: Training analysis...



5 Composer Classification Using Deep Learning

5.1 Project Overview

The music of **Bach**, **Beethoven**, **Chopin**, and **Mozart** represents some of the most famous and most studied works in music history. In this project, our team explored the application of **deep learning** techniques to accurately identify the composer of a given musical piece.

We implemented and evaluated **Long Short-Term Memory (LSTM)** networks and **Convolutional Neural Networks (CNN)**, aiming to leverage both temporal and spatial patterns in symbolic music data. Our goal was to assess how well these architectures can classify classical music compositions by composer.

5.2 Methodology

1. Data Preparation

- Collected .mid files for the four composers.
- Cleaned filenames to remove spaces and punctuation (keeping the .mid extension).
- Converted MIDI sequences into numerical arrays for model input.

2. Models Implemented

- **CNN Model:** Captures local sequential patterns in encoded music.
- **LSTM Model 1 & LSTM Model 2:** Models temporal dependencies directly.

- **Multiple Runs:** To evaluate stability and performance consistency.

3. Evaluation

- **Test Accuracy** as the main metric.
 - **Confusion Matrices** to analyze per-class performance.
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5.3 CNN Model

Run 1

- Test Accuracy: **75.17%**
- Confusion Matrix:

Per-Class Analysis:

- **Mozart**: 24 correct; often confused with Bach (15) and Beethoven (5).
- **Chopin**: Only 3 correct — heavily misclassified as Beethoven (12) and Mozart (8).
- **Beethoven**: 26 correct; some confusion with Mozart (9) and Bach (6).
- **Bach**: 165 correct; minimal confusion, highly distinctive.

Observation: Chopin is the weakest-performing class here, showing significant confusion with Beethoven and Mozart. Bach stands out as the most consistently recognized composer.

Run 2

- Test Accuracy: **71.19%**
- Confusion Matrix:

Per-Class Analysis:

- **Mozart**: 83 correct; major confusion with Beethoven (63) and minor confusion with Chopin (14).
- **Chopin**: 158 correct — massive improvement over Run 1, much less misclassification.
- **Beethoven**: 108 correct; still confused with Chopin (35) and Mozart (20).
- **Bach**: 155 correct; small confusion with Beethoven (9) and Mozart (11).

Observation: Chopin accuracy improved dramatically compared to Run 1, but Mozart-Beethoven confusion increased. Bach remains strong.

5.3.1 CNN Confusion Matrix Insights

1. **Bach Consistency** – Bach’s works are consistently the easiest to classify, likely due to distinctive baroque characteristics such as counterpoint-heavy structure.
2. **Mozart-Beethoven Overlap** – Both runs show frequent confusion between Mozart and Beethoven, reflecting their shared classical period stylistic features.
3. **Chopin Variability** – In Run 1, Chopin accuracy collapsed, with the majority of samples misclassified. In Run 2, Chopin became one of the strongest classes, suggesting sensitivity to

training variability or class imbalance handling.

4. **CNN Strength** – CNN models capture distinctive motif-level patterns better than LSTM-only models, but inter-class stylistic overlaps remain a challenge.
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5.4 LSTM Model

LSTM Model 1

- Test Accuracy: **45.31%**
- Confusion Matrix:

Per-Class Analysis:

- **Bach**: 70 correct; highly distinctive with minimal confusion (only 1 Beethoven, 2 Chopin, 7 Mozart misclassifications).
- **Beethoven**: 34 correct; substantial misclassification into Bach (26) and Mozart (15).
- **Chopin**: 49 correct; misclassified into Bach (21) and Mozart (7).
- **Mozart**: 21 correct; large confusion with Bach (31) and Chopin (24).

Observation: Bach recognition remains strong, but all other composers suffer from high misclassification rates. Mozart is particularly problematic, often mistaken for Bach and Chopin.

LSTM Model 2

- Test Accuracy: **43.44%**
- Confusion Matrix:

Per-Class Analysis:

- **Bach**: 80 correct; perfect class-level precision in this run (0 misclassified as other composers).
- **Beethoven**: 27 correct; large confusion with Bach (40) and Mozart (8).
- **Chopin**: 19 correct; confusion with Beethoven (31) and Bach (22).
- **Mozart**: 13 correct; heavily misclassified as Bach (42) and Beethoven (15).

Observation: Bach classification reaches 100% in this run, but Mozart, Chopin, and Beethoven show severe misclassification patterns, especially Mozart into Bach.

5.4.1 LSTM Confusion Matrix Insights

1. **Bach Dominance** – Bach consistently achieves the highest correct classification rate in both LSTM runs, even reaching perfect classification in LSTM Model 2.
2. **Mozart Vulnerability** – Mozart is frequently misclassified, especially into Bach, reflecting a weakness in how the LSTM captures its stylistic nuances.

3. **Beethoven-Chopin Confusion** – Strong bidirectional confusion between Beethoven and Chopin appears in both runs, suggesting overlapping harmonic and rhythmic features.
 4. **LSTM Weakness** – Without prior feature extraction (e.g., CNN layers), the LSTM struggles to distinguish between stylistically similar composers, leading to much lower accuracy compared to CNN runs.
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5.5 Overall Comparison and Key Takeaways

- **Accuracy:** CNN outperforms LSTM significantly, with ~71–75% vs. ~43–45%.
 - **Class Stability:** Bach is strong in all runs; Chopin is unstable in CNN runs but weak in LSTM runs; Mozart often overlaps with Beethoven.
 - **Feature Learning:** CNN’s local pattern detection gives it an advantage over LSTM’s purely sequential modeling in this dataset.
 - **Future Potential:** A hybrid CNN-LSTM approach could combine the strengths of both, improving long-term dependency modeling while retaining motif-level feature extraction.
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5.6 Future Enhancements

- **Hybrid CNN-LSTM Model** – Combine CNN feature extraction with LSTM sequence modeling.
 - **Data Augmentation** – Apply pitch transposition, rhythm changes, and ornamentation variations to improve generalization.
 - **Transformer Architectures** – Explore models like Music Transformer for long-range dependencies.
 - **Additional Feature Engineering** – Add harmonic, melodic, and rhythmic descriptors alongside raw encodings.
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5.7 Conclusion

CNN-based models achieved higher accuracy than LSTM-only architectures in composer classification. Bach was consistently recognized across all runs, but Mozart-Beethoven confusion persisted, and Chopin showed high variability in performance. Future work should explore **hybrid CNN-LSTM** and **transformer-based architectures** for improved robustness and accuracy.

5.8 Disclaimer

This project utilized **Visual Studio Code’s built-in coding capabilities** for code implementation and debugging.

Additionally, **ChatGPT-5** was used to assist in drafting summaries, refining result descriptions, proofreading text, and structuring the final report.