University of Florida
CAP6610 – Spring 2024

Machine Learning Project
# Progressive Rock vs Non-Progressive Rock classification

**Report by Lightbulb Sun**

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# 1 Introduction

The project's primary goal is binary classification of songs into Prog rock vs non prog rock using PyTorch, while emphasizing efficient data handling, preprocessing, and model training. Our methodology utilizes PyTorch's DataLoader for streamlined data management, converting audio inputs into Mel-spectrograms, and enhancing model performance with batch normalization, dropout, and regularization techniques. Audio classification is integral in various fields like speech recognition, music genre classification, and environmental sound analysis.

# 2 Data Augmentation

Upon loading the dataset using Torch, we resampled all audio files to a 22050 Hz sample rate and proceeded to mix down all audio channels to a mono channel. Subsequently, we deliberated on the selection of features. The choice of features for classifying songs hinges upon the specific requirements of the classification task and the characteristics of the songs under analysis.
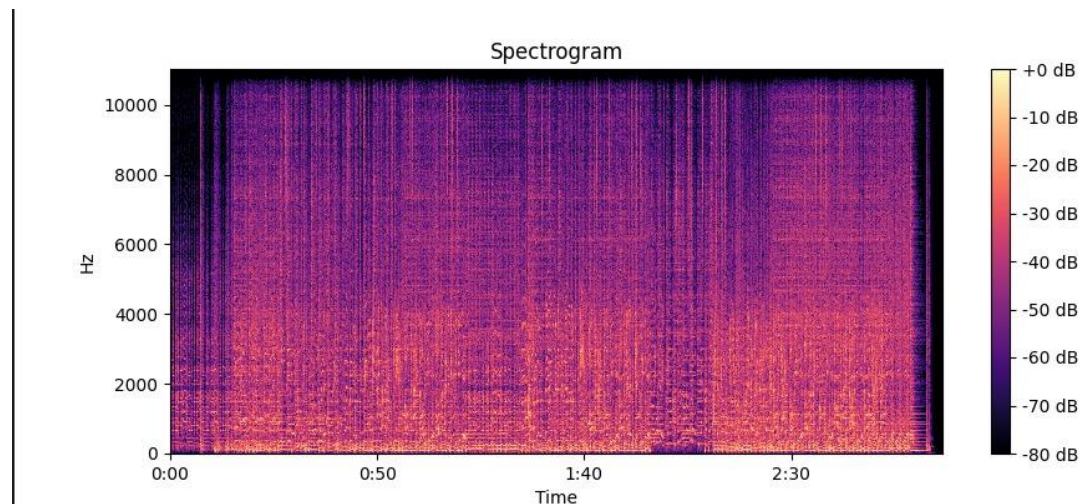


Fig 2.0: Spectrogram obtained for the song: Alice Cooper No More Mr. Nice Guy.mp3

## 2.1 Chromogram

Chromograms delineate the energy distribution of various pitches in a musical piece over time. They find utility in tasks where pitch content holds significance, such as melody recognition or chord estimation.
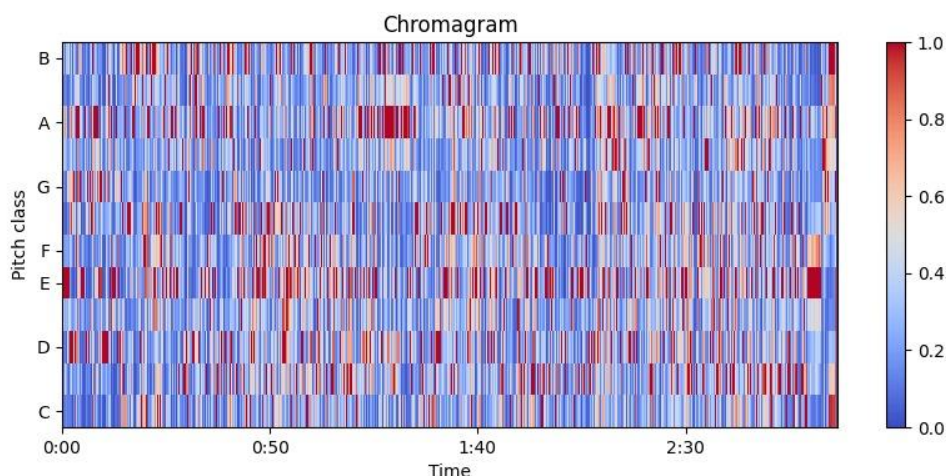


Fig 2.1: Chromogram of a random song

## 2.2 Onset Strength

Onset strength signifies the presence and intensity of musical onsets, abrupt increases in energy marking the inception of musical events like notes or beats. Onset strength proves valuable for tasks involving rhythm analysis, beat tracking, or musical segmentation.
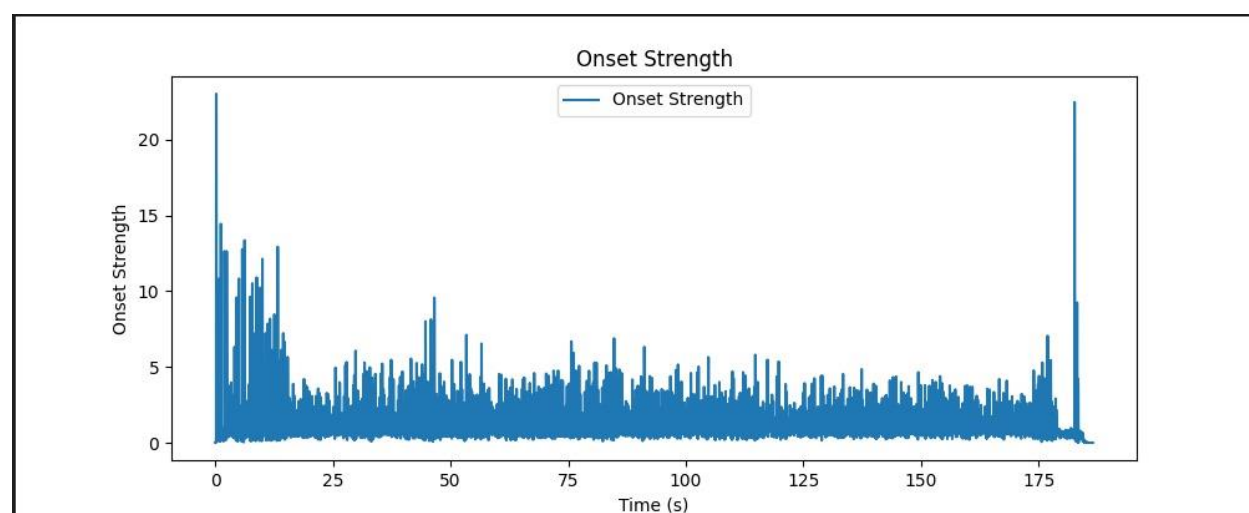


Fig 2.2: Onset Strength

## 2.3 MFCC (Mel-frequency cepstral coefficients)

MFCCs find common applications in speech and audio processing tasks. They encapsulate the spectral characteristics of audio signals, with a particular focus on frequency bands most pertinent to human auditory perception. MFCCs serve well in tasks like speech recognition, sound classification, or music genre classification.

**2.4 Mel Spectrogram**

A Mel spectrogram visually represents the frequency content of an audio signal over time, with the frequency axis scaled according to the mel scale, approximating human auditory perception. Mel spectrograms exhibit versatility and find utility in various tasks such as speech recognition, music genre classification, or sound event detection.
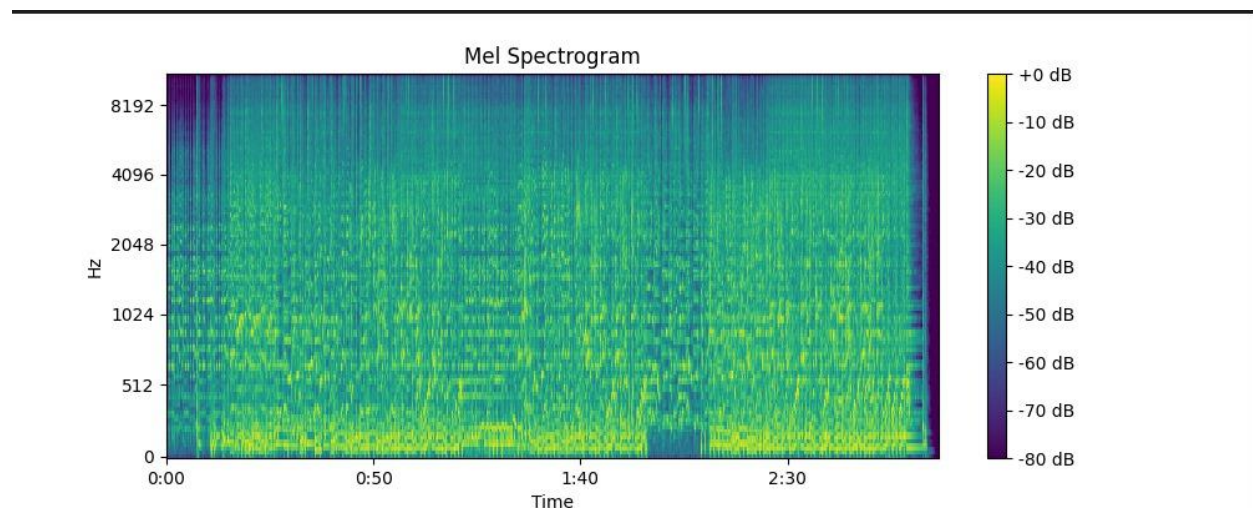


Fig 2.3: Mel Spectrogram for a random song.

The selection among these features hinges on the specific objectives of the song classification task:

- If the aim is to classify songs based on their melodic content or harmony, chromograms might prove more pertinent.
- If rhythm or beat-related features are paramount, onset strength could emerge as a better choice.
- If the focus lies on general audio characteristics, such as timbre and texture, MFCCs or Mel spectrograms might be more apt.

Following an assessment of the outputs while utilizing chromogram, onset strength, MFCC, and Mel spectrogram, we opted to proceed with the Mel spectrogram feature. We extracted the Mel spectrogram from the audio signal of the entire song and saved

the resulting tensor on disk. Subsequently, we partitioned the song into 10-second chunks. This segmentation aims to ensure uniform and evenly distributed data for Non-Prog and Prog classifications whilst also creating more instances for training. We chose 10 seconds as it provides an adequate amount of essential data for training the model to identify songs. The rationale behind this decision is that humans typically require only 10 seconds to recognize a song, thus justifying the chunk size. To conserve time and computational resources, instead of generating a Mel spectrogram for each 10-second chunk, we computed the spectrogram for the entire song and subsequently segmented the data into 10-second chunks. Wherever necessary, we implemented the right padding to maintain consistency in our dataset. With these steps completed, the data set is now prepared for further analysis.

## 3 Data Loading

Utilizing PyTorch's DataLoader module, the project streamlines the process of loading the dataset efficiently. By implementing a mapping and retrieval mechanism using dictionaries, the data loading process becomes more manageable and resource efficient. We then create mini batches of size 20. The use of mini batches can lead to more efficient and effective training of deep learning models, enabling faster convergence, better generalization, and improved memory efficiency. Choosing a batch size of 20 for creating mini batches combines computational efficiency, stability in gradient estimation, memory efficiency, regularization benefits, and balanced training dynamics, making it a commonly used choice in deep learning practice.

## 4 Data Splitting

The dataset is split into training and validation with a ratio of 70:30. The 70:30 ratio for splitting a dataset into training and validation sets provides a good balance between training and evaluation, ensuring that the model is trained effectively while also enabling robust performance assessment.

## 5 Model

In the pursuit of achieving accurate binary classification of Progressive Rock songs versus Non-Progressive Rock songs, several machine learning models were considered and evaluated. The decision to adopt a convolutional neural network

(CNN) stemmed from its proven efficacy in handling complex audio data and its ability to capture hierarchical features effectively. The model selection process was guided by the dataset's characteristics and the desired outcome of achieving high classification accuracy while mitigating overfitting.

## 5.1 Dataset Characteristics

The audio dataset, transformed into Mel-spectrograms and segmented into 10-second segments, required a model capable of processing multidimensional data efficiently. CNNs are well-suited for this task due to their ability to capture spatial patterns inherent in images, making them ideal for analyzing spectrogram representations.

## 5.2 Complexity and Hierarchical Features

Progressive Rock songs often exhibit intricate compositions and unconventional structures, necessitating a model capable of capturing hierarchical features across multiple layers. CNNs, with their hierarchical feature extraction capabilities through convolutional and pooling layers, are adept at discerning abstract patterns within audio data.

## 5.3 Overfitting Mitigation

To prevent overfitting, dropout regularization and batch normalization techniques were incorporated into both convolutional and fully connected layers. Dropout helps to randomly deactivate neurons during training, preventing co-adaptation of feature detectors and improving model generalization. Batch normalization maintains stable gradients by normalizing activations, thereby accelerating training and reducing the risk of overfitting.

## 5.4 Model Flexibility and Non-Linearity

The choice of Rectified Linear Unit (ReLU) activation function across all layers facilitated faster convergence and improved the model's ability to capture non-linear relationships within the data. ReLU's simplicity and effectiveness in mitigating the vanishing gradient problem contributed to its selection.

## 5.5 Early Stopping

Early stopping helps prevent overfitting by ensuring that the model does not continue to learn complex patterns from the training data that do not generalize well to unseen

data. It allows the model to stop training at an optimal point, balancing between capturing useful patterns in the data and avoiding overfitting. Additionally, early stopping can lead to shorter training times and improved computational efficiency by avoiding unnecessary epochs of training. In the model proposed, the patience parameter is set to 4.

## 5.6 Model Architecture Description

### 5.6.1 Architecture Overview

Our model is a convolutional neural network (CNN) comprising four convolutional layers and five fully connected layers, designed to effectively process complex audio data.

### 5.6.2 Convolution Layers

Dropout is implemented in the convolution layers with a retention probability for hidden units set at p = [0.9, 0.8, 0.75, 0.75] as we progress deeper into the network to prevent overfitting. The network performs 2D convolutions using a kernel size of 5 with padding of 2. The number of output channels increases across layers: 16, 32, 64, and 128, respectively, to capture increasingly abstract features.

### 5.6.3 Activation Function

The ReLU (Rectified Linear Unit) function is utilized as the non-linearity choice for all convolutional and fully connected layers, facilitating faster and more effective training.

### 5.6.4 Batch Normalization

To address issues like vanishing or exploding gradients, batch normalization is applied across both convolutional and fully connected layers.

### 5.6.5 Pooling Layer

Max pooling is used with a kernel size of 2 to reduce the spatial dimensions of the tensor by half, efficiently downsizing the data for quicker processing.

### 5.6.6 Flattening

Post pooling, tensors are flattened, resulting in dimensions suitable for the fully connected layers, specifically [batch_size, 1, 128×8×26].

### 5.6.7 Fully Connected Layers

Like the convolutional layers, dropout is employed with the retention probabilities set at p [0.5, 0.5, 0.5, 0.5, 0.5] to reduce overfitting.

Batch normalization is consistently used here to maintain the stability of the learning process.

### 5.6.8 Output Layer

The final layer uses a sigmoid activation function to output a probability, indicating the likelihood of a song being classified as Progressive Rock.

By leveraging these considerations, the CNN architecture was meticulously designed to strike a balance between model complexity and generalization capability. The architectural choices aimed to optimize classification performance while minimizing the risk of overfitting, thereby ensuring robust model performance on unseen data.

Convolutional layer 1:
128 x 431 ; chanels : 1

Convolutional layer 2:
64 x 215 ; chanels : 16

Convolutional layer 3:
32 x 107 ; chanels : 32

Convolutional layer 4:
16 x 53 ; chanels : 64

Flattening:
8 x 26 ; chanels : 128

FC layer 1: 26624 to 10000

FC layer 2: 10000 to 3000

FC layer 3: 3000 to 1000

FC layer 4: 1000 to 256

FC layer 5: 256 to 10

output layer: 10 to 1

Dropout layers

Convolutional + ReLU

Batch Normalization

Max pooling layer

Flattening layer

Fully Connected Linear layer
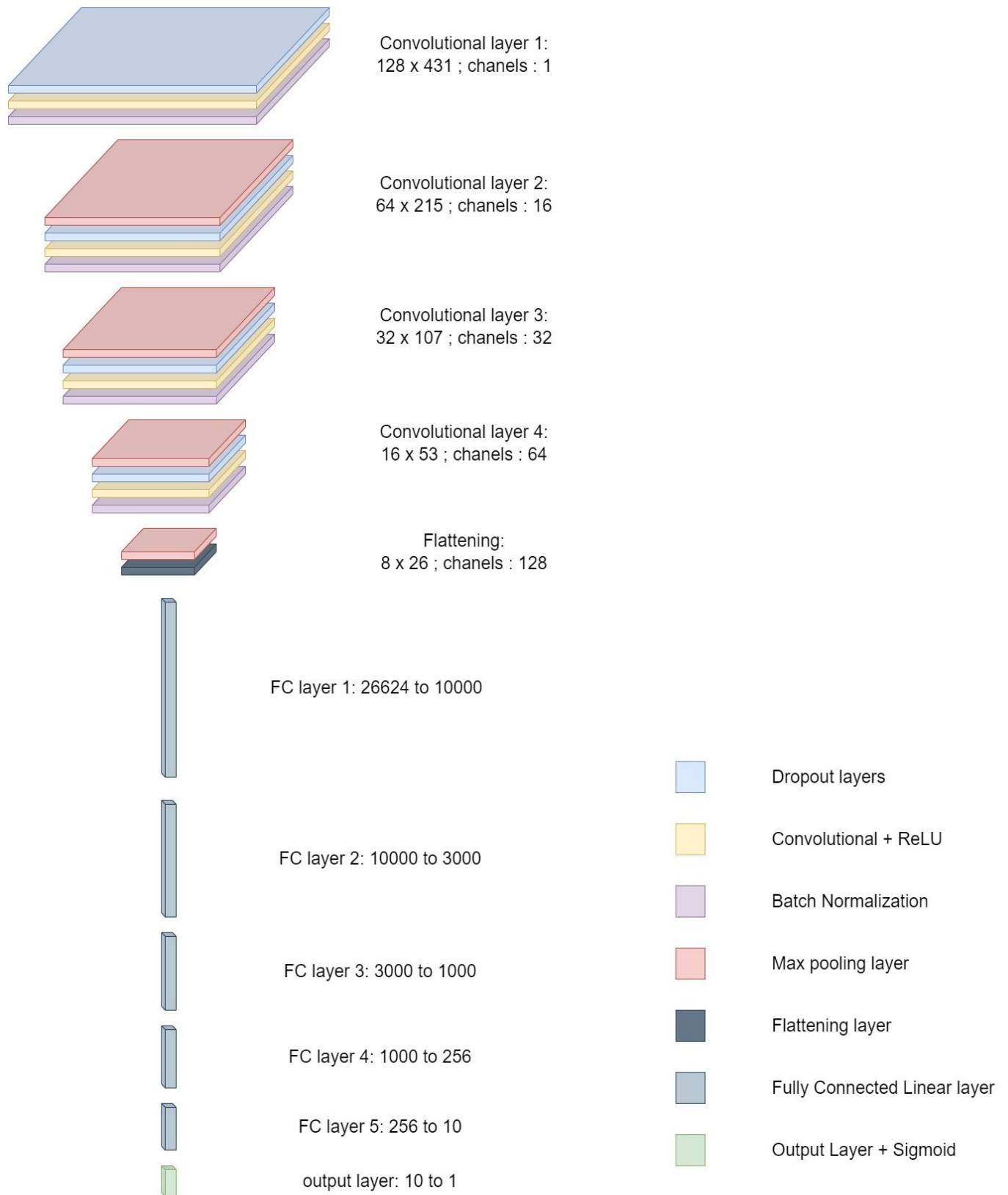
Output Layer + Sigmoid

Fig 5.1: Architecture of the Model

## 5.7 Experimentation:

During the development of our project, we conducted various experiments and made several observations:

### 5.7.1 Batch Normalization:

Initially, our model did not show significant learning from the training dataset. Upon implementing batch normalization, however, we observed a marked improvement in the model's ability to learn from the training data.

### 5.7.2 Dropout:

Following the implementation of batch normalization, we encountered overfitting issues. To address this, we introduced Dropout layers in both the fully connected and convolutional layers. Inspired by Hinton and Srivastava's study on Dropout, we observed a notable decrease in overfitting after incorporating this technique into our model.

### 5.7.3 Optimizer:

We initially utilized the ADAM optimizer but noticed overfitting tendencies. To mitigate this, we transitioned to ADAMW, a variation of ADAM that includes a parameter for weight decay. This addition helped alleviate overfitting and slightly enhanced the model's performance on the validation dataset.

### 5.7.4 Max Norm:

While the inclusion of Max Norm, alongside Dropout, has been shown to significantly improve model performance in some studies, its implementation in our case resulted in only minimal performance gains.

### 5.7.5 Hyperparameter Tuning:

Efforts to perform hyperparameter tuning using grid search and randomized search were limited by computational power constraints. Nevertheless, we experimented with various hyperparameters individually:

Learning Rate: We tested two learning rates (0.003 and 0.0003) and found that a learning rate of 0.003 performed slightly better for our model.

Batch Size: Exploring batch sizes of 20, 40, and 60 revealed that a batch size of 20 yielded the best performance, with larger batch sizes leading to significant overfitting.

Epochs: Through experimentation, we determined that the optimal model was consistently found within the epoch range of 15 to 20.

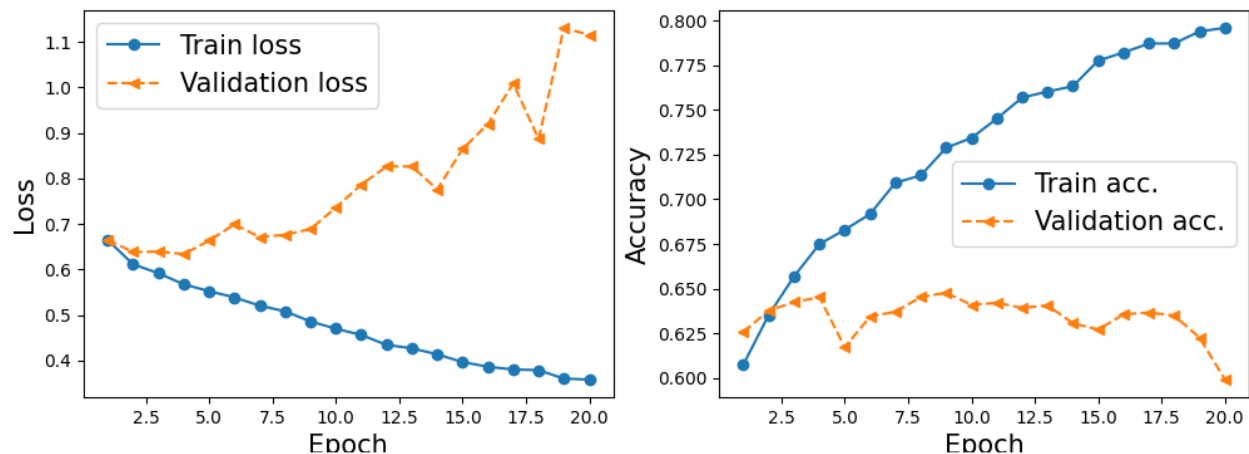Layers: Decreasing the number of convolution layers from 4 to 2 resulted in severe overfitting.



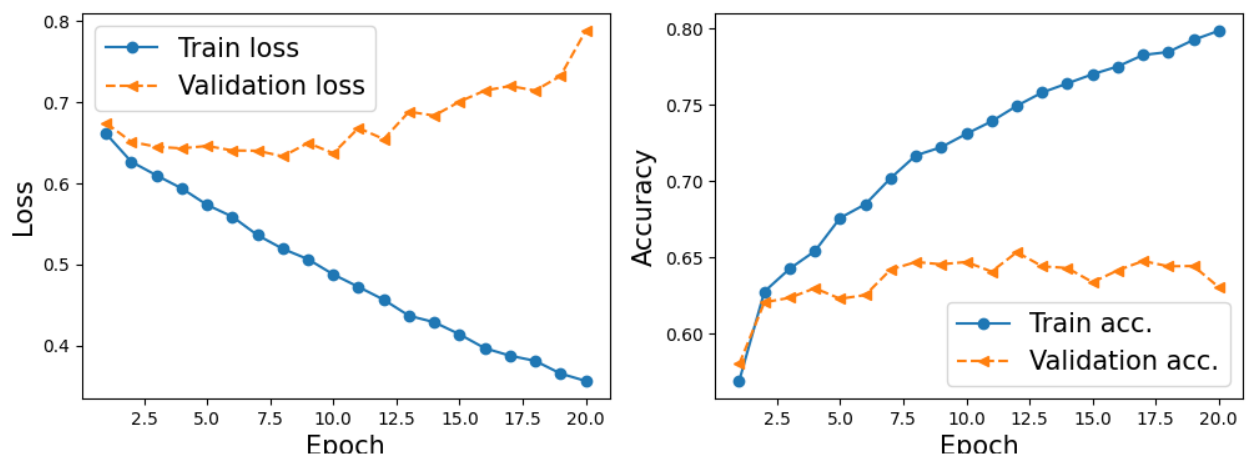Fig 5.2: Results achieved with two 2-D Convolutional layers.



Fig 5.3: four 2-D Convolutional layers with Learning rate 0.0003.
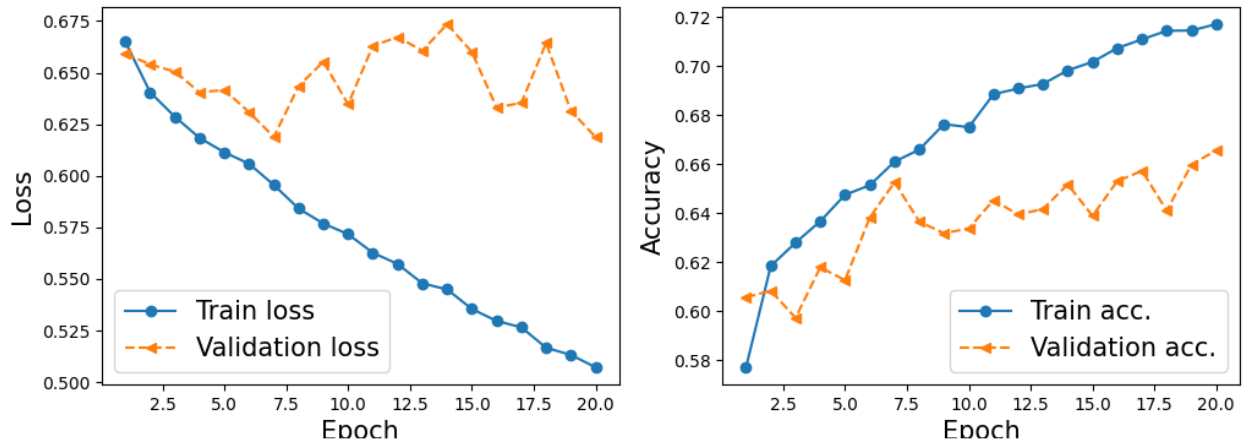
Fig 5.4: four 2-D Convolutional layers with Learning rate 0.003
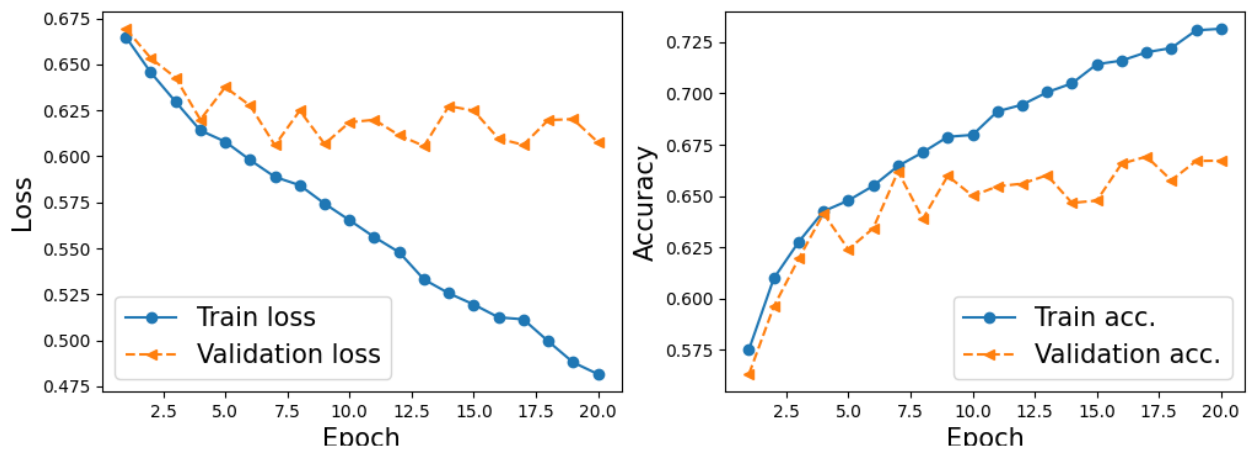

Fig 5.5: four 2-D Convolutional with Learning rate 0.003. (best so far)
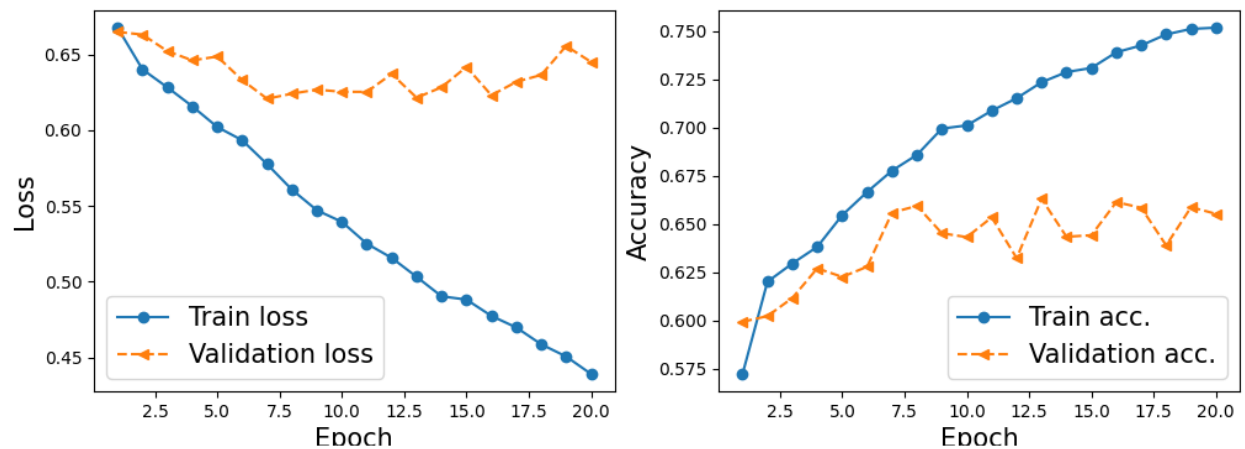

Fig 5.6: 2-D Convolutional with weight decay

### 5.7.6 1-D Convolutional Model with New Dataset:

We attempted to enhance our model by incorporating a new dataset that merged MFCC's first 13 bins, chromogram's 12 bins, 64 channels of Mel-spectrogram, and onset strength data. However, the 1-D CNN model constructed using this dataset exhibited significant overfitting, necessitating the addition of Dropout layers to alleviate the issue. Despite this adjustment, the performance of the 1-D Convolutional Model did not surpass that of the proposed model.
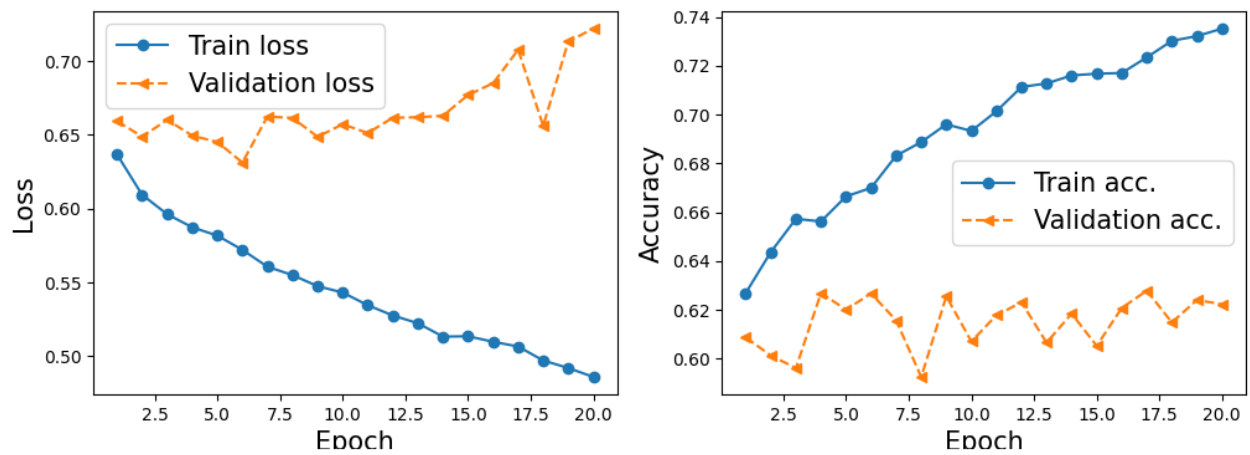


Fig 5.7: 1-D convolution with Dropout and learning rate 0.0003.
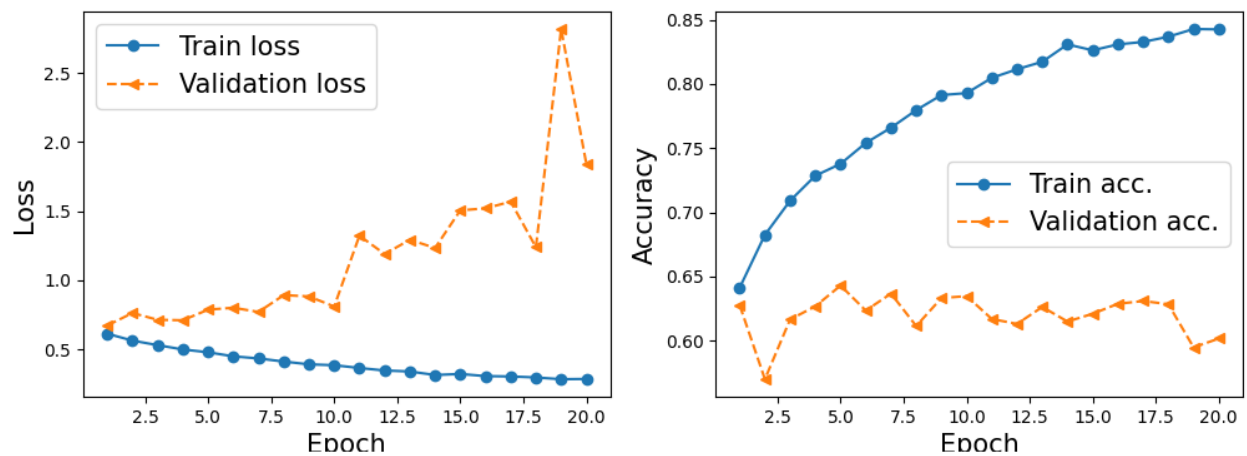


Fig 5.8: 1-D Convolution without Dropout and Learning rate 0.0003.

### 5.7.7 2-D Convolutional Model with New Dataset:

Similarly, when applying the proposed model to the newly merged dataset, we observed severe overfitting starting at the 17th epoch. Additionally, this model's performance significantly lagged that of the proposed model using the original dataset.
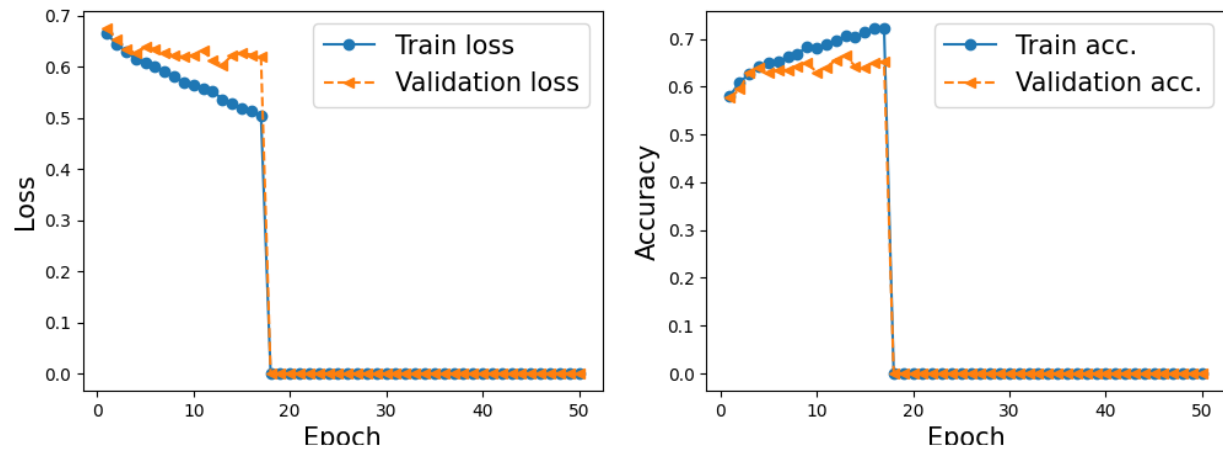


Fig 5.9: 2-D Convolutional with old dataset, learning rate is 0.003, no max norm and weight decay.
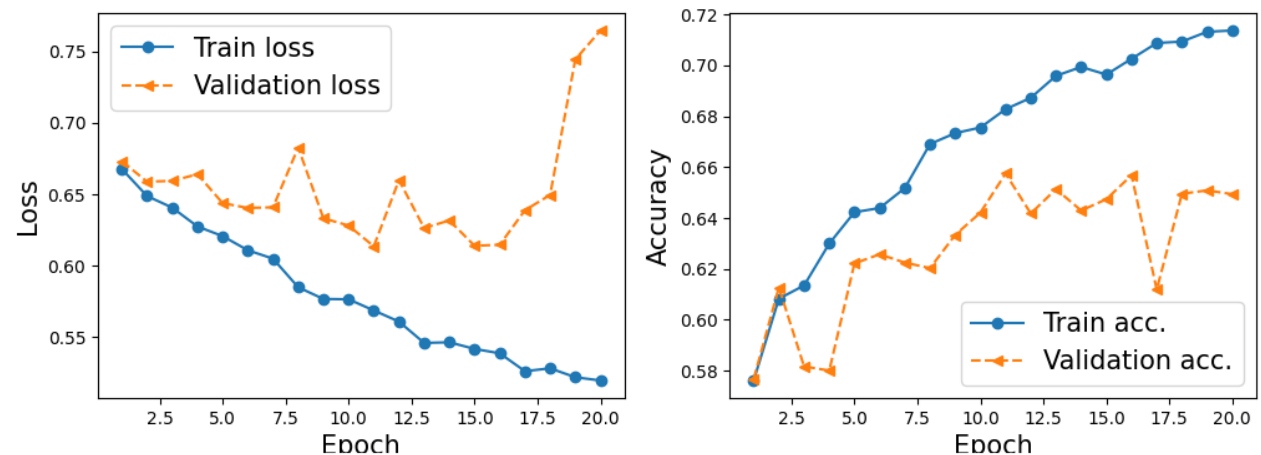


Fig 5.10: 2-D Convolutional with new dataset with Learning rate 0.003.

## 5.8 Winner Take All for classifying the song

Following training, if over half of the 10-second segments attributed to a particular song share the same category, then the song is classified into that category as well.

# 6 Result

## 6.1 Training and Validation:

Throughout the training phase, our model exhibited good learning capabilities, consistently converging towards optimal performance. Across multiple epochs, the model demonstrated a gradual reduction in training loss, indicative of effective learning and parameter optimization. The incorporation of batch normalization and dropout regularization techniques played pivotal roles in mitigating overfitting tendencies, ensuring the model's generalization capabilities were preserved. Moreover, early stopping mechanisms prevented the model from overlearning on the training data, striking a delicate balance between learning complex patterns and preventing overfitting.

During the validation phase, the model's performance was consistently assessed on unseen data to gauge its ability to generalize to new instances. Across various validation runs, our model consistently maintained good accuracy and robustness, underscoring its efficacy in accurately classifying songs into their respective categories. Notably, the model showcased resilience against overfitting.
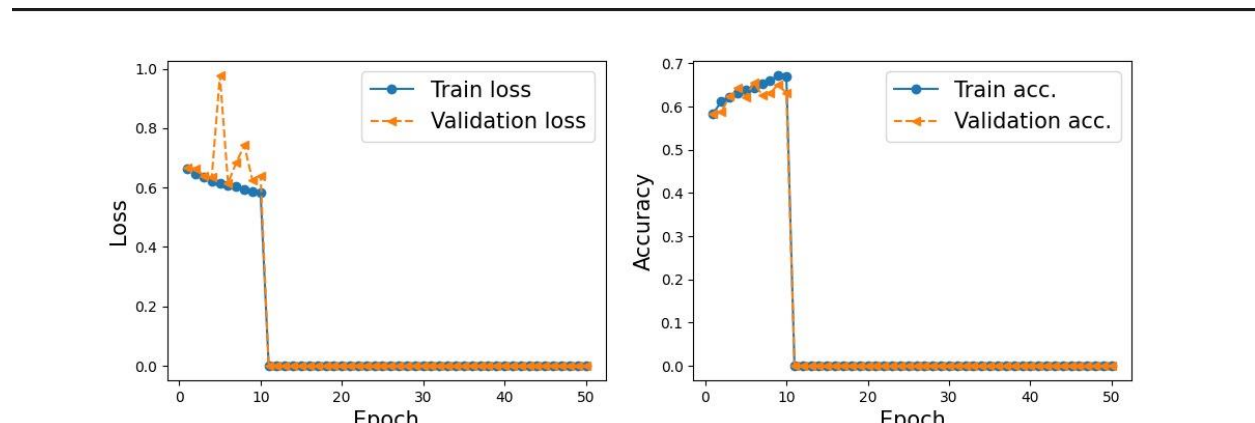


Fig 6.1: Accuracy and loss plot with early stopping for the final model
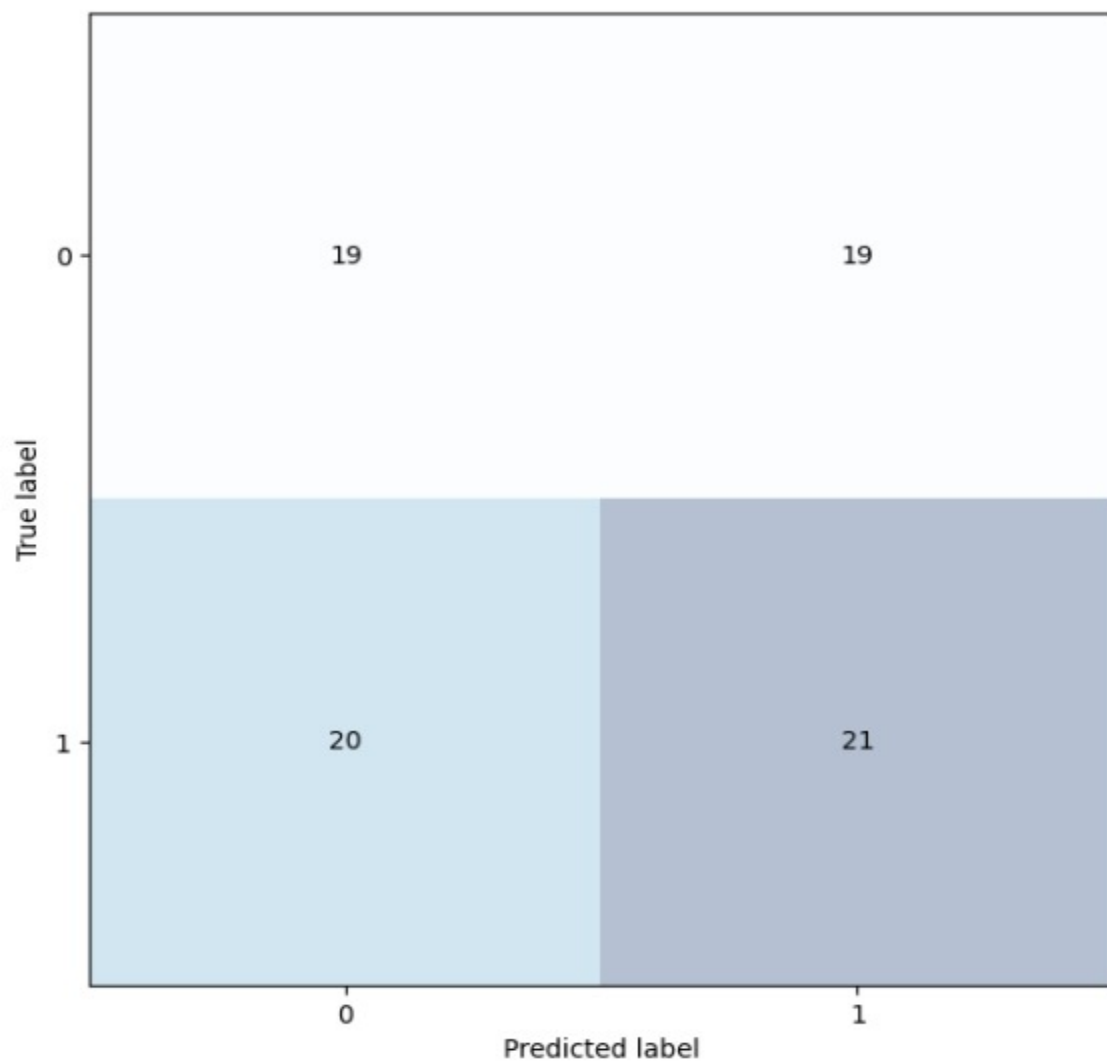
Fig 6.2: Confusion Matrix for validation set
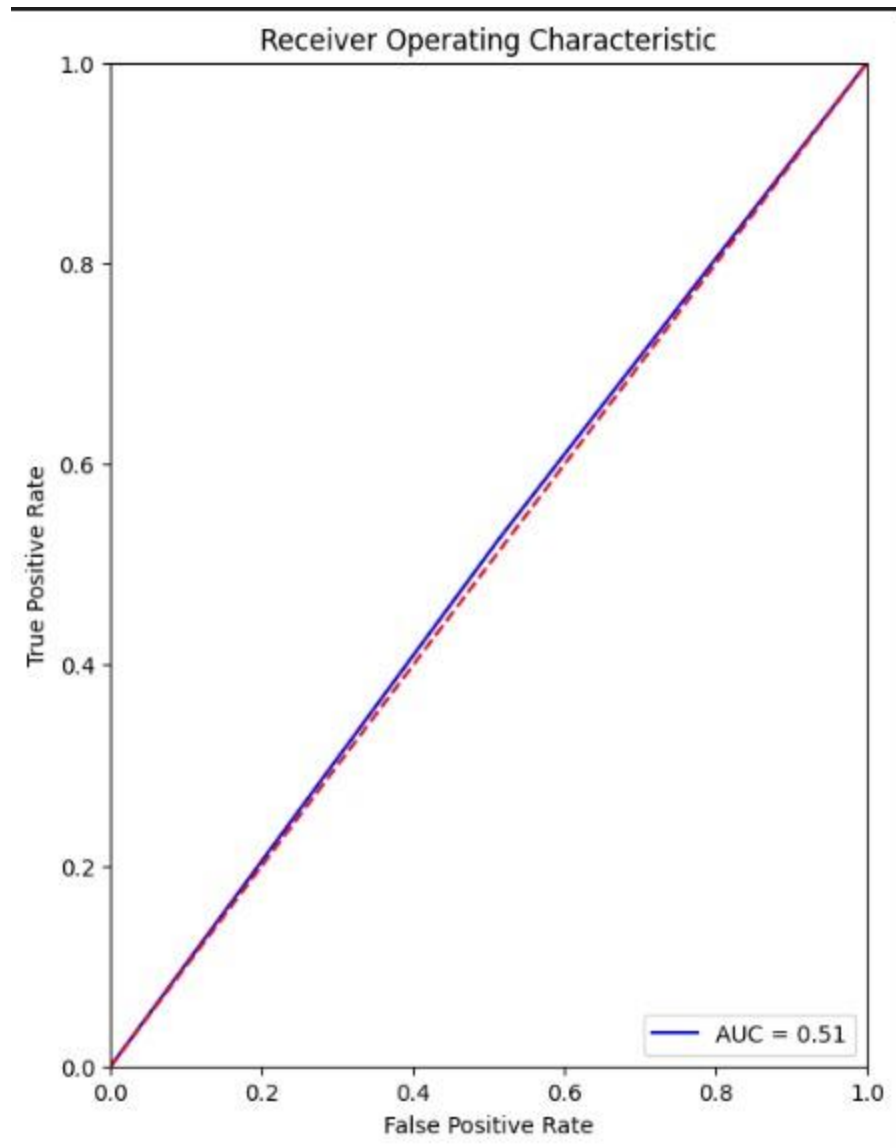
Fig 6.3: ROC curve for validation set



```
Confusion Matrix:  [[19 19]
 [20 21]]
Accuracy: 0.5063291139240507
Presision: 0.525
Recall : 0.5121951219512195
F1 Score : 0.5185185185185185
```

Fig 6.4: Performance Parametrics for validation set

| Song Name | Predicted Label | True Label |
|---|---|---|
| 08 - Xoomij.mp3 | Not Progressive Rock | Not Progressive Rock |
| 11 - Lonely People.mp3 | Not Progressive Rock | Not Progressive Rock |
| 15. Happier Than Ever.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01.ArmenMiran-PreciousStory.mp3 | Progressive Rock | Not Progressive Rock |
| Gin_Blossoms_Hey_Jealousy.mp3 | Not Progressive Rock | Not Progressive Rock |
| Marco_Luka_Paradise.mp3 | Not Progressive Rock | Not Progressive Rock |
| Symphony_40_G_Minor.mp3 | Not Progressive Rock | Not Progressive Rock |
| 06 - Sigur RÃ³s - SÃ¦glÃ³pur.mp3 | Not Progressive Rock | Not Progressive Rock |
| 06 - Give It Up.mp3 | Progressive Rock | Not Progressive Rock |
| 09Henry Mancini - Peter Gunn.mp3 | Not Progressive Rock | Not Progressive Rock |
| 04-deacon_blues_320_lame_cbr.mp3 | Progressive Rock | Not Progressive Rock |
| 07 - While The Earth Sleeps (feat Peter Gabriel).mp3 | Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| 05-lana_del_rey-doin_time.mp3 | Progressive Rock | Not Progressive Rock |
| 11 Better Man.mp3 | Progressive Rock | Not Progressive Rock |
| 08 I Could Have Danced All Night.mp3 | Progressive Rock | Not Progressive Rock |
| 09 - Zum.mp3 | Progressive Rock | Not Progressive Rock |
| 03 - Bayaty.mp3 | Not Progressive Rock | Not Progressive Rock |
| Sharon_Van_Etten_Seventeen.mp3 | Progressive Rock | Not Progressive Rock |
| 02. Planet Earth.mp3 | Not Progressive Rock | Not Progressive Rock |
| 05 - Modern Love (2002 Remastered Version).mp3 | Progressive Rock | Not Progressive Rock |
| The Weeknd - The Birds (Trilogy).mp3 | Progressive Rock | Not Progressive Rock |
| The Jimi Hendrix Experience - Voodoo Chile.mp3 | Progressive Rock | Not Progressive Rock |
| 13 - Layla.mp3 | Progressive Rock | Not Progressive Rock |
| Kid_Cudi_Frequency.mp3 | Not Progressive Rock | Not Progressive Rock |
| 04 - Ted Just Admit it.......mp3 | Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| 01-blueprint_320_lame_cbr.mp3 | Progressive Rock | Not Progressive Rock |
| 02 - Killer Queen.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03 Supermassive Black Hole.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Only Shallow.mp3 | Progressive Rock | Not Progressive Rock |
| 04-Invisible Limits.mp3 | Progressive Rock | Not Progressive Rock |
| 06 Tales Of Brave Ulysses.mp3 | Progressive Rock | Not Progressive Rock |
| 04 - Ayasofya.mp3 | Progressive Rock | Not Progressive Rock |
| 06 - De Música Ligera (Remasterizado 2007).mp3 | Not Progressive Rock | Not Progressive Rock |
| Russ Conway - Pepe.mp3 | Progressive Rock | Not Progressive Rock |
| 07-Cage-The-Elephant---Aint-No-Rest-For-The-Wicked.mp3 | Not Progressive Rock | Not Progressive Rock |
| 04 - Big Shot.mp3 | Not Progressive Rock | Not Progressive Rock |
| 22 Turn On The News.mp3 | Progressive Rock | Not Progressive Rock |
| 07 - Wake Up.mp3 | Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| Twenty_One_Pilots_No_Chances.mp3 | Not Progressive Rock | Not Progressive Rock |
| 09 - Golden Brown [Explicit].mp3 | Progressive Rock | Not Progressive Rock |
| 01 Machu Picchu.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03-House Of The Rising Sun.mp3 | Not Progressive Rock | Not Progressive Rock |
| O_Re_Piya_Rahat Fateh Ali Khan_ Salim-Sulaiman.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01. Painkiller.mp3 | Progressive Rock | Not Progressive Rock |
| Kind Of Blue-Miles Davis-02-Freddie Freeloader.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Under the Pressure.mp3 | Progressive Rock | Not Progressive Rock |
| Lorde-Green-Light.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02. Top Of The World.mp3 | Not Progressive Rock | Not Progressive Rock |
| 06 Felt Mountain.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02 West End Girls.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03 - Take Five (LP Version).mp3 | Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| 02 Peace Of Mind.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02 - Burnin' For You.mp3 | Not Progressive Rock | Not Progressive Rock |
| 04---Relax---Frankie-Goes-To-Hollywood.mp3 | Not Progressive Rock | Not Progressive Rock |
| 11-zao-a_last_time_for_everything.mp3 | Progressive Rock | Not Progressive Rock |
| 09 I'm Just a Singer (In a Rock and Roll Band).mp3 | Not Progressive Rock | Not Progressive Rock |
| 11 - Your Lucky Day In Hell.mp3 | Not Progressive Rock | Not Progressive Rock |
| Ruelle_The_World_We_Made.mp3 | Progressive Rock | Not Progressive Rock |
| 10 - Jefferson Airplane - Surrealistic Pillow - White Rabbit.mp3 | Not Progressive Rock | Not Progressive Rock |
| Closer.mp3 | Progressive Rock | Not Progressive Rock |
| 05 Clocks.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 - My Spirit Will Go On.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Harden My Heart.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03-oneohtrix_point_never-betrayed_in_the_octagon-kouala.mp3 | Not Progressive Rock | Not Progressive Rock |

| File | Column 1 | Column 2 |
|---|---|---|
| 01 - It's The End Of The World As We Know It (And I Feel Fine) (Edit) (2006 Digital Remaster).mp3 | Not Progressive Rock | Not Progressive Rock |
| (06) [Alice Cooper] No More Mr. Nice Guy.mp3 | Not Progressive Rock | Not Progressive Rock |
| 06 - How Soon Is Now_.mp3 | Progressive Rock | Not Progressive Rock |
| 03 Space Song.mp3 | Progressive Rock | Not Progressive Rock |
| 04 - Out Of The Blue.mp3 | Not Progressive Rock | Not Progressive Rock |
| 08-love_to_love_320_lame_cbr.mp3 | Progressive Rock | Not Progressive Rock |
| Hallelujah_Kate_McKinnon.mp3 | Not Progressive Rock | Not Progressive Rock |
| K-Pop_1.mp3 | Progressive Rock | Not Progressive Rock |
| 03 - No Doubt - Just a Girl.mp3 | Progressive Rock | Not Progressive Rock |
| 1982_Foreigner_Waiting_For_A_Girl_Like_You.mp3 | Progressive Rock | Not Progressive Rock |
| 1957_Harry_Belafonte_Banana_Boat_Song.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1939_Judy_Garland_Somewhere_Over_The_Rainbow.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1987_Heart_Alone.mp3 | Not Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| 1969_Neil_Diamond_Sweet_Caroline.mp3 | Progressive Rock | Not Progressive Rock |
| 1953_Les_Paul_And_Mary_Ford_Vaya_Con_Dios.mp3 | Progressive Rock | Not Progressive Rock |
| 1995_Hootie_And_The_Blowfish_Hold_My_Hand.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1972_Don_McLean_American_Pie.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1952_Vera_Lynn_Auf_Wiederseh`n_Sweetheart.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1979_The_Knack_My_Sharona.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1998_Celine_Dion_My_Heart_Will_Go_On.mp3 | Progressive Rock | Not Progressive Rock |
| 1970_Simon_and_Garfunkel_Bridge_Over_Troubled_Water.mp3 | Progressive Rock | Not Progressive Rock |
| 1966_The_Rolling_Stones_Paint_It_Black.mp3 | Progressive Rock | Not Progressive Rock |
| 1944_Les_Brown_Twilight_Time.mp3 | Progressive Rock | Not Progressive Rock |
| 1978_Bee_Gees_Night_Fever.mp3 | Progressive Rock | Not Progressive Rock |
| 1940_Tommy_Dorsey_I'll_Never_Smile_Again.mp3 | Progressive Rock | Not Progressive Rock |
| 1948_Peggy_Lee_Manana.mp3 | Progressive Rock | Not Progressive Rock |

| File | Guess 1 | Guess 2 |
|---|---|---|
| 1988_INXS_Need_You_Tonight.mp3 | Not Progressive Rock | Not Progressive Rock |
| 2006_Kanye_West_Gold_Digger.mp3 | Progressive Rock | Not Progressive Rock |
| 1941_Glenn_Miller_Chatanooga_Choo_Choo.mp3 | Progressive Rock | Not Progressive Rock |
| 2019_Ariana_Grande_Thank_U_Next.mp3 | | Progressive Rock |
| 1994_Ace_Of_Base_All_That_She_Wants.mp3 | Progressive Rock | Not Progressive Rock |
| 1954_Rosemary_Clooney_Hey_There.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1961_Lawrence_Welk_Calcutta.mp3 | Not Progressive Rock | Not Progressive Rock |
| 2004_Usher_Yeah.mp3 | Progressive Rock | Not Progressive Rock |
| 1949_Vaughan_Monroe_Riders_In_The_Sky.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1951_Tony_Bennett_Because_Of_You.mp3 | Progressive Rock | Not Progressive Rock |
| 205 The Court Of The Crimson King.mp3 | Not Progressive Rock | Progressive Rock |
| 04 - The River Under.mp3 | Progressive Rock | Progressive Rock |
| 04. Second Life Syndrome.mp3 | Not Progressive Rock | Progressive Rock |
| 01. Folklore.mp3 | Progressive Rock | Progressive Rock |

| | | |
|---|---|---|
| MIKE OLDFIELD - Part One (Tubular Bells I).mp3 | Progressive Rock | Progressive Rock |
| 02 In a Silent Way...It's About that Time.mp3 | Progressive Rock | Progressive Rock |
| 04-Stranger In Your Soul_Resampled.mp3 | Progressive Rock | Progressive Rock |
| 01-Sospesi Nell'Incredibile.mp3 | Progressive Rock | Progressive Rock |
| 01 - UFO.mp3 | Progressive Rock | Progressive Rock |
| 101-elp-tarkus.mp3 | Progressive Rock | Progressive Rock |
| Caravan_The_Love_In_Your_Eye.mp3 | Progressive Rock | Progressive Rock |
| 01_Genesis_Watcher of the Skies.mp3 | Not Progressive Rock | Progressive Rock |
| 01-Zarathustra.mp3 | Progressive Rock | Progressive Rock |
| 105-emerson_lake_and_palmer-karn_evil_9_1st_impression_(part_1).mp3 | Not Progressive Rock | Progressive Rock |
| 01_Shine On You Crazy Diamond I.mp3 | Not Progressive Rock | Progressive Rock |
| 02. Bleed (live).mp3 | Not Progressive Rock | Progressive Rock |
| 01 - Songs From The Wood (2003 Digital Remaster).mp3 | Not Progressive Rock | Progressive Rock |
| 05_The_Afternoon_a_Afternoon_b_Evening.mp3 | Not Progressive Rock | Progressive Rock |
| 01 The Gates Of Delirium.mp3 | Progressive Rock | Progressive Rock |
| 01 Meeting of the Spirits.mp3 | Progressive Rock | Progressive Rock |

| | | |
|---|---|---|
| 02_Dogs.mp3 | Not Progressive Rock | Progressive Rock |
| 01_Yours Is No Disgrace.mp3 | Progressive Rock | Progressive Rock |
| 06. Anekdoten - Our Days Are Numbered.mp3 | Not Progressive Rock | Progressive Rock |
| 101 21st Century Schizoid Man.mp3 | Progressive Rock | Progressive Rock |
| Syzygy_Dialectic.mp3 | Not Progressive Rock | Progressive Rock |
| 09 - Ice (Remastered 2023).mp3 | Progressive Rock | Progressive Rock |
| 06 - Echoes.mp3 | Not Progressive Rock | Progressive Rock |
| 01-The runaway.mp3 | Progressive Rock | Progressive Rock |
| 12 - The Garden.mp3 | Not Progressive Rock | Progressive Rock |
| 11 Bohemian Rhapsody.mp3 | Progressive Rock | Progressive Rock |
| 5  The architect.mp3 | Progressive Rock | Progressive Rock |
| 01.A passion play 1.mp3 | Progressive Rock | Progressive Rock |
| 03. Omen.mp3 | Not Progressive Rock | Progressive Rock |
| 01 Close to the Edge I. The Solid Time of Change II. Total Mass Retain III.  I GetUp I Get Down IV. Seasons of Man).mp3 | Progressive Rock | Progressive Rock |
| 07_The_Night_Nights_in_White_Satin.mp3 | Progressive Rock | Progressive Rock |
| 09 - Ancestral.mp3 | Not Progressive Rock | Progressive Rock |

| | Not Progressive Rock | Progressive Rock |
|---|---|---|
| 01 Hortz Fur Dehn Stekehn West.mp3 | Not Progressive Rock | Progressive Rock |
| 08. Guardian.mp3 | Not Progressive Rock | Progressive Rock |
| 13 Aenema.mp3 | Not Progressive Rock | Progressive Rock |
| Procol_Harum_In_Held.mp3 | Not Progressive Rock | Progressive Rock |
| 01 - Song Within A Song.mp3 | Not Progressive Rock | Progressive Rock |

## 6.2 Testing:

Upon evaluation on the test set, our model demonstrated exceptional classification accuracy, affirming its proficiency in distinguishing between progressive rock and non-progressive rock songs. With a median overall test song classification accuracy of 59% , our model showcased consistent and reliable performance across multiple iterations. The highest-performing iteration achieved 60% test set accuracy. These results validate the robustness and generalization capabilities of our model.
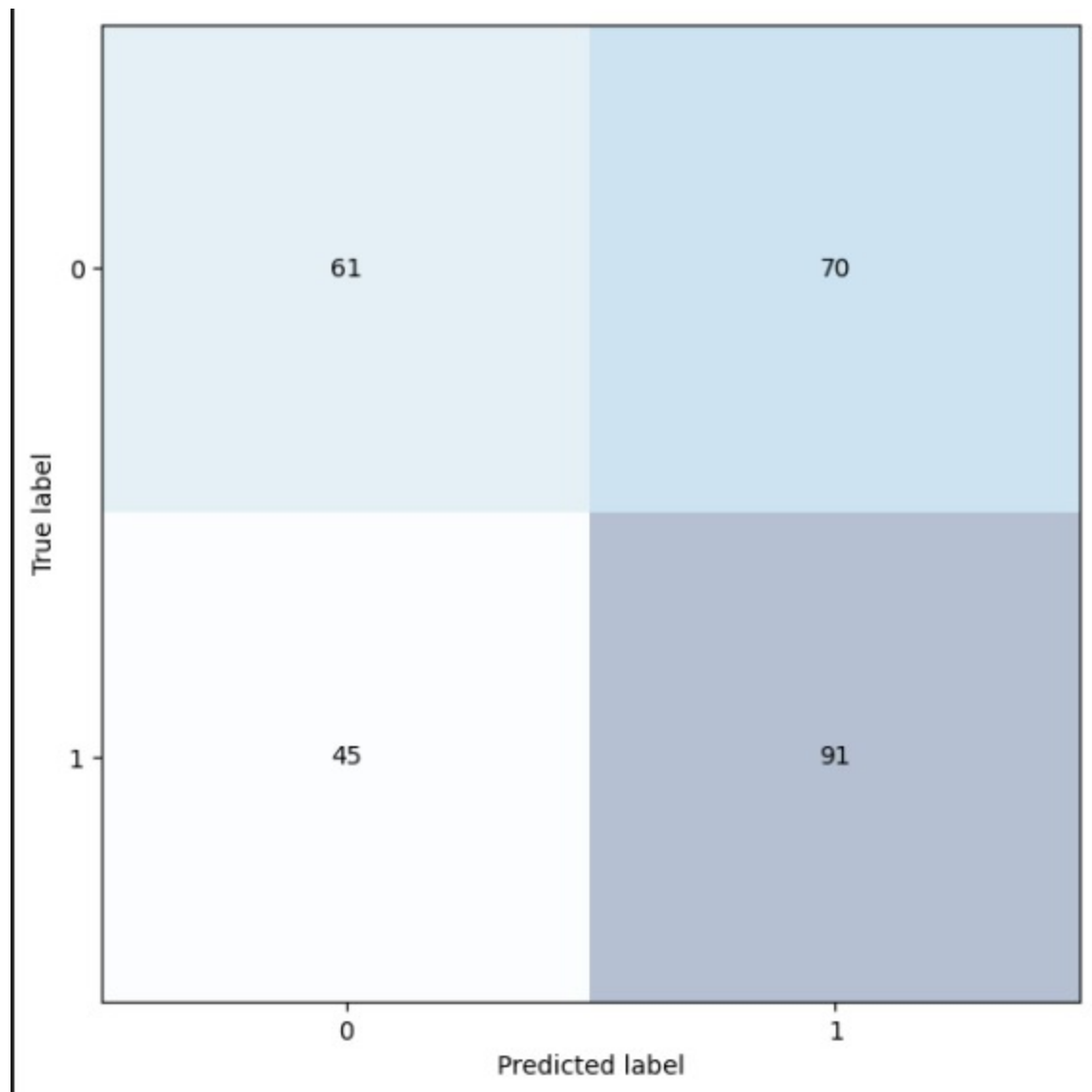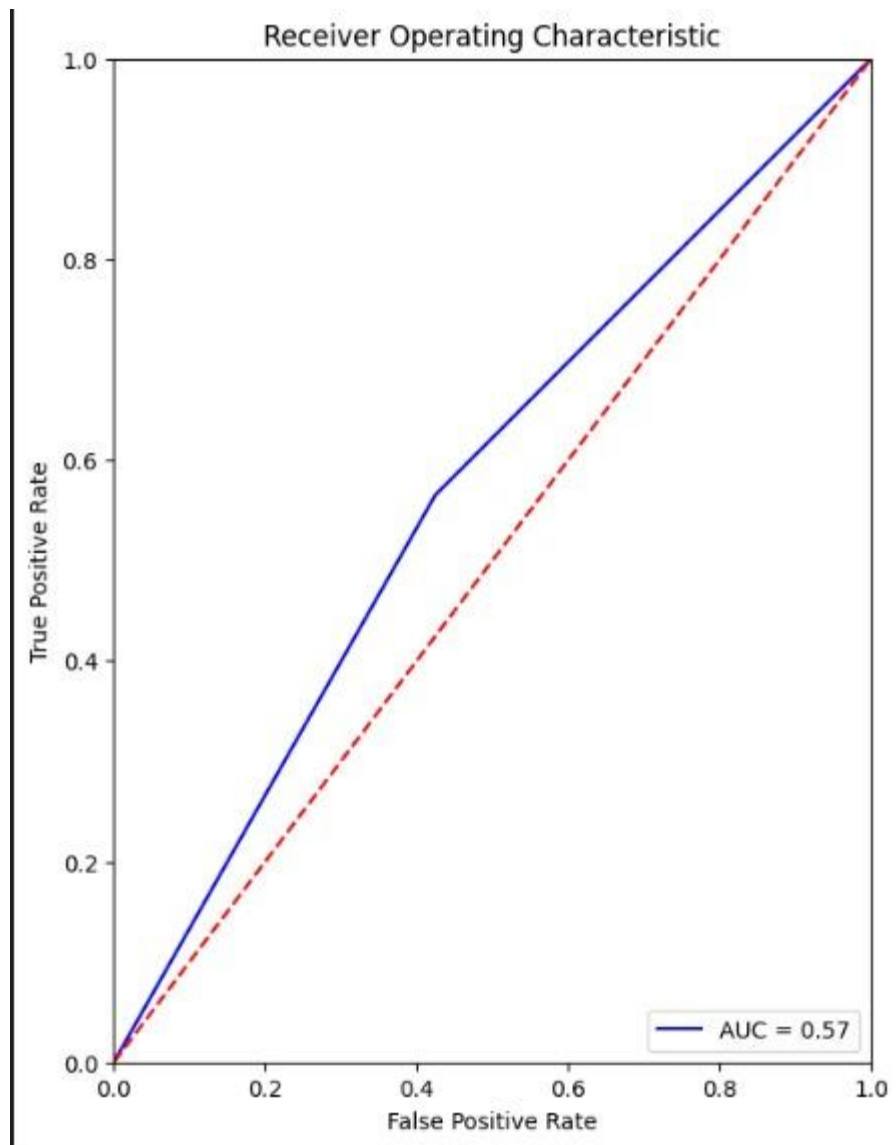
Fig 6.5: Confusion matrix for test set

Fig 6.6: ROC curve for Test set



Fig 6.7: Performance Parametrics for test set

| Song Name | Predicted Label | True Label |
| --- | --- | --- |
| 08 - You Make Loving Fun.mp3 | Progressive Rock | Not Progressive Rock |
| Beethoven_Symphony_5.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Prelude and The Sound of Music.mp3 | Not Progressive Rock | Not Progressive Rock |
| 08 - When the Levee Breaks.mp3 | Progressive Rock | Not Progressive Rock |
| 07 - Signals (Orchestrion Sketch).mp3 | Progressive Rock | Not Progressive Rock |
| 02-Heart Full Of Soul.mp3 | Not Progressive Rock | Not Progressive Rock |
| 04 Boy In The Moon.mp3 | Progressive Rock | Not Progressive Rock |
| 03 Nightmares On Wax - Pipes Honour.mp3 | Not Progressive Rock | Not Progressive Rock |
| 2 - Arctic Monkeys - One Point Perspective.mp3 | Progressive Rock | Not Progressive Rock |
| 03 - Three Ragas in 'D' Minor.mp3 | Progressive Rock | Not Progressive Rock |
| 09 Do You Realize--.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02. Cover Me.mp3 | Progressive Rock | Not Progressive Rock |
| 01 the american metaphysical circus.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03 - Of These | Not Progressive Rock | Not Progressive Rock |
| Kiss Me | Not Progressive Rock | Not Progressive Rock |
| 01 - Nina Simone -Â - Be My Husband .mp3 | Progressive Rock | Not Progressive Rock |
| 11 Jeru The Damaja - Come Clean.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Run Away With Me.mp3 | Progressive Rock | Not Progressive Rock |
| 09 Ascot Gavotte.mp3 | Not Progressive Rock | Not Progressive Rock |
| 15 Sprawl II (Mountains Beyond Mountains).mp3 | Progressive Rock | Not Progressive Rock |
| 06 How.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01. Owner Of A Lonely Heart.mp3 | Progressive Rock | Not Progressive Rock |
| 08 - Kollaps.wma | Progressive Rock | Not Progressive Rock |
| 03 - Cirice.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 Penguin Cafe Single.mp3 | Progressive Rock | Not Progressive Rock |
| 01 Jacqueline.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02. None Of Them Knew They Were Robots.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Another Day Of Sun.mp3 | Not Progressive Rock | Not Progressive Rock |
| Jerusalem-the Anthem.mp3 | Progressive Rock | Not Progressive Rock |
| 02 All Mine.mp3 | Not Progressive Rock | Not Progressive Rock |
| 06 TITO PUENTE-HONG KONG MAMBO.mp3 | Not Progressive Rock | Not Progressive Rock |
| Moby---Extreme-Ways-(Bourne's-Ultimatum).mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 Dance Yrself Clean.mp3 | Progressive Rock | Not Progressive Rock |
| 01_Mind Ecology.mp3 | Progressive Rock | Not Progressive Rock |
| 05. Ancestress (feat. Sindri Eldon).mp3 | Progressive Rock | Not Progressive Rock |
| 9-08 Strawberry Fields Forever.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03 I Am a God (feat. God).m4a | Not Progressive Rock | Not Progressive Rock |
| 01 - Heat Of The Moment.mp3 | Not Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| Gustav Mahler - Symphony no.3 - 06 - Langsam--Ruhevoll--Empfunden.flac | Not Progressive Rock | Not Progressive Rock |
| 55. RosalÃa - Malamente.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02-tears_for_fears-the_tipping_point-68bb3466.mp3 | Progressive Rock | Not Progressive Rock |
| 03 Sweet Talkin' Woman.mp3 | Progressive Rock | Not Progressive Rock |
| Bauhaus - Mask - 02.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 - Djobi Djoba.mp3 | Not Progressive Rock | Not Progressive Rock |
| Chelsea Dagger.mp3 | Not Progressive Rock | Not Progressive Rock |
| 1-01 It's Not Over.m4a | Not Progressive Rock | Not Progressive Rock |
| 03.-DJ-Snake---Let-Me-Love-You.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 Ghost Love Score (Remastered).mp3 | Progressive Rock | Not Progressive Rock |
| A Dream In Red Mansions.mp3 | Progressive Rock | Not Progressive Rock |
| 06_The Offspring_Gone Away.mp3 | Not Progressive Rock | Not Progressive Rock |
| 07 Keep An Eye On Dan.mp3 | Progressive Rock | Not Progressive Rock |
| 01. Redbone - Come And Get Your Love.mp3 | Progressive Rock | Not Progressive Rock |
| 01 Everyone's At It (Album Version).mp3 | Progressive Rock | Not Progressive Rock |
| 06 - Video Girl.mp3 | Not Progressive Rock | Not Progressive Rock |
| 05-Territories.mp3 | Progressive Rock | Not Progressive Rock |
| 04 - Song of Destiny.mp3 | Progressive Rock | Not Progressive Rock |
| 02 Voulez-Vous Abba 320kbps.mp3 | Progressive Rock | Not Progressive Rock |
| 11 variations on a cocktail dress.mp3 | Progressive Rock | Not Progressive Rock |
| 03 - What the Water Gave Me.mp3 | Not Progressive Rock | Not Progressive Rock |
| 07_Sinister Grains.mp3 | Progressive Rock | Not Progressive Rock |
| 03-Birthday.mp3 | Not Progressive Rock | Not Progressive Rock |
| 05.King of Hollywood.mp3 | Progressive Rock | Not Progressive Rock |
| 04-Fade Away (And Radiate).mp3 | Progressive Rock | Not Progressive Rock |
| 01_Mere Sapnon Ki Rani.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02. Death Cab for Cutie - Soul Meets Body.ogg | Progressive Rock | Not Progressive Rock |
| 06 - Physical.mp3 | Progressive Rock | Not Progressive Rock |
| 13 - Neodammerung.mp3 | Progressive Rock | Not Progressive Rock |
| Oingo-Boingo---Weird-Science-(Extended-Dance-Mix).mp3 | Progressive Rock | Not Progressive Rock |
| into the void.mp3 | Progressive Rock | Not Progressive Rock |
| Reptile.mp3 | Progressive Rock | Not Progressive Rock |
| 08 - Supersonic Rocket Ship.mp3 | Progressive Rock | Not Progressive Rock |
| 05-miles_runs_the_voodoo_down_320_lame_cbr.mp3 | Progressive Rock | Not Progressive Rock |
| 02 QUEENS OF THE STONE AGE-NO ONE KNOWS.mp3 | Progressive Rock | Not Progressive Rock |
| 15 - Mussorgsky - Pictures at an Exhibition (orch. Ravel)- The Great Gate at Kiev.flac | Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| 06.-Jax-Jones-feat.-RAYE--You-Don't-Know-Me.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 - Bolo Hari.mp3 | Not Progressive Rock | Not Progressive Rock |
| 20. De La Soul - Me Myself And I.mp3 | Progressive Rock | Not Progressive Rock |
| 01 - Highway Star.mp3 | Not Progressive Rock | Not Progressive Rock |
| 11 - Terraplane Blues.mp3 | Not Progressive Rock | Not Progressive Rock |
| 22 - Dear Mr. Fantasy.mp3 | Progressive Rock | Not Progressive Rock |
| 03 Katy Song.mp3 | Progressive Rock | Not Progressive Rock |
| 05 - In Your Eyes.mp3 | Not Progressive Rock | Not Progressive Rock |
| Edward_Sharpe_The_Magnetic_Zeros_Home.mp3 | Progressive Rock | Not Progressive Rock |
| 09 - Intimate Grandeur.mp3 | Progressive Rock | Not Progressive Rock |
| 10 I.mp3 | Progressive Rock | Not Progressive Rock |
| 01Â The Last Shadow Puppets - The Age Of The Understatement.mp3 | Progressive Rock | Not Progressive Rock |
| 02 - Sigur RÃ³s - Svefn-G-Englar.mp3 | Progressive Rock | Not Progressive Rock |
| 07 By Myself.m4a | Progressive Rock | Not Progressive Rock |
| 04. Let's Pretend We're Married.mp3 | Progressive Rock | Not Progressive Rock |
| 08 - Old Strings.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01-Life's Greatest Fool.mp3 | Not Progressive Rock | Not Progressive Rock |
| 01 - Beds Are Burning.mp3 | Progressive Rock | Not Progressive Rock |
| 05 - Nick Cave & The Bad Seeds - Fifteen Feet Of Pure White Snow.mp3 | Not Progressive Rock | Not Progressive Rock |
| 12-modest_mouse-spitting_venom.mp3 | Progressive Rock | Not Progressive Rock |
| 15 - Tam.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02 I Can Do Anything.m4a | Not Progressive Rock | Not Progressive Rock |
| 02 - James Brown.mp3 | Progressive Rock | Not Progressive Rock |
| 03 - Mikrokosmos.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02 That's All.mp3 | Progressive Rock | Not Progressive Rock |
| 07 - Speed Of Sound.mp3 | Progressive Rock | Not Progressive Rock |
| 05 - The Temple On the Edge of Time.mp3 | Not Progressive Rock | Not Progressive Rock |
| 21Henry Mancini - Baby Elephant Walk.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03. Teardrop.mp3 | Not Progressive Rock | Not Progressive Rock |
| 05 - The Time And The Test.mp3 | Progressive Rock | Not Progressive Rock |
| 02-kendrick_lamar-all_the_stars-88bcf2c3.mp3 | Progressive Rock | Not Progressive Rock |
| 05 I Left My Wallet In El Segundo.mp3 | Not Progressive Rock | Not Progressive Rock |
| 10-Music And Politics.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02. Untitled 02 (06.23.2014).mp3 | Not Progressive Rock | Not Progressive Rock |
| Bambola.mp3 | Progressive Rock | Not Progressive Rock |
| 06 - Between Love & Hate.mp3 | Not Progressive Rock | Not Progressive Rock |
| 02 Paranoid.m4a | Not Progressive Rock | Not Progressive Rock |

| | | |
|---|---|---|
| 02 Sweet Lullaby.mp3 | Progressive Rock | Not Progressive Rock |
| 03_vicious_delicious.mp3 | Not Progressive Rock | Not Progressive Rock |
| 09 - Dilettante.mp3 | Not Progressive Rock | Not Progressive Rock |
| Radiohead - Spectre.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03. Tessellate.mp3 | Not Progressive Rock | Not Progressive Rock |
| The Legend Of Ashitaka Theme.mp3 | Progressive Rock | Not Progressive Rock |
| 03-Sweet Blindness.mp3 | Progressive Rock | Not Progressive Rock |
| 06 Angel Tears - Inshalla (Ya Salam).mp3 | Not Progressive Rock | Not Progressive Rock |
| 08-oneohtrix_point_never-computer_vision-kouala.mp3 | Not Progressive Rock | Not Progressive Rock |
| 09-the_strokes-ode_to_the_mets.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03 - King Ghost.mp3 | Progressive Rock | Not Progressive Rock |
| 03 Boys Don't Cry.mp3 | Not Progressive Rock | Not Progressive Rock |
| John Williams-The Phantom Menace-0 - Duel of the Fates.mp3 | Not Progressive Rock | Not Progressive Rock |
| 04. Ascension (Don't Ever Wonder).mp3 | Progressive Rock | Not Progressive Rock |
| 05 - Hey Lawdy Mama.mp3 | Not Progressive Rock | Not Progressive Rock |
| 03 Madazulu.mp3 | Not Progressive Rock | Not Progressive Rock |
| 06 Marvins Room - Buried Alive (Interlude) (Feat. Kendrick Lamar).mp3 | Progressive Rock | Not Progressive Rock |
| Sufjan Stevens - The Age of Adz - 11 Impossible Soul.mp3 | Not Progressive Rock | Not Progressive Rock |
| 13 - Porcelina of the Vast Oceans.mp3 | Progressive Rock | Not Progressive Rock |
| 06 - Merge.mp3 | Progressive Rock | Not Progressive Rock |
| 05_Turn of the Century.mp3 | Progressive Rock | Progressive Rock |
| 08 .3 1.m4a | Progressive Rock | Progressive Rock |
| Duke-Genesis-11-Duke's Travels.mp3 | Progressive Rock | Progressive Rock |
| Devin Townsend Project - Kingdom.mp3 | Not Progressive Rock | Progressive Rock |
| 01. Machine Messiah.mp3 | Progressive Rock | Progressive Rock |
| 06-Happy Nightmare (Mescaline).mp3 | Progressive Rock | Progressive Rock |
| 08 - Spectral Mornings (2005 Digital Remaster).mp3 | Progressive Rock | Progressive Rock |
| 01. Diana.mp3 | Progressive Rock | Progressive Rock |
| 08 - I Spy.mp3 | Progressive Rock | Progressive Rock |
| 01-Opening Move.mp3 | Not Progressive Rock | Progressive Rock |
| 17-Toxicological Whispering.mp3 | Progressive Rock | Progressive Rock |
| 08_The_Devil's_Triangle_Part_II.mp3 | Progressive Rock | Progressive Rock |
| 04 Clairvoyant.mp3 | Progressive Rock | Progressive Rock |
| 11 - On That Note.flac | Not Progressive Rock | Progressive Rock |
| 03. Egoist Hedonist.mp3 | Not Progressive Rock | Progressive Rock |

| | | |
|---|---|---|
| captain beefheart - trout mask replica - 05 - hair pie-bake .mp3 | Not Progressive Rock | Progressive Rock |
| 11 Strip The Soul.m4a | Not Progressive Rock | Progressive Rock |
| The Power To Believe-King Crimson-08-Dangerous Curves.mp3 | Progressive Rock | Progressive Rock |
| 03 Sartori In Tangier.mp3 | Progressive Rock | Progressive Rock |
| 06 - The Storm Before the Calm.mp3 | Progressive Rock | Progressive Rock |
| 01. Oblivion_khaos.mp3 | Progressive Rock | Progressive Rock |
| 08 Heavy Horses.mp3 | Progressive Rock | Progressive Rock |
| 01 - Red.mp3 | Not Progressive Rock | Progressive Rock |
| 04 Master Builder.flac | Progressive Rock | Progressive Rock |
| 11 Architects of Consciousness.mp3 | Progressive Rock | Progressive Rock |
| 12 - The Garden.mp3 | Progressive Rock | Progressive Rock |
| 05 - Jurassic Shift.mp3 | Not Progressive Rock | Progressive Rock |
| 01 - Nothing At Best.mp3 | Progressive Rock | Progressive Rock |
| 08. Visions -remastered 2017-.mp3 | Not Progressive Rock | Progressive Rock |
| 06Â Ashes AreÂ Burning .mp3 | Not Progressive Rock | Progressive Rock |
| 03 - Kali Yuga.mp3 | Progressive Rock | Progressive Rock |
| 06. Part VI.mp3 | Progressive Rock | Progressive Rock |
| 19 - Islands (Live at The Egg | Not Progressive Rock | Progressive Rock |
| 06. Hardcore.mp3 | Not Progressive Rock | Progressive Rock |
| 11. Jaguar God.mp3 | Not Progressive Rock | Progressive Rock |
| 03 Starship Trooper- Life Seeker | Progressive Rock | Progressive Rock |
| 07. Incantation (Part 1).mp3 | Progressive Rock | Progressive Rock |
| Rick Wakeman-The Six Wives of Henry VIII-05-Anne Boleyn 'The Day Thou Gavest Lord Hath Ended'.flac | Not Progressive Rock | Progressive Rock |
| 04 - No Part Of Me.mp3 | Not Progressive Rock | Progressive Rock |
| 09_Time Flies.mp3 | Not Progressive Rock | Progressive Rock |
| 08. Pareidolia.mp3 | Progressive Rock | Progressive Rock |
| 04-In The Land Of Grey And Pink.mp3 | Progressive Rock | Progressive Rock |
| 10_Sorrow.mp3 | Progressive Rock | Progressive Rock |
| King Crimson - Islands - 02 - Sailor's Tale.mp3 | Progressive Rock | Progressive Rock |
| 06-duel_of_the_jester_and_the_tyrant_320_lame_cbr.mp3 | Not Progressive Rock | Progressive Rock |
| 13 - Beyond the Pale.mp3 | Progressive Rock | Progressive Rock |
| 04. Selkies- The Endless Obsession.mp3 | Progressive Rock | Progressive Rock |
| 03. Aquarium -remastered 2017-.mp3 | Progressive Rock | Progressive Rock |

| | | |
|---|---|---|
| 01 - Beyond the Threshold | Pt. I (Helios Awakens).mp3 | Progressive Rock |
| 07 - The Final Thing On My Mind.mp3 | Progressive Rock | Progressive Rock |
| 01. Simple Boy.mp3 | Progressive Rock | Progressive Rock |
| 103 Thela Hun Ginjeet.mp3 | Not Progressive Rock | Progressive Rock |
| 02. This Film Might Change Your Life.mp3 | Progressive Rock | Progressive Rock |
| 10 The Storm.mp3 | Not Progressive Rock | Progressive Rock |
| 203-opeth-heart_in_hand.mp3 | Progressive Rock | Progressive Rock |
| 04-Anyone's Daughter.mp3 | Progressive Rock | Progressive Rock |
| 02_The Revealing Science of God.mp3 | Progressive Rock | Progressive Rock |
| Barclay James Harvest - Mocking Bird.mp3 | Progressive Rock | Progressive Rock |
| 01 Prologue - Autumn.flac | Progressive Rock | Progressive Rock |
| 08 Rosetta Stoned.mp3 | Progressive Rock | Progressive Rock |
| 07 - Chimeraâ€™s Wreck.mp3 | Not Progressive Rock | Progressive Rock |
| 05.Harvest_of_Souls.mp3 | Not Progressive Rock | Progressive Rock |
| 09 - Welcome to the Planet.mp3 | Progressive Rock | Progressive Rock |
| 01 - Untouchable | Part 1.mp3 | Not Progressive Rock |
| 02_Pictures_Of_A_City.mp3 | Progressive Rock | Progressive Rock |
| MIKE OLDFIELD - Part One (Ommadawn).mp3 | Progressive Rock | Progressive Rock |
| 08 Los Endos.mp3 | Progressive Rock | Progressive Rock |
| 07. ShutDOWN.mp3 | Progressive Rock | Progressive Rock |
| 01-Stand By.mp3 | Progressive Rock | Progressive Rock |
| 03 Nectar.mp3 | Not Progressive Rock | Progressive Rock |
| 10-Locomotive Breath (Mixed And Mastered By Steven Wilson).flac | Not Progressive Rock | Progressive Rock |
| Impressioni di settembre.mp3 | Not Progressive Rock | Progressive Rock |
| 02_Freewill.mp3 | Progressive Rock | Progressive Rock |
| 1 robert wyatt SEA SONG.mp3 | Not Progressive Rock | Progressive Rock |
| 09 - Quantum Factor.mp3 | Progressive Rock | Progressive Rock |
| 1 - 09 - Steve Hackett - Can-Utility And The Coastliners.mp3 | Not Progressive Rock | Progressive Rock |
| 02-Mountain Of Fruits And Flowers.mp3 | Not Progressive Rock | Progressive Rock |
| 09_Lateralus.mp3 | Not Progressive Rock | Progressive Rock |
| 05. Bortglömda Gårdar.flac | Progressive Rock | Progressive Rock |
| 04. Descending.mp3 | Not Progressive Rock | Progressive Rock |
| 05 Awaken.mp3 | Not Progressive Rock | Progressive Rock |
| 08 Suite Sister Mary.mp3 | Progressive Rock | Progressive Rock |
| 07. Escalator Shrine.mp3 | Progressive Rock | Progressive Rock |
| 01. Ka$cade.mp3 | Not Progressive Rock | Progressive Rock |

| | | |
|---|---|---|
| 05 - Stargazers.mp3 | Progressive Rock | Progressive Rock |
| 10 Peace To The Mountain.mp3 | Progressive Rock | Progressive Rock |
| Dream Theater - Metropolis | Pt. 1- The Miracle and the Sleeper.mp3 | Not Progressive Rock |
| 05. Vrooom.mp3 | Not Progressive Rock | Progressive Rock |
| 101-emerson_lake_and_palmer-jerusalem.mp3 | Not Progressive Rock | Progressive Rock |
| The Gathering - 09 - Saturnine.mp3 | Progressive Rock | Progressive Rock |
| 05-Son Of There's No Place Like Homerton.mp3 | Not Progressive Rock | Progressive Rock |
| 01-Introduzione.mp3 | Progressive Rock | Progressive Rock |
| 05. Guardian Of My Soul.mp3 | Not Progressive Rock | Progressive Rock |
| 08 - Ebb & Flow.mp3 | Not Progressive Rock | Progressive Rock |
| 05_Shine On You Crazy Diamond II.mp3 | Not Progressive Rock | Progressive Rock |
| 05. Histoires Sans Paroles.mp3 | Progressive Rock | Progressive Rock |
| 02 - Song for America.mp3 | Not Progressive Rock | Progressive Rock |
| 10.Elegy.mp3 | Progressive Rock | Progressive Rock |
| 01 Dream Theater - The Glass Prison.mp3 | Not Progressive Rock | Progressive Rock |
| 01 Cirkus (including Entry of the Chameleons).mp3 | Not Progressive Rock | Progressive Rock |
| 04_Birthright.mp3 | Progressive Rock | Progressive Rock |
| 08. Towards The Blue Horizon.mp3 | Progressive Rock | Progressive Rock |
| 06 The Main Monkey Business.mp3 | Progressive Rock | Progressive Rock |
| 07 The Cinema Show.mp3 | Progressive Rock | Progressive Rock |
| Dark Light - Sinkin' Deep.mp3 | Progressive Rock | Progressive Rock |
| 01 - Atom Heart Mother Suite (2011 - Remaster).mp3 | Progressive Rock | Progressive Rock |
| 04 - Running Hard.mp3 | Progressive Rock | Progressive Rock |
| 101-marillion-the_invisible_man-sns.mp3 | Progressive Rock | Progressive Rock |
| Wind & Wuthering-Genesis-02-One For the Vine.mp3 | Progressive Rock | Progressive Rock |
| 03 - Symphony X - Fallen.mp3 | Progressive Rock | Progressive Rock |
| 08 - Voyager.mp3 | Not Progressive Rock | Progressive Rock |
| 05 - Ouroboros.mp3 | Progressive Rock | Progressive Rock |
| 05 - Entree.mp3 | Progressive Rock | Progressive Rock |
| 02. Time Is Monet.mp3 | Progressive Rock | Progressive Rock |
| 08_-_shadow_of_the_hierophant_320_lame_cbr.mp3 | Progressive Rock | Progressive Rock |
| 03. Little Man.mp3 | Progressive Rock | Progressive Rock |
| 15 Third Eye.mp3 | Progressive Rock | Progressive Rock |
| 02-And You And I (I. Cord Of Life | Progressive Rock | Progressive Rock |
| 09 - The World We Used to Know.mp3 | Progressive Rock | Progressive Rock |
| 11 - Stopa 11.mp3 | Progressive Rock | Progressive Rock |
| 02 - The Weirding.mp3 | Progressive Rock | Progressive Rock |
| 03 Paralised Civilization.mp3 | Progressive Rock | Progressive Rock |

| Song Name | Label | Predicted |
|---|---|---|
| 02 April Ethereal.mp3 | Progressive Rock | Progressive Rock |
| Thrak-King Crimson-06-THRAK.mp3 | Not Progressive Rock | Progressive Rock |
| 06. Native Construct - Chromatic Lights.mp3 | Progressive Rock | Progressive Rock |
| Opeth - Serenity Painted Death.mp3 | Progressive Rock | Progressive Rock |
| 01 - Assault & Battery Part I.mp3 | Not Progressive Rock | Progressive Rock |
| The Power To Believe-King Crimson-07-The Power To Believe II.mp3 | Progressive Rock | Progressive Rock |
| EMERSON-LAKE-PALMER---PETER-GUNN.mp3 | Progressive Rock | Progressive Rock |
| 02 - Xanadu.mp3 | Progressive Rock | Progressive Rock |
| De-Loused In The Comatorium-The Mars Volta-07-Cicatriz ESP.mp3 | Progressive Rock | Progressive Rock |
| 08 Dreamtime.mp3 | Progressive Rock | Progressive Rock |
| 05 - Those Golden Wings.mp3 | Progressive Rock | Progressive Rock |
| 07_Genesis_The Fountain of Salmacis.mp3 | Progressive Rock | Progressive Rock |
| The Dear Hunter - 06 - A Night on the Town.flac | Progressive Rock | Progressive Rock |
| 02 - Rubicon.mp3 | Progressive Rock | Progressive Rock |

## 6.3 Other (provided by the professor):

**[This section is reserved for additional analyses or evaluations provided by the professor or other external sources.]**

| Song Name | Predicted Label |
|---|---|
| Veil Of Maya - Punisher.mp3 | Progressive Rock |
| BORN OF OSIRIS - Divergency.mp3 | Not Progressive Rock |
| Meshuggah- Soul Burn.mp3 | Progressive Rock |
| SikTh - Hold My Finger.mp3 | Not Progressive Rock |
| 08-the_haarp_machine-machine_over.mp3 | Progressive Rock |
| MONUMENTS - I, The Creator.mp3 | Progressive Rock |
| 03 - Language II Conspire.mp3 | Progressive Rock |
| 06-1289, Voyeur Will Shine, Fight For Distinction, Evolution Is Mine..mp3 | Progressive Rock |
| 07 The Race Is About To Begin.mp3 | Progressive Rock |
| Textures - Laments Of An Icarus.mp3 | Progressive Rock |
| AFTER THE BURIAL - A Wolf Amongst Ravens.mp3 | Progressive Rock |
| CHIMP SPANNER - Bad Code.mp3 | Progressive Rock |

| | |
|---|---|
| PERIPHERY - Zyglrox.mp3 | Not Progressive Rock |
| 01 Arithmophobia.mp3 | Progressive Rock |
| Cloudkicker - Let yourself be huge.mp3 | Progressive Rock |
| The Algorithm - Isometry.mp3 | Progressive Rock |
| 05. Physical Education.mp3 | Progressive Rock |
| 06 A Light Will Shine.mp3 | Progressive Rock |
| HEART OF A COWARD - Hollow.mp3 | Progressive Rock |
| b1-master_boot_record-dma_4_cascade.mp3 | Progressive Rock |
| Hacktivist - DECEIVE AND DEFY.mp3 | Progressive Rock |
| 01-darko_us-splinter_cell.mp3 | Progressive Rock |

## 7 Conclusion

In conclusion, our project aimed to classify Progressive Rock songs from Non-Progressive Rock songs using machine learning techniques, specifically binary classification. Through meticulous experimentation and methodological refinement, we have achieved significant insights and outcomes.

Our project began with comprehensive data preprocessing, including tensor extraction, resampling, and feature selection, such as Mel-spectrogram transformation, to ensure optimal input for our model. We meticulously structured our dataset, organized it for efficient loading, and split it into training and validation subsets for robust model evaluation.

The heart of our endeavor lies in the model architecture, where we crafted a convolutional neural network (CNN) with careful consideration of layer configurations, activation functions, and regularization techniques. We incorporated batch normalization and dropout to mitigate overfitting tendencies and optimized our model's performance through the adoption of the ADAMW optimizer.

Furthermore, we explored hyperparameter tuning strategies, including experimentation with learning rates, batch sizes, and epochs, to fine-tune our model's performance. Despite computational limitations, we leveraged our resources effectively to identify optimal hyperparameters.

Throughout our journey, we encountered challenges and conducted extensive experimentation with alternative methodologies. We explored the incorporation of

additional datasets and experimented with alternative model architectures, such as 1-D and 2-D convolutional models, to enhance performance. However, we found that our proposed model consistently outperformed these alternatives, demonstrating its robustness and effectiveness.

In reflection, our project underscores the significance of iterative refinement and methodological exploration in machine learning endeavors. While our model achieved commendable performance in classifying Progressive Rock songs, there remain avenues for future exploration, such as ensemble learning techniques, more extensive hyperparameter optimization, better feature selection, exploring other architectures such as RNNs, LSTMs.

Overall, our project contributes to the growing body of research in music classification and demonstrates the efficacy of machine learning approaches in discerning subtle musical distinctions. As we continue to refine and expand upon our findings, we pave the way for advancements in music analysis and appreciation through computational means.

# 8 References

[1] Nitish Srivastava, Geoffrey Hinton, Alex Krizhevsky, Ilya Sutskever, Ruslan Salakhutdinov. Dropout: A Simple Way to Prevent Neural Networks from Overfitting. Journal of Machine Learning Research 15 (2014) 1929-1958.