Music Genre Classification

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1 Introduction

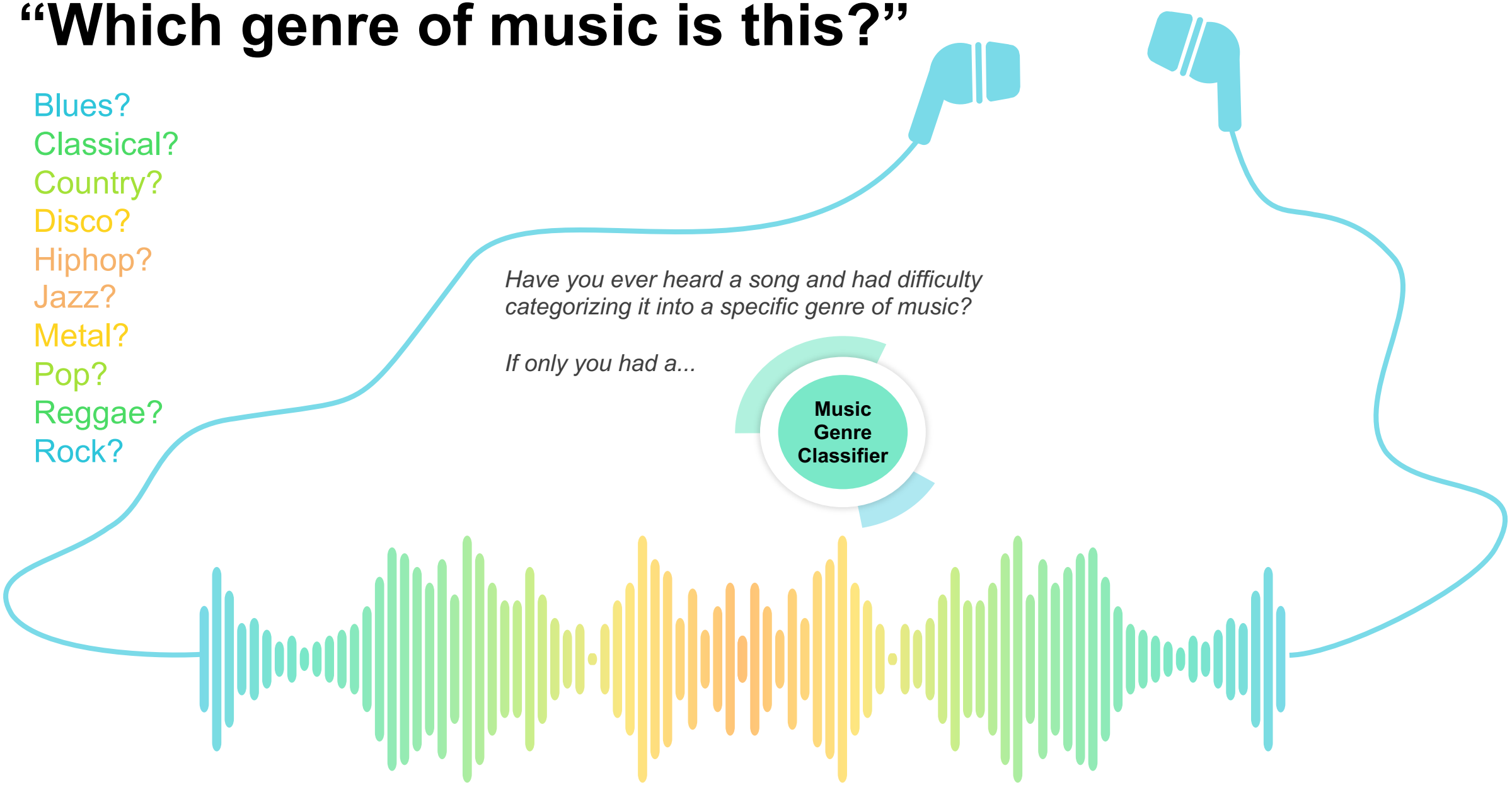
“Which genre of music is this?”

Blues?
Classical?
Country?
Disco?
Hiphop?
Jazz?
Metal?
Pop?
Reggae?
Rock?

Have you ever heard a song and had difficulty categorizing it into a specific genre of music?

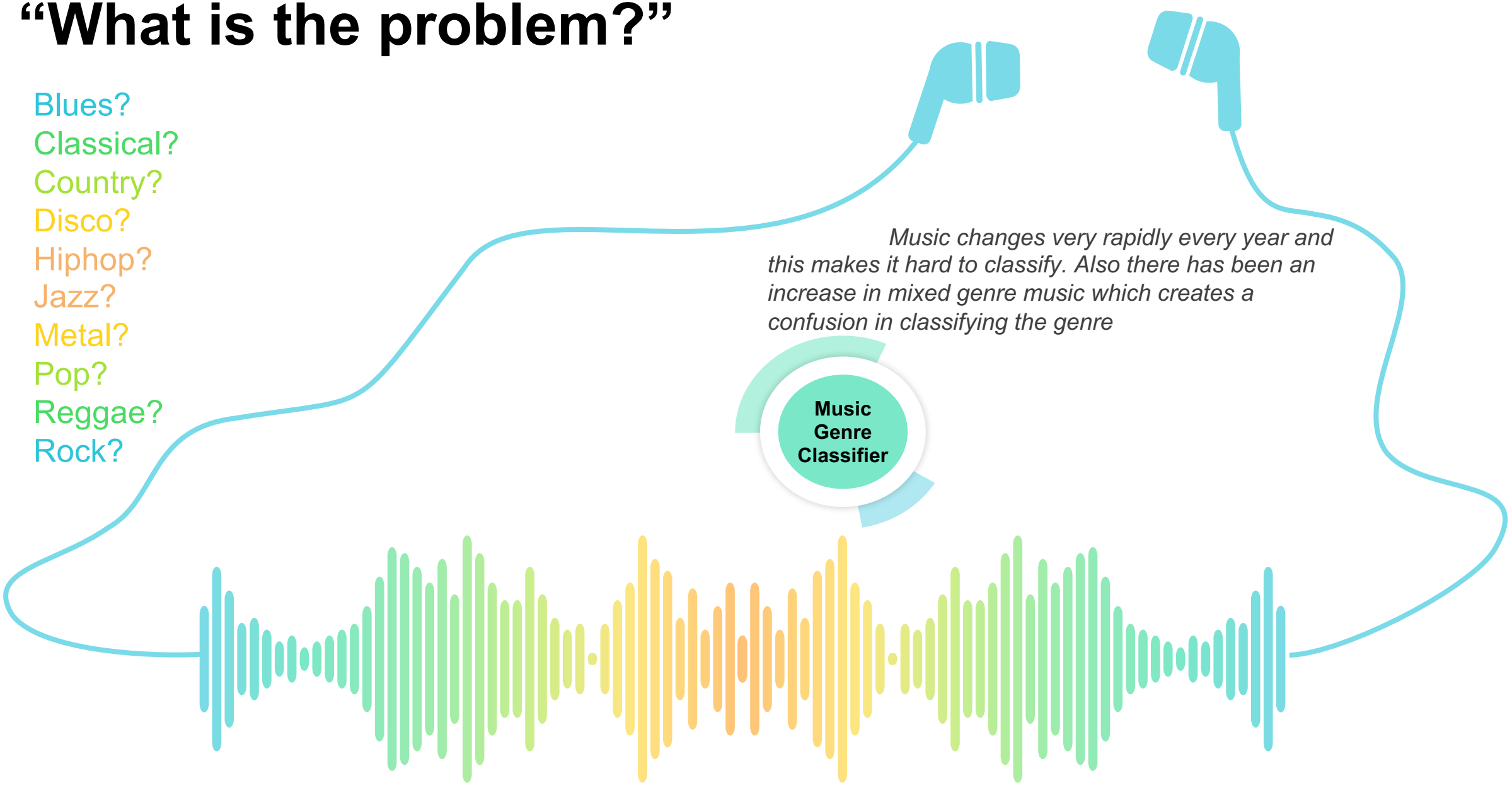
If only you had a...

Music Genre Classifier



“What is the problem?”

Blues?
Classical?
Country?
Disco?
Hiphop?
Jazz?
Metal?
Pop?
Reggae?
Rock?



Music changes very rapidly every year and this makes it hard to classify. Also there has been an increase in mixed genre music which creates a confusion in classifying the genre

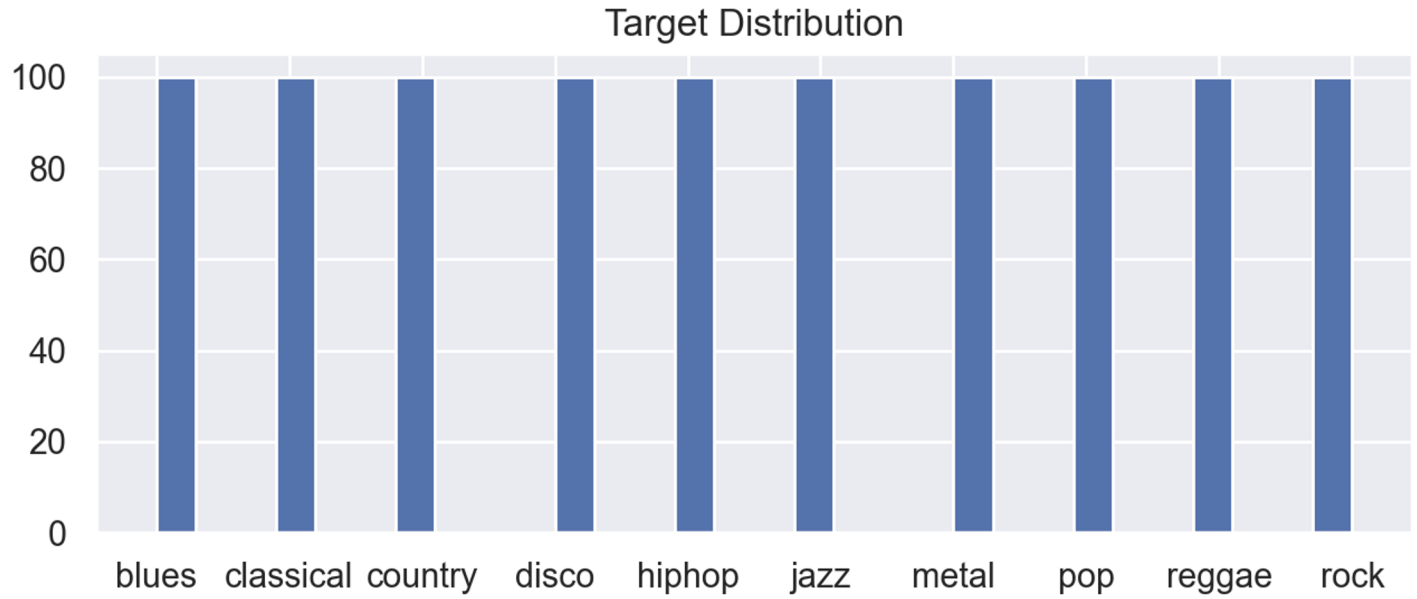
Music Genre Classifier

2 Dataset Overview

Dataset

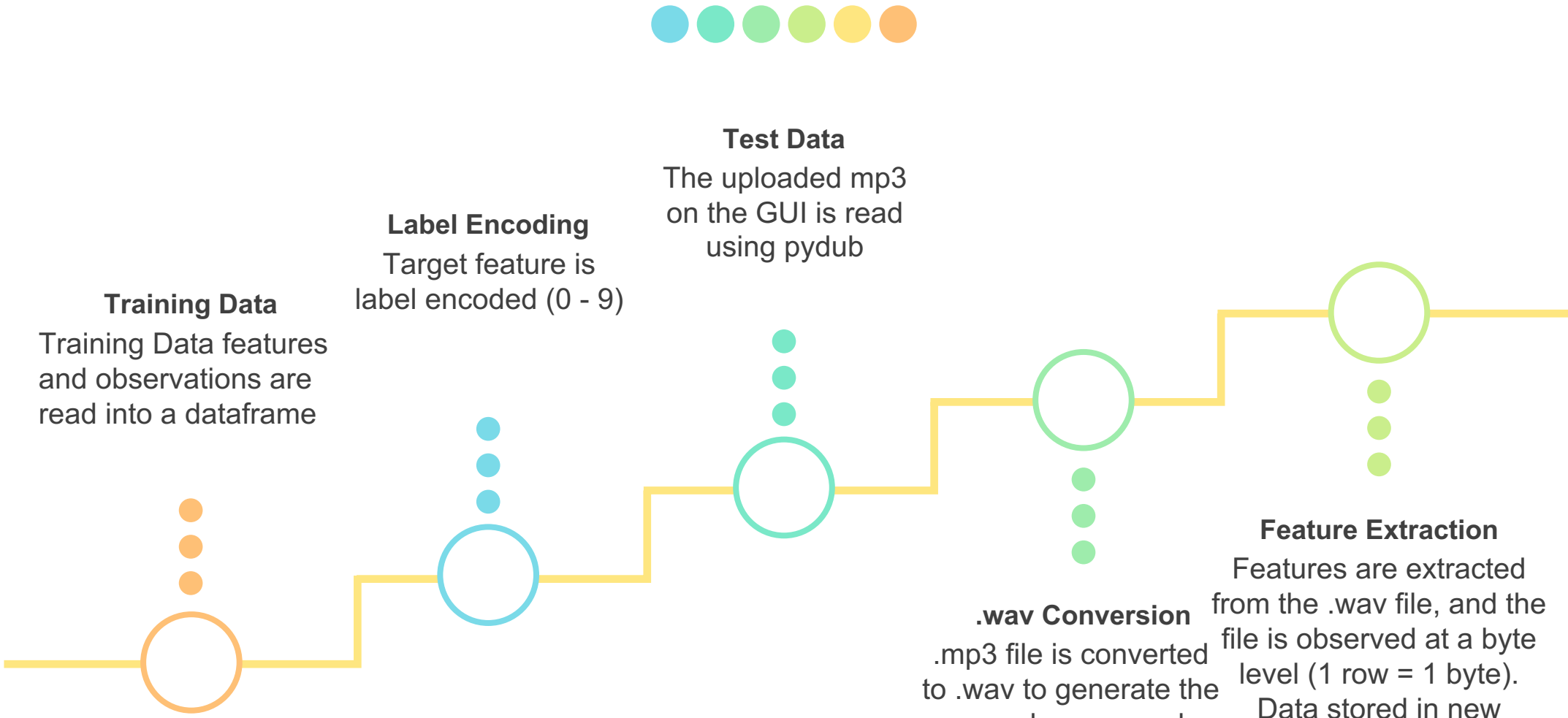
- Dataset: music genre classification dataset found on Kaggle.
- This dataset contains 27 features (filename, rmse, chromasft, central_spectroid, central_bandwidth, rolloff, zero_cross, and 20 mfcc for the various frequencies within each .wav (Mel frequency, the way in which humans perceive sound))
- Label: 10 classes (blues, classical, country, disco, hiphop, jazz, metal, pop, reggae, rock)
- 1,000 rows, each row representing a single .wav file.

Target Balance



3 Experimental Setup

Data Preprocessing



Training Data

Training Data features and observations are read into a dataframe

Label Encoding

Target feature is label encoded (0 - 9)

Test Data

The uploaded mp3 on the GUI is read using pydub

.wav Conversion

.mp3 file is converted to .wav to generate the sound waves and signals

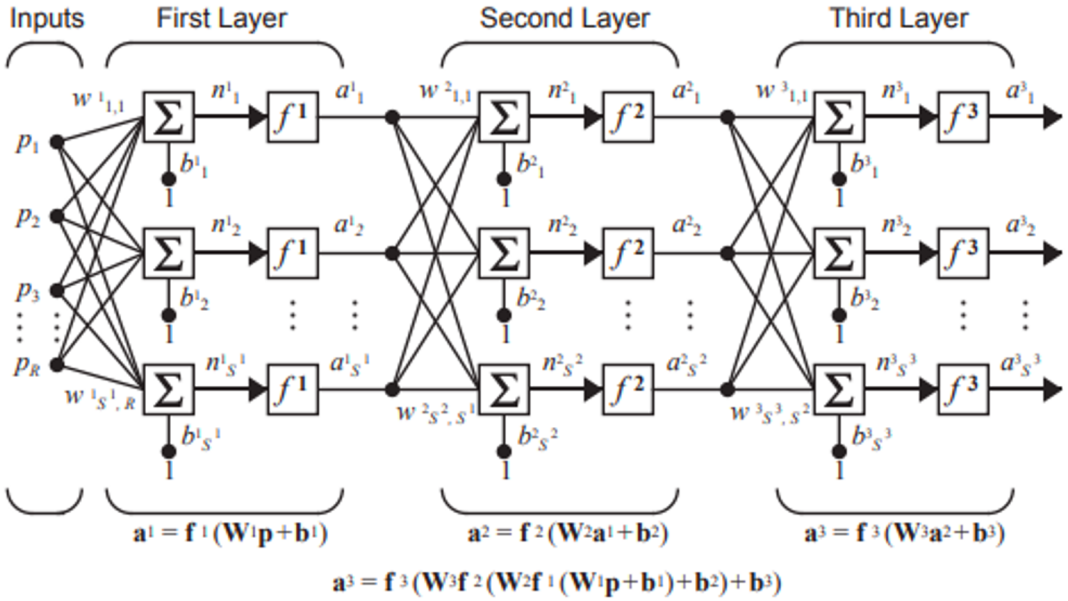
Feature Extraction

Features are extracted from the .wav file, and the file is observed at a byte level (1 row = 1 byte). Data stored in new dataframe.

4 Modeling

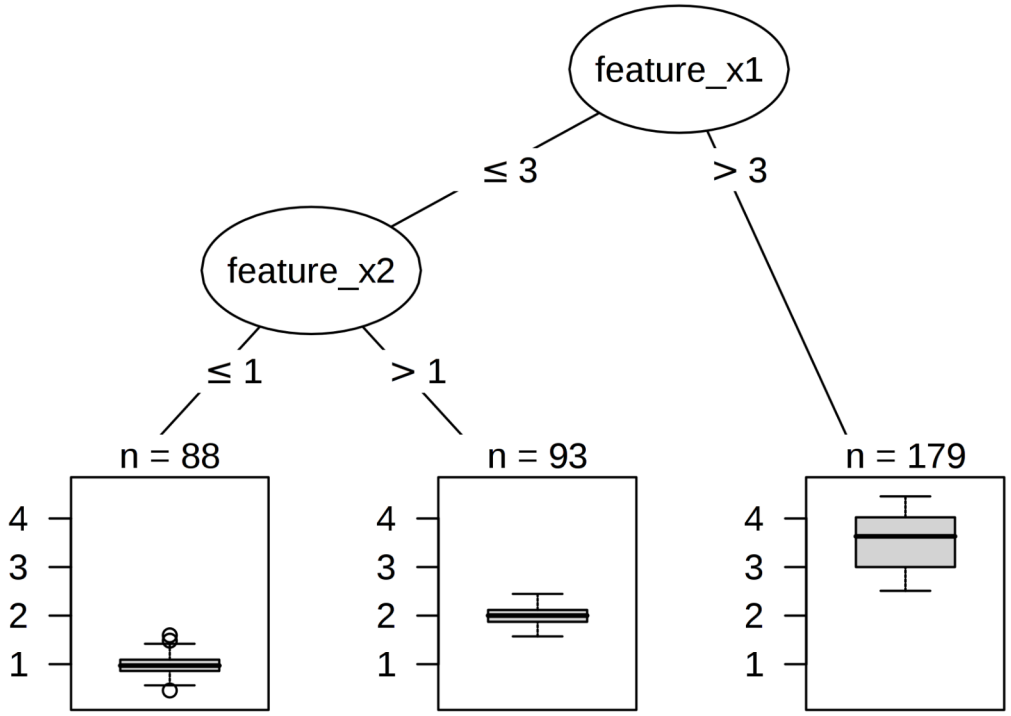
Multilayer Perceptron

- Feedforward artificial neural network
- Consists of three or more layers:
  - Input, Hidden Output
- Utilizes backpropagation
  - Supervised learning technique
- Benefits:
  - Can distinguish data that is not linearly separable
  - Can perform regression or classification



Decision Tree

- Consists of a root node and its successor children nodes
- Each node is split into binary groups based on a threshold of one of the features in the dataset
- Recursive partitioning continuously occurs until a subset of a node all have the same features, in which case they are grouped as a class
- Benefits:
  - Easy to read and interpret
  - Less data cleaning is required



Modeling

01 **Create Network**

Cross-Validation - GridSearchCV

```
MLPClassifier(
    hidden_layer_sizes=(60,100,60),max_iter=10000,learning_ra
    te='invscaling,solver="adam", activation='tanh', alpha=
    0.0001)
```

02 **Fit Data**

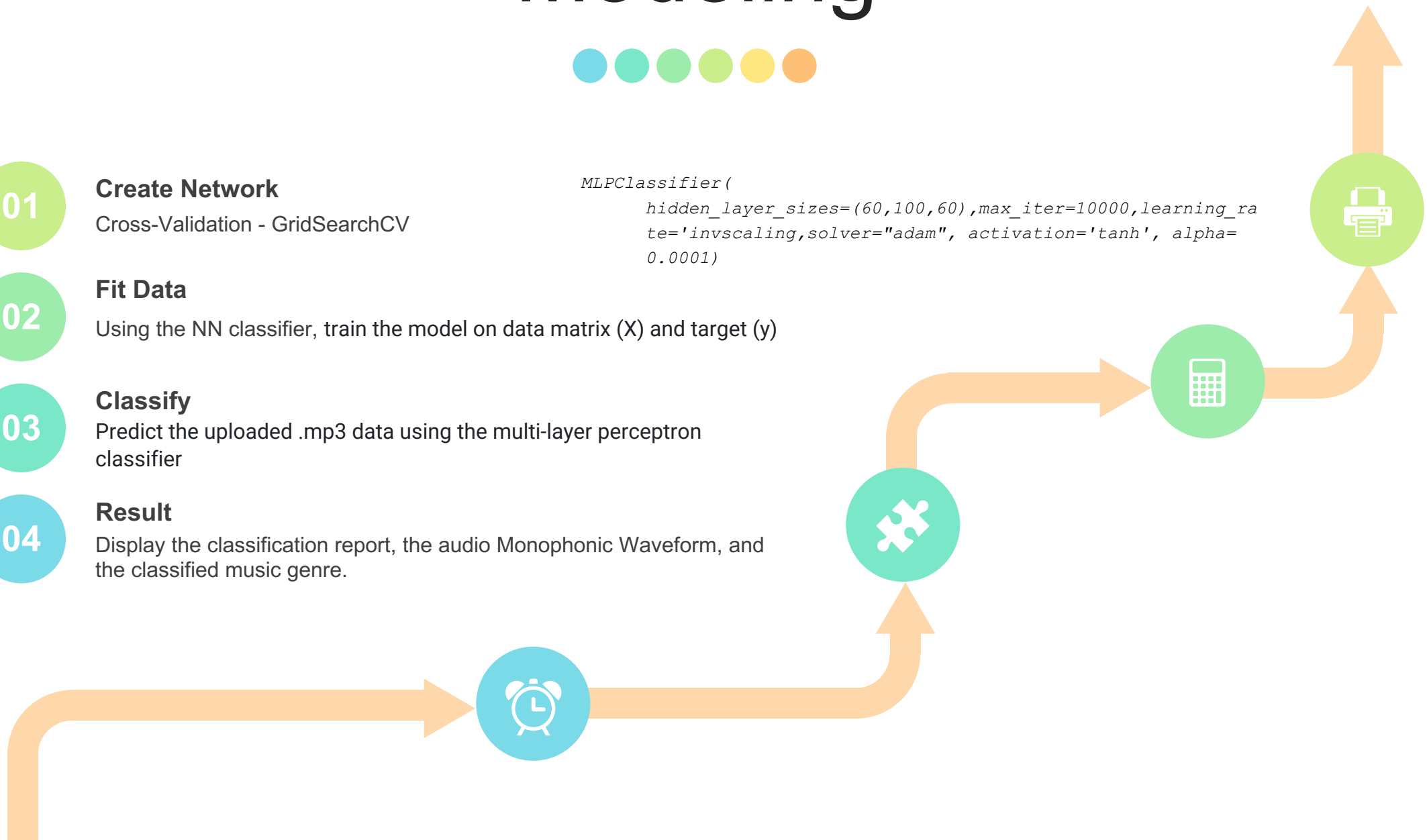
Using the NN classifier, train the model on data matrix (X) and target (y)

03 **Classify**

Predict the uploaded .mp3 data using the multi-layer perceptron classifier

04 **Result**

Display the classification report, the audio Monophonic Waveform, and the classified music genre.

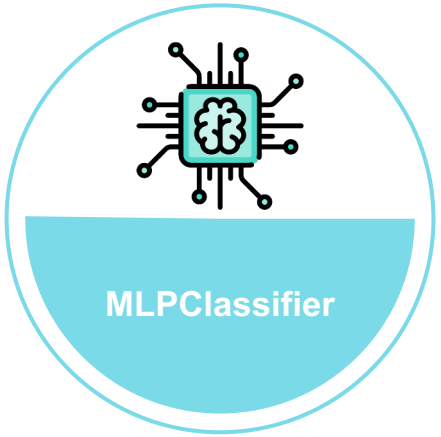


5 Results

.mp3 file to .wav conversion

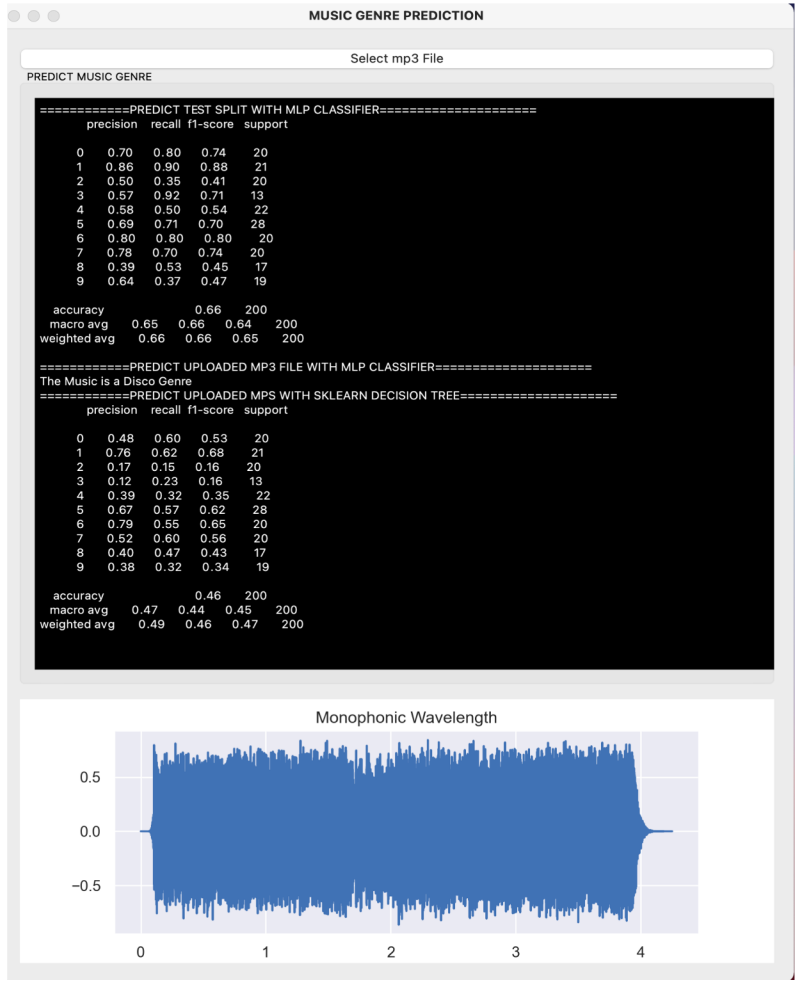
	chroma_stft	rmse	spectral_centroid	spectral_bandwidth	rolloff	zero_crossing_rate	mcff1	mcff2	mcff3	mcff4	mcff5	mcff6	mcff7	mcff8	mcff9	mcff10	
...	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.93994	0.00000	5512.49994	3185.74988	9377.70996	0.00000	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.44115	0.00000	5678.89222	3056.50287	9313.11035	0.21777	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.70805	0.00000	5361.18569	3064.92454	9054.71191	0.38281	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.82350	0.00001	4802.39228	3216.80506	8796.31348	0.46826	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.60006	0.00002	4318.46333	3309.27007	8559.44824	0.48682	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.79990	0.00004	3483.50141	3408.31884	7988.81836	0.27490	-529.10089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.
...	0.62671	0.00007	2620.33720	3294.50589	7202.85645	0.11182	-528.79077	0.43820	0.43731	0.43582	0.43375	0.43108	0.42784	0.42401	0.41962	0.41464	0.
...	0.68632	0.00011	2008.32484	3077.75282	6244.62891	0.02734	-527.45721	2.31599	2.29047	2.24832	2.19012	2.11663	2.02886	1.92798	1.81534	1.69241	1.
...	0.54665	0.00015	1545.11068	2787.94296	4877.27051	0.01318	-525.89618	4.51953	4.48180	4.41934	4.33279	4.22302	4.09113	3.93844	3.76648	3.57695	3.
...	0.51823	0.00024	1318.34394	2639.79371	3919.04297	0.00879	-525.14532	5.58221	5.54691	5.48838	5.40702	5.30344	5.17839	5.03276	4.86762	4.68412	4.
...	0.64215	0.00031	994.34481	2334.38658	1421.19141	0.00879	-522.88074	8.76673	8.67737	8.52962	8.32521	8.06655	7.75666	7.39918	6.99823	6.55844	6.
...	0.45984	0.00038	884.45728	2215.99874	333.76465	0.00830	-522.16919	9.76613	9.65611	9.47423	9.22269	8.90455	8.52362	8.08448	7.59237	7.05309	6.
...	0.16414	0.00041	960.06231	2288.33100	904.39453	0.00781	-522.44226	9.37844	9.26424	9.07559	8.81493	8.48568	8.09210	7.63926	7.13295	6.57960	5.
...	0.41382	0.00043	850.20524	2146.75109	312.23145	0.00977	-521.38928	10.86087	10.72671	10.50516	10.19922	9.81307	9.35190	8.82193	8.23019	7.58455	6.
...	0.33165	0.00041	880.53545	2216.09804	312.23145	0.01172	-521.71289	10.40563	10.27851	10.06848	9.77830	9.41173	8.97354	8.46936	7.90566	7.28960	6.
...	0.62237	0.00049	799.93302	2112.65480	279.93164	0.01367	-520.50372	12.08891	11.88276	11.54484	11.08335	10.50940	9.83648	9.08005	8.25693	7.38471	6.
...	0.29923	0.00063	662.89770	1880.09483	258.39844	0.01318	-518.33258	15.12630	14.82193	14.32343	13.64364	12.79991	11.81345	10.70859	9.51196	8.25160	6.
...	0.34909	0.00077	498.01452	1595.95793	193.79883	0.01270	-516.67798	17.47368	17.19068	16.72543	16.08737	15.28937	14.34735	13.27989	12.10768	10.85308	9.
...	0.39692	0.00098	459.21371	1519.95102	183.03223	0.01074	-516.26294	18.05709	17.76353	17.28049	16.61716	15.78609	14.80286	13.68575	12.45525	11.13361	9.
...	0.45517	0.00130	404.79293	1407.08609	183.03223	0.01025	-513.96021	21.26886	20.84291	20.14599	19.19709	18.02179	16.65129	15.12132	13.47078	11.74042	9.
...	0.75818	0.00185	331.72571	1205.09499	183.03223	0.00928	-510.84933	25.59777	24.96401	23.93273	22.54013	20.83438	18.87336	16.72187	14.44866	12.12323	9.
...	0.58436	0.00213	260.29502	1018.40441	150.73242	0.00830	-508.03717	29.53022	28.76546	27.52433	25.85514	23.82194	21.50120	18.97785	16.34100	13.67950	11
...	0.38707	0.00243	266.53030	1040.25391	172.26562	0.00928	-507.24017	30.62309	29.75799	28.35791	26.48297	24.21255	21.64082	18.87155	16.01244	13.16936	10
...	0.57163	0.00269	247.28033	997.40442	150.73242	0.00781	-507.82108	29.83179	29.05579	27.79891	26.11364	24.06926	21.74797	19.24030	16.64017	14.03992	11
...	0.47392	0.00255	261.83398	1022.88742	150.73242	0.00830	-507.40305	30.41983	29.63422	28.36056	26.65031	24.57143	22.20473	19.63938	16.96825	14.28298	11
...	0.46362	0.00298	251.89269	983.44430	161.49902	0.00830	-506.61523	31.50892	30.64956	29.25799	27.39277	25.13107	22.56430	19.79288	16.92075	14.04975	11
...	0.79689	0.00321	229.15735	901.05962	161.49902	0.00830	-504.93976	33.80588	32.73438	31.00665	28.70582	25.94064	22.83844	19.53712	16.17667	12.89084	9.
...	0.40423	0.00332	228.53342	861.34349	183.03223	0.00977	-502.18408	37.58883	36.18439	33.93279	30.96045	27.43041	23.52999	19.45685	15.40474	11.55024	8.
...	0.17391	0.00378	253.37690	915.81119	204.56543	0.01074	-501.38419	38.66582	37.10230	34.59746	31.29454	27.37835	23.06115	18.56686	14.11483	9.90472	6.
...	0.25591	0.00376	246.20275	882.60088	204.56543	0.01221	-501.22665	38.89997	37.36938	34.91563	31.67654	27.82972	23.57901	19.13922	14.72063	10.51473	6.
...	0.40655	0.00367	229.98729	818.37265	204.56543	0.01172	-500.52823	39.91838	38.47433	36.14706	33.05037	29.33307	25.16954	20.74882	16.26301	11.89609	7.
...	0.59033	0.00383	241.28080	839.99425	236.86523	0.01123	-498.94885	42.07455	40.40487	37.72287	34.17213	29.93906	25.23985	20.30571	15.36751	10.64125	6.
...	0.61516	0.00427	225.87106	813.26123	236.86523	0.01123	-497.34061	44.22132	42.18718	38.95680	34.75290	29.85538	24.57425	19.22089	14.08107	9.39268	5.
...	0.41121	0.00456	211.20642	725.51225	236.86523	0.01074	-495.76105	46.42645	44.30723	40.93861	36.54876	31.42536	25.88839	20.26115	14.84257	9.88414	5.

Outcome



- Accuracy Score: ~0.65
- Max F1-score variance: ~0.40
- Consistently outperformed decision tree model

- Accuracy Score: ~0.45
- Max F1-score variance: ~0.50



6 Conclusion

Conclusion

Overview

- Surprised the neural network outperformed a traditional model given the small dataset size
- MLPClassifier consistently outperformed the DecisionTreeClassifier

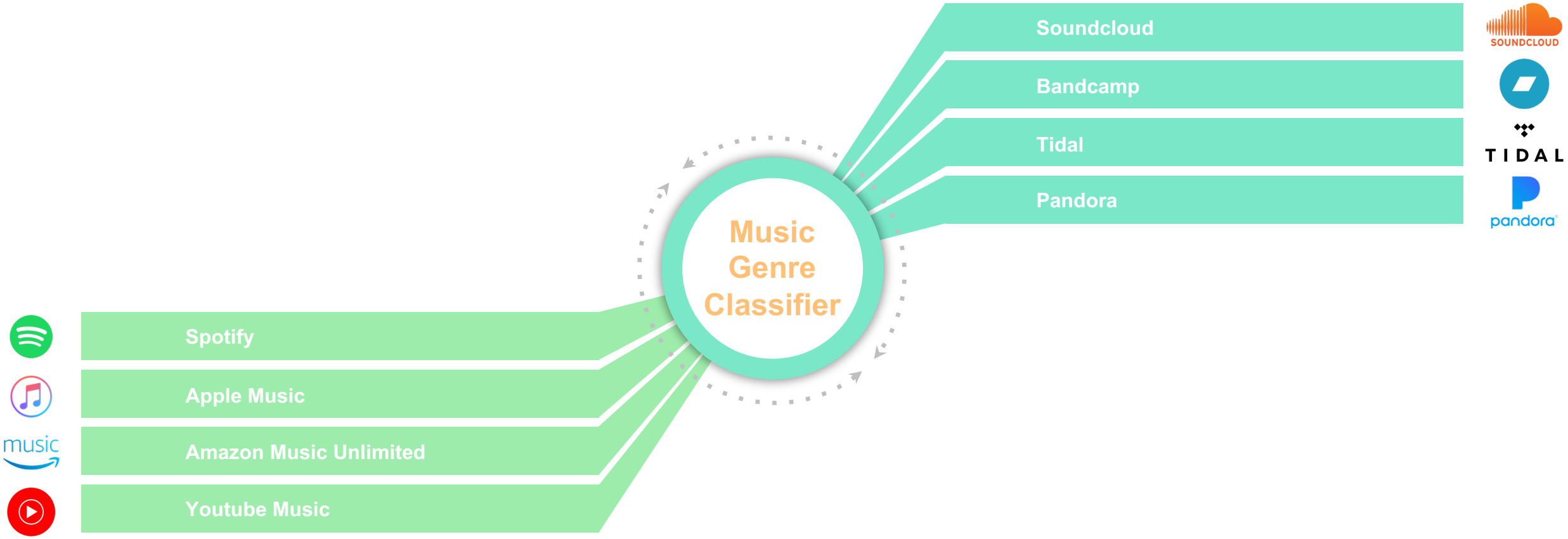
Difficulties

- Songs might not always fit into one genre
- High single-label precision is difficult to achieve

Caveats

- Training data limited to 10 core genres - ideal if training data consisted of larger array of genres
- Single-labeled classification is difficult to work with - interested to see how well the models would perform on multi-labeled data

Potential Clients



Citations

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Thank You