Project Proposal: Genre Prediction and Personalized Playlist Generation

UPDATE: 9th of August 2024

Introduction

In the landscape of digital music consumption, personalized music recommendation systems play a pivotal role in enhancing user experience. Analyzing the vast amount of track metadata available through platforms like Spotify, this project aims to develop a machine learning model capable of accurately predicting a song's genre based on its characteristics. Furthermore, it seeks to utilize this model to build personalized playlists for users, thereby tailoring music discovery to individual tastes and preferences.

artists	album_name	track_name	popularity	duration_ms	explicit	danceability	energy	...	loudness	mode	loudness	mode	speechiness	acousticness	instrumentalness	liveness	valence	tempo	time_signature	track_genre
Gen Hoshino	Comedy	Comedy	73	230666	False	0.676	0.4610	...	-6.746	0	-6.746	0	0.1430	0.0322	0.000001	0.3580	0.715	87.917	4	acoustic
Ben Woodward	Ghost (Acoustic)	Ghost - Acoustic	55	149610	False	0.420	0.1660	...	-17.235	1	-17.235	1	0.0763	0.9240	0.000006	0.1010	0.267	77.489	4	acoustic
Ingrid Michaelson;ZAYN	To Begin Again	To Begin Again	57	210826	False	0.438	0.3590	...	-9.734	1	-9.734	1	0.0557	0.2100	0.000000	0.1170	0.120	76.332	4	acoustic
Kina Grannis	Crazy Rich Asians (Original Motion Picture Sou...	Can't Help Falling In Love	71	201933	False	0.266	0.0596	...	-18.515	1	-18.515	1	0.0363	0.9050	0.000071	0.1320	0.143	181.740	3	acoustic
Chord Overstreet	Hold On	Hold On	82	198853	False	0.618	0.4430	...	-9.681	1	-9.681	1	0.0526	0.4690	0.000000	0.0829	0.167	119.949	4	acoustic

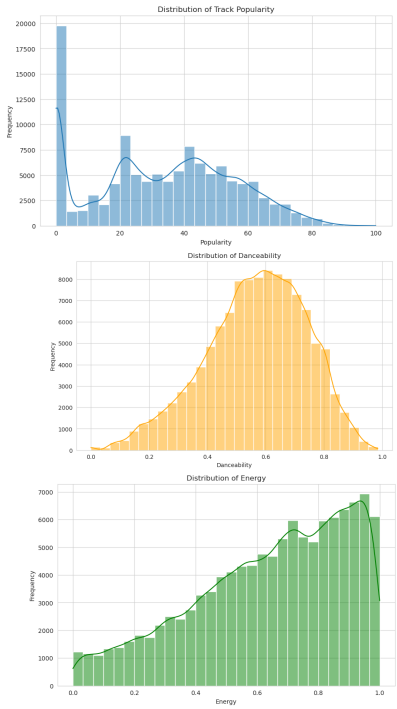
This dataset was discovered on Kaggle and compiles various features that I am interested in analyzing.

Detailed Project Objectives

1. Genre Prediction Model

Feature Engineering: Identify and extract relevant features from the dataset that significantly impact genre classification. Analyze correlations between track features and genres to refine the input feature set for the model. Explore dimensionality reduction for improved model performance and efficiency.

The first three graphs **below** are designed to kickstart the exploration of the dataset, focusing on understanding the nuances and patterns within the music tracks.



Track Popularity Distribution offers a snapshot of how tracks are spread across popularity levels. This insight is invaluable because the appeal of different genres can vary widely, with some being more mainstream than others.

Danceability Distribution delves into the rhythm and beat characteristics of tracks, which are crucial for dance genres. This metric varies by genre, and identifying its pattern helps pinpoint genre-defining attributes.

Energy Distribution examines track intensity. Since genres range from high-energy rock and dance to more subdued classical pieces, this distribution helps differentiate between them.

Model Development: Test multiple machines learning algorithms, including Random Forest, Gradient Boosting Machines, and Neural Networks, K-mean, (clustering). TBD

Evaluation Metrics: Employ metrics like Precision, Recall, F1 Score, and Confusion Matrix to thoroughly assess model performance, focusing on strengths and handling class imbalances. *TBD*

2. Personalized Playlist Generation

User Profile Development:

- **Dynamic User Profiles:** Implement user profiles that evolve based on interactions within a database, capturing preferences and listening history to refine recommendation logic.

Recommendation System:

- **Engine Design:** Develop a recommendation engine that uses database user profiles and song characteristics to suggest tracks. Utilize similarity scoring to prioritize songs that align closely with user preferences.

Feedback Loop Integration:

- **Iterative Feedback:** Create a feedback loop where user interactions (like a song for example) adjust profiles and recommendations, continually enhancing the system's accuracy and user satisfaction.

Note: Part 1 & 2 will be both related as, ML models from part 1 will be used for the recommendation system.

3. Implementation and Deployment

Prototype Development:

Streamlit Application: Develop a desktop prototype using Streamlit to demonstrate the functionality of the genre prediction and personalized playlist systems. Streamlit provides a seamless way to create a web-based interface that can run locally, offering an easy-to-use solution for rapid prototyping and offline usage.

User Experience Design:

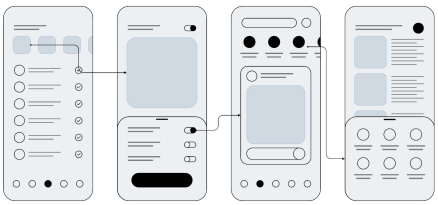
Intuitive Interface: Design a user-friendly interface with Streamlit, featuring straightforward navigation and immediate feedback mechanisms. Streamlit's ability to quickly integrate interactive components and visualizations will enhance user understanding and transparency of the recommendation process.

2. Personalized Playlist Generation

User Profile Development: Create dynamic user profiles that evolve based on interactions, tracking users' genre preferences, and favored artists to inform recommendation logic.

Recommendation System: Design a recommendation engine that suggests tracks by matching the user's profile with song characteristics and predicted genres, prioritizing songs with higher similarity scores.

Feedback Loop Integration: Develop an iterative feedback loop where user interactions continually inform and adjust the recommendation algorithm, improving future recommendations.



3. Implementation and Deployment

Prototype Development: Build a prototype to demonstrate the functionality of the genre prediction model and the personalized playlist generation system.

User Experience Design: Focus on creating an intuitive and engaging user interface that allows easy interaction and feedback provision, including visualization tools for enhanced transparency.

Conclusion

In exploring the concepts introduced throughout this course, I aim to construct a model that predicts musical genres from intricate data patterns and relationships between various track features. This model lays the groundwork for a second objective: crafting a unique user interface that leverages this predictive capability to curate personalized playlists, enhancing the listening experience with machine learning-driven recommendations.

Navigating through this project, I recognize my technical expertise is still developing. This proposal is more a reflection of my enthusiasm and vision for what can be achieved, rather than a comprehensive technical plan. I'm keen to push my boundaries and see how far this project can take m.I must express my appreciation to Anna and Maria Pia for their mentorship and the time they've dedicated for the meeting. I'm hopeful for a positive reception to this proposal and am open to any additional advice that can help refine my approach.

Desired Structure

```
├── notebooks/          # Jupyter notebooks for data analysis
|   └── data_analysis.ipynb
|
├── src/                # Source code for the Tkinter application
|   ├── __init__.py
|   ├── main.py         # Main application script for Tkinter
|   ├── gui.py          # GUI setup and logic
|   ├── models.py       # Python module to load and use ML models
|   └── utils.py        # Utility functions, e.g., data preprocessing
|
└── requirements.txt    # Project dependencies
```