**Course Project Proposal: Music Genre Classification**

**Introduction**

The objective of this project is to create a machine learning model that automatically classifies music genres from audio files. By leveraging the K-Nearest Neighbors (KNN) algorithm, the model will predict a music genre based on the audio’s features. This will contribute to improved music categorization, which is essential for recommendation systems and media applications.

**Dataset**

We are using the GTZAN genre classification dataset, which consists of 1000 audio tracks. Each track is 30 seconds long and belongs to one of 10 genres: Blues, Classical, Country, Disco, Hiphop, Jazz, Metal, Pop, Reggae, and Rock. This balanced dataset provides an excellent foundation for building and testing the classification model.

**Methodology**

**1**. **Feature Extraction**: We will extract relevant audio features that capture time and frequency domain characteristics using Python’s `LibROSA` library. Key features include:

- Mel Frequency Cepstral Coefficients (MFCCs): Represents the power spectrum of sound, often used in speech and music analysis.

- Zero Crossing Rate: Measures how often the signal changes sign, indicating frequency content.

- Spectral Centroid and Roll-off: These describe the "brightness" and energy distribution in the sound, useful for distinguishing genres.

**2**. **KNN Algorithm**:

- KNN will be used as the classifier because of its simplicity and effectiveness in this type of task. It works by comparing the audio tracks based on their feature distances (Euclidean distance).

- **Hyperparameter Tuning**: We will experiment with different values of `k` (the number of neighbors) to find the one that offers the best accuracy.

**3**. **Training and Validation**:

The dataset will be split into training and testing sets. We’ll use cross-validation to evaluate the model's performance and ensure its generalization on unseen data.

**Evaluation**

To measure the model’s effectiveness, we will use several evaluation metrics:

- Accuracy: The proportion of correctly classified music genres.

- Confusion Matrix: A breakdown of true positives, false positives, and other error types to analyze model performance by genre.

- Precision, Recall, and F1-Score: These metrics will be used to assess the balance between precision and recall for each genre, ensuring the model performs well across all classes.

In summary, this project will utilize the KNN algorithm to classify music genres, focusing on feature extraction and model evaluation. The outcome will deepen our understanding of audio processing and machine learning for music classification.

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