# Music Feature Classification: Using Techniques of Machine Learning to Detect Genre

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## Introduction and Statement of Problem

A music genre is a conventional category that identifies some pieces of music as belonging to a shared tradition or set of conventions[1]. It is an attribute of a musical piece or song that can be used as a label or a method of classification. Music can be divided into genres in varying ways, such as popular music and art music, or religious music and secular music[2]. Genre is an unusually fluid category. In some cases, even music experts can disagree on the genre of a given piece. Historically, genre classification was done manually. As more music is released online, it is of importance and interest to classify types of music automatically and in a way that is purely for the purposes of *music information retrieval* (MIR)[3]. Most current research has been focused on applying *machine learning* (ML) algorithms to identify and classify the genre of a music file. This project utilizes a convolutional neural network and a random forest to attempt a new method of automatic genre classification.

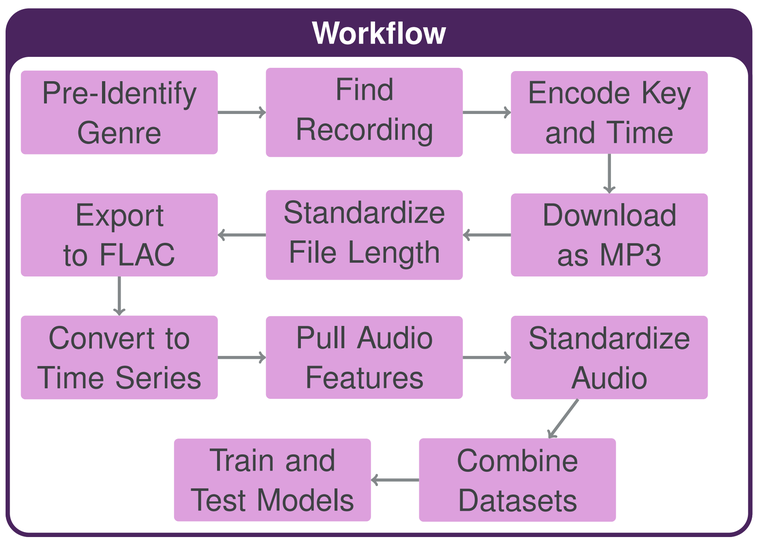
## Key Terms

*Genre:* a method of categorizing music functioning as a fluid heuristic

*Convolutional Neural Network:* a stacked series of logistic regression models suited to classify one-dimensional signals

*Random Forest:* a supervised ensemble model composed of a group of decision trees

## Methods




### Variables of Interest

*Zero Crossing Rate:* a sound feature that measures the number of times in a given frame that the time series passes a zero frequency

*Spectral Centroid:* a sound feature that measures spectral shape, or brightness of sound

*Mel Frequency Cepstral Coefficients:* a sound feature vector derived from the Fourier transform and mapped onto the mel scale that measures timbre

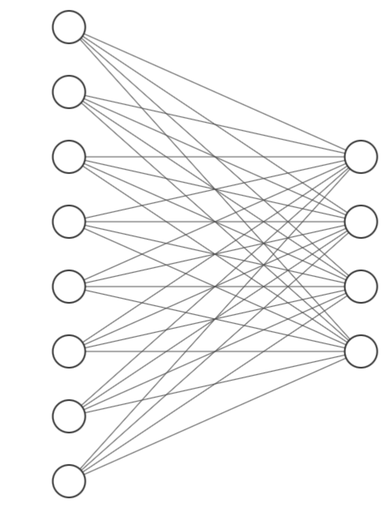
*Key Signature:* a music feature that determines the default tones used in a piece

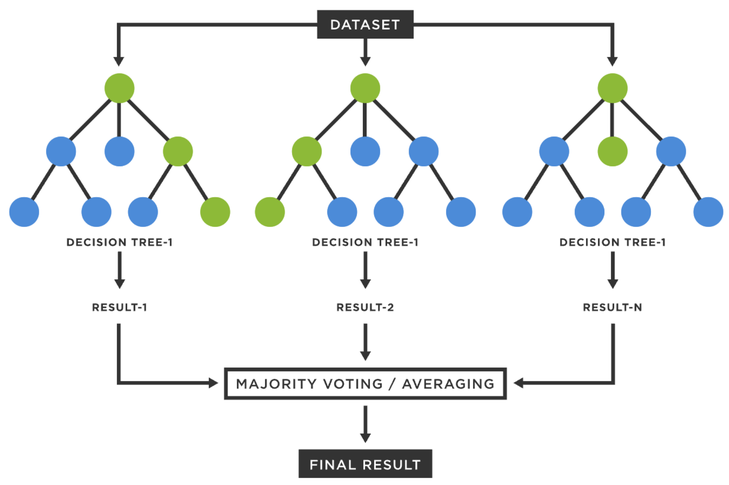
*Time Signature:* a music feature that determines the rhythmic structure of a piece

## Packages and Algorithms

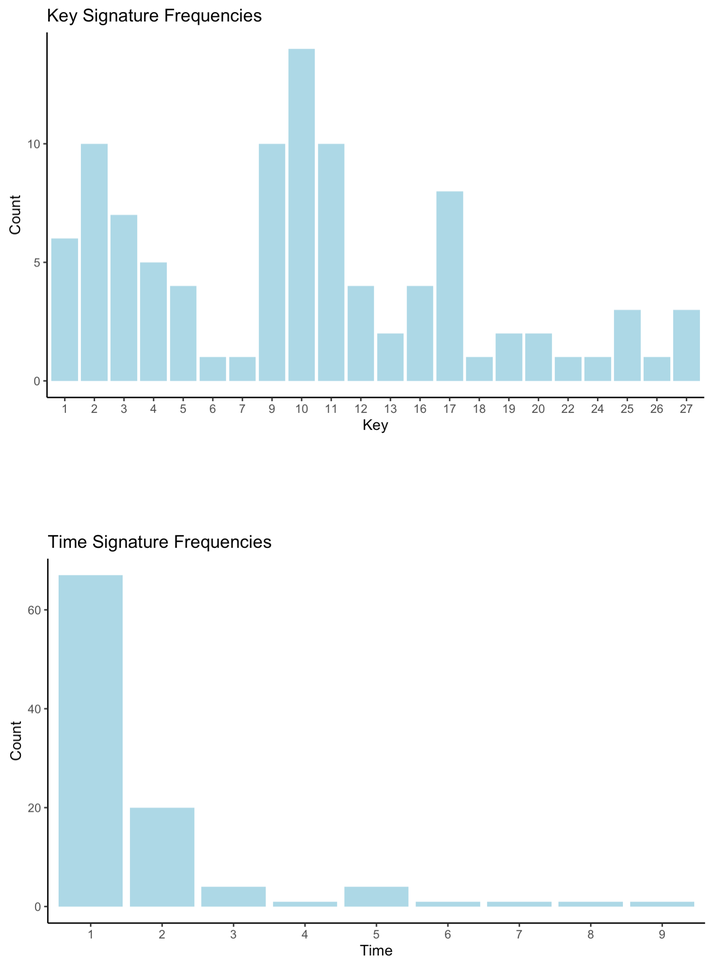
**Packages**

- Pandas
- NumPy
- Random
- Tidyverse (R)
- SoundFile
- Librosa
- PyDub
- SciKitLearn
- Keras




## Data Distribution Analysis




## Results

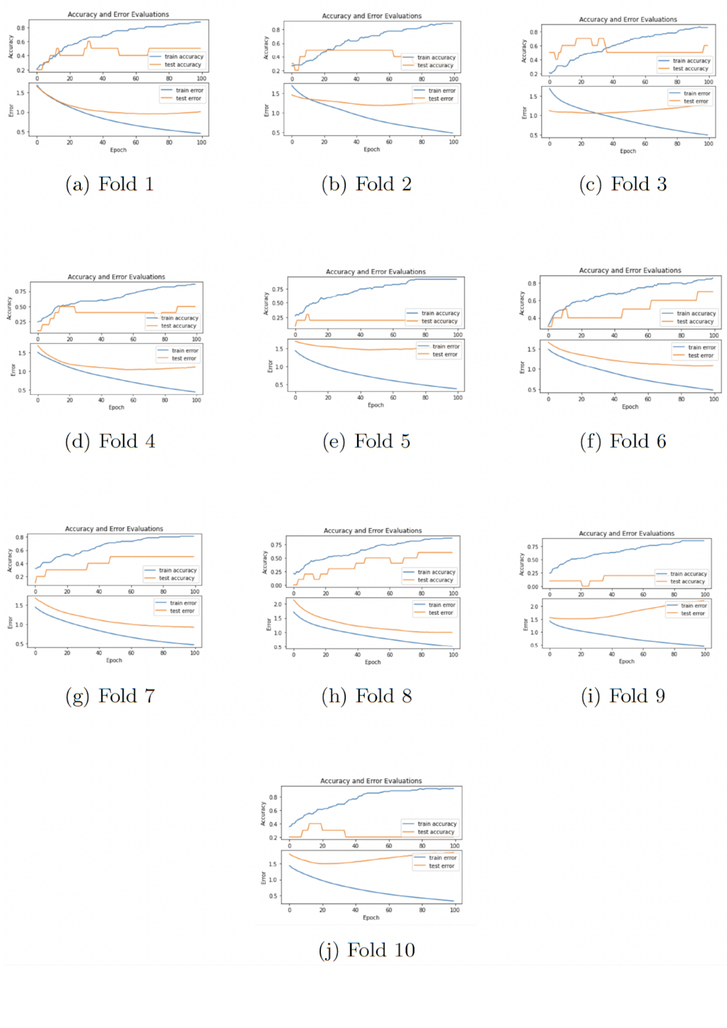
**CNN with 10-Fold Cross Validation**

*Mean Accuracy:* 46%

*Range of Accuracy:* 20% - 90%

*Mean Loss:* 1.30

*Range of Loss:* 0.62 to 1.88



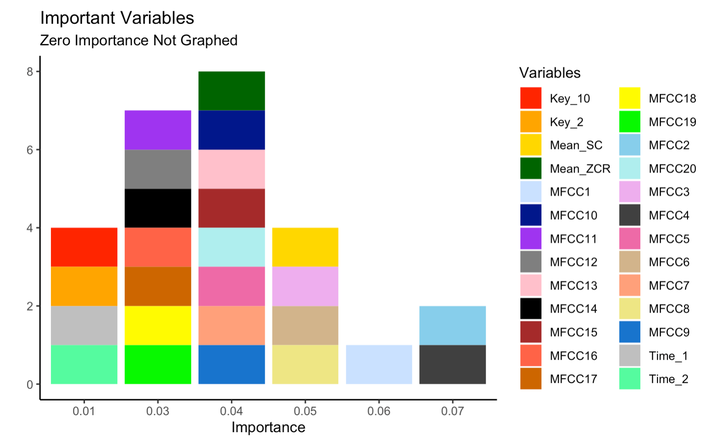

(a) Fold 1 (b) Fold 2 (c) Fold 3

(d) Fold 4 (e) Fold 5 (f) Fold 6

(g) Fold 7 (h) Fold 8 (i) Fold 9

(j) Fold 10

### Random Forest




## Conclusions

Overall, our findings indicated that the addition of musical attributes such as time signature and key signature do not improve the accuracy of machine learning algorithms trained to classify a piece's genre. This may be due to the imbalanced frequencies in which these features occur. Limitations of our findings come from the difficulty of creating a large, robust dataset solely from existing recordings. Future work may include lyric patterns as an additional variable. One variable that was taken under consideration but eventually rejected was the year of publication of each piece. Time of publication is often inextricably linked to the definition of the genre itself. An interesting avenue of future exploration could take our setup and reverse the direction of analysis. Instead of using attributes of a piece to classify genre, it may be interesting to use genre and musical attributes to predict a narrow potential period of publication.

1: J. Samson, Genre, In Grove Music Online. Oxford Music Online. Accessed March 4, 2012.

2: Music genre. In Wikipedia, The Free Encyclopedia. Retrieved 01:18, April 24, 2022

3: F. Pachet and D. Cazaly, A classification of musical genre, in Proc. RIAO Content-Based Multimedia Information Access Conf., Paris, France, March 2000.

4: Random forest. In Wikipedia, The Free Encyclopedia. Retrieved 09:52, May 5, 2022

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