SYMPHONY: As You Like It!

(Music Recommendation System)

Capstone Project Proposal

Submitted by:

(101503004) ABHIMANYU SHARMA

(101503023) AMANDEEP SINGH

(101503086) HARNOOR SINGH BEDI

BE Third Year, CSE

Project Team No. CPG-142

Under the mentorship of:

Ms. Vineeta Bassi
Assistant Professor

Mr. Sanjeev Rao
Lecturer

Computer Science and Engineering Department

Thapar Institute of Engineering and Technology, Patiala

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Mentor Consent Form

Project Overview

Music recommender system is a system which learns from the users past listening history and recommends them songs which they would probably like to hear in future. The project involves implementation of various algorithms to build an effective music recommender system.

- Firstly, it involves implementation of Non-Personalized popularity based model which provides each song in descending order of popularity skipping those songs already consumed by the user.
- The recommender system also provides the user with the greatest hits of the artist that the user has already listened to.
- Collaborative filtering algorithms which predict (filtering) taste of a user by collecting preferences and tastes from many other users (collaborating) is also implemented.
- The project also involves experiments on content based models, based on latent factors and metadata.

The Data set to be used is provided by Million Song Data Challenge hosted by Kaggle. It was released by Columbia University Laboratory for the Recognition and Organization of Speech and Audio. The dataset includes meta-data (e.g., artist identifiers, tags, etc.), audio content analysis and standardized identifiers for all the songs.

Need Analysis

With the rise of digital content distribution, people now have access to music collections on an unprecedented scale. Commercial music libraries easily exceed 15 million songs, which vastly exceeds the listening capability of any single person. With millions of songs to choose from, people sometimes feel overwhelmed. Thus, an efficient music recommender system is necessary in the interest of both music service providers and customers. Users will have no more pain to make decisions on what to listen while music companies can maintain their user group and attract new users by improving users' satisfaction.

In the academic field, the domain of user centric music recommendation has always been ignored due to the lack of publicly available, open and transparent data. Million Song Dataset Challenge provides data which is open and large scale which facilitates academic research in user centric music recommender system which hasn't been studied a lot.

Literature Survey

With the explosion of network in the past decades, internet has become the major source of retrieving multimedia information such as video, books, and music etc. People has considered that music is an important aspect of their lives and they listen to music, an activity they engaged in frequently. Previous research has also indicated that participants listened to music more often than any of the other activities (i.e. watching television, reading books, and watching movies). Music, as a powerful communication and self-expression approach, therefore, has appealed a wealth of research.

However, the problem now is to organize and manage the millions of music titles produced by society. MIR techniques have been developed to solve problems such as genre classification, artist identification, and instrument recognition. Since 2005, an annual evaluation event called Music Information Retrieval Evaluation exchange (MIREX1) is held to facilitate the development of MIR algorithms.

Additionally, music recommender is to help users filter and discover songs according to their tastes. A good music recommender system should be able to automatically detect preferences and generate playlists accordingly. Meanwhile, the development of recommender systems provides a great opportunity for industry to aggregate the users who are interested in music. More importantly, it raises challenges for us to better understand and model users' preferences in music.

Currently, based on users' listening behavior and historical ratings, collaborative filtering algorithm has been found to perform well. Combined with the use of content-based model, the user can get a list of similar songs by low level acoustic features such as rhythm, pitch or high-level features like genre, instrument etc.

Some music discovery websites such as Last.fm, Allmusic, Pandora and Shazam have successfully used these two approaches into reality. At the meantime, these websites provide a unique platform to retrieve rich and useful information for user studies. Music is subjective and universal. It not only can convey emotion, but also can it modulate a listener's mood. The tastes in music are varied from person to person, therefore, the previous approaches cannot always meet the users' needs. An

emotion-based model and a context-based model have been proposed. The former one recommends music based on mood which allows the user to locate their expected perceived emotion on a 2D valence-arousal interface. The latter one collects other contextual information such as comments, music review, or social tags to generate the playlist. Though hybrid music recommender systems would outperform the conventional models, the development is still at very early stage. Due to recent studies in psychology, signal processing, machine learning and musicology, there is much room for future extension.

Music as a self-expression tool, it always performs with affection. Rich in content and expressivity, the conventional approaches for music information retrieval are no longer sufficient. Music emotion has appealed lots of research and it has become the main trend for music discovery and recommendation. A commercial web service called 'Musicovery' uses the fundamental emotion model (2D valence-arousal) found by psychologists. It allows users to locate their expected perceived emotion in a 2D space: valence (how positive or negative) and arousal (how exciting or calming).

Similar to content-based model, the emotion perception is associated with different patterns of acoustic cues. Different perceptual features such as energy, rhythm, temporal, spectral, and harmony have been widely used in emotion recognition.

Hybrid model aims at combining two or more models to increase the overall performance. Burke pointed out several methods to build a hybrid model such as weighted, switching, mixed, feature combination, and cascade. There is no doubt that a proper hybrid model would outperform a single approach, since it can incorporate the advantages of both methods while inheriting the disadvantages of neither.

Objectives

- Personalized music recommendation system with the goal of predicting the songs that a user is going to listen.

- Measure the precision and recall of different algorithms and decide which is more efficient to apply on the dataset.

- Integrate this algorithms into a webpage where user can login and search for their music and get personalized recommendations according to their taste.

- To improve overall efficiency of the recommendation system using more optimized algorithms.

Methodology

Data Set: Data is provided by Million Song Data Challenge hosted by Kaggle. It was released by Columbia University Laboratory for the Recognition and Organization of Speech and Audio.

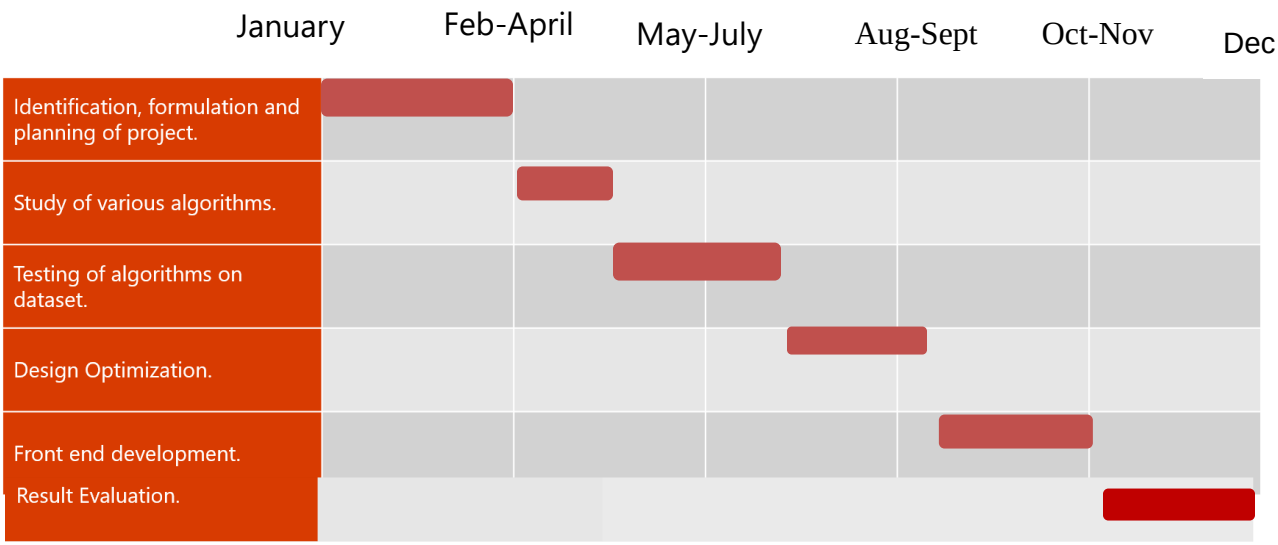
Algorithms: Various algorithms to be implemented build an efficient recommendation system.

- **Popularity based Model:** It is the most basic and simple algorithm. We find the popularity of each song by considering the training set and calculating the number of users who had listened to this song. Songs are then sorted in the descending order of their popularity.
- **Collaborative based Model**: Collaborative filtering involves collecting information from many users and then making predictions based on some similarity measures between users and between items. This can be classified into user-based and item based models.
    - In item-based model, it is assumed that songs that are often listened together by some users tend to be similar and are more likely to be listened together in future also by some other user.
    - According to user based similarity model, users who have similar listening histories, i.e., have listened to the same songs in the past tend to have similar interests and will probably listen to the same songs in future too.
- **SVD Model (Singular Value Decomposition):** Listening histories are influenced by a set of factors specific to the domain (e.g. genre, artist). These factors are in general not at all obvious and we need to infer those so called latent factors from the data. Users and songs are characterized by latent factors.
- **KNN Mode:** In this method, the available metadata is utilized. A space of songs is created according to their features from metadata and find out neighborhood of each song. Some of the available features are chosen (e.g., loudness, genre, mode, etc.) which are found to be most relevant to distinguish a song from others. After creating the feature space, to recommend songs to the users, each

user's profile is looked and suggest songs which are neighbors to the songs present in his listening history.

Evaluation Metrics: Precision and recall are used as evaluation metrics for the algorithms.

Work Plan


January
Feb-April
May-July
Aug-Sept
Oct-Nov
Dec
Identification, formulation and planning of project.
Study of various algorithms.
Testing of algorithms on dataset.
Design Optimization.
Front end development.
Result Evaluation.

Project Outcomes

- Working software prototype.

  A web application would be available for user in which user can search for music and get recommendations based on its history.

- Accurate Recommendations.

  Various algorithms are analyzed and compared based on precision and recall providing accurate recommendations to the user.

- User friendly web applications.

  User will be able to easily search for his choice of music with help of user friendly interface which can be accessed by people from all age groups.

Individual Roles

Team Member	Role
Abhimanyu Sharma	Understanding and implementation of the various algorithms
Amandeep Singh	Optimizing the algorithms, Web development.
Harnoor Singh Bedi	Study of statistics and linear algebra behind the mathematics used in algorithms

Course Subjects

- Machine Learning
- Database Management System
- Data Analytics and Visualization.
- Statistics
- Linear Algebra
- Artificial Intelligence

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