

User Customized Playlist Generation Based on Music Similarity



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About the Presenter



- **Name**
 - Karan Kumar Budhraj
- **Qualifications**
 - B.Tech. from National Institute of Technology, Jalandhar (2010)
- **Other Contributions**
 - “Probability Based Playlist Generation Based on Music Similarity and User Customization” (NCCCS 2012)

Introduction



- Large music databases
 - Playlist generation helpful
- Songs (N) considered as nodes of a graph
 - Similarity between two songs related to weight of edge
 - Exhaustive approach has $O(N^2)$ calculations
- Songs divided into groups
 - Some multiplications replaced by additions
 - Calculations greatly reduced

Musical Attributes



- Classification of attributes
 - Temporal, spectral, perceptual, harmonic, statistical
- Mel Frequency Cepstrum Coefficients (MFCC) used
 - Perceptual feature
 - Coefficient values translated using Gaussian Mixture Model (GMM)

Song Selection Methodology



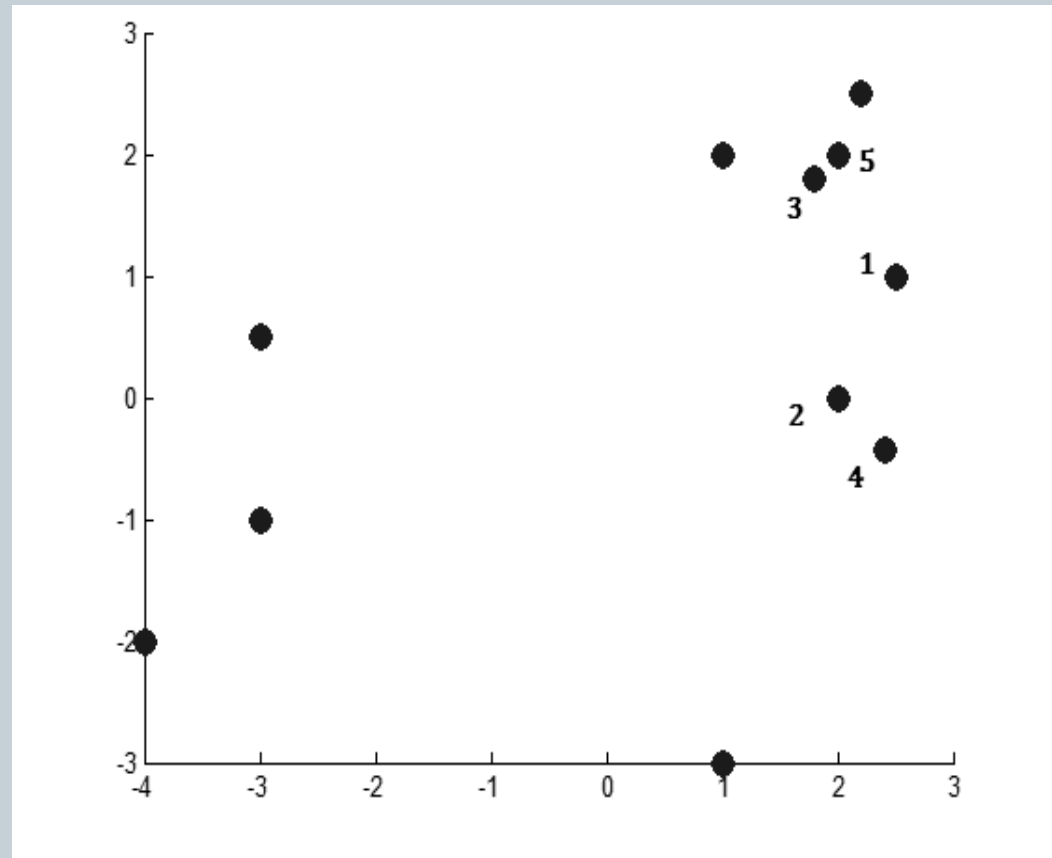
- Song Similarity
 - Each song represented in Euclidian space
 - Considered as vectors
 - Cosine similarity based on angle between two vectors
 - ▮ Does not distinguish magnitudes
 - ▮ Distance based term added to check this

$$\text{Similarity} = \cos \theta - \frac{\tan^{-1}(d)}{p}$$

Song Selection Methodology



Even though the items mapped to points 2 and 3 are close to the item mapped to point 1, if considered as a pair, they are both individually closer to other items (mapped to points 4 and 5 respectively).



Song Selection Methodology



- Exhaustive Suggestion Algorithm
 - Each song considered for similarity calculation
 - $N.(N-1)$ computations per iteration

Song Selection Methodology



- **Proposed Suggestion Algorithm**

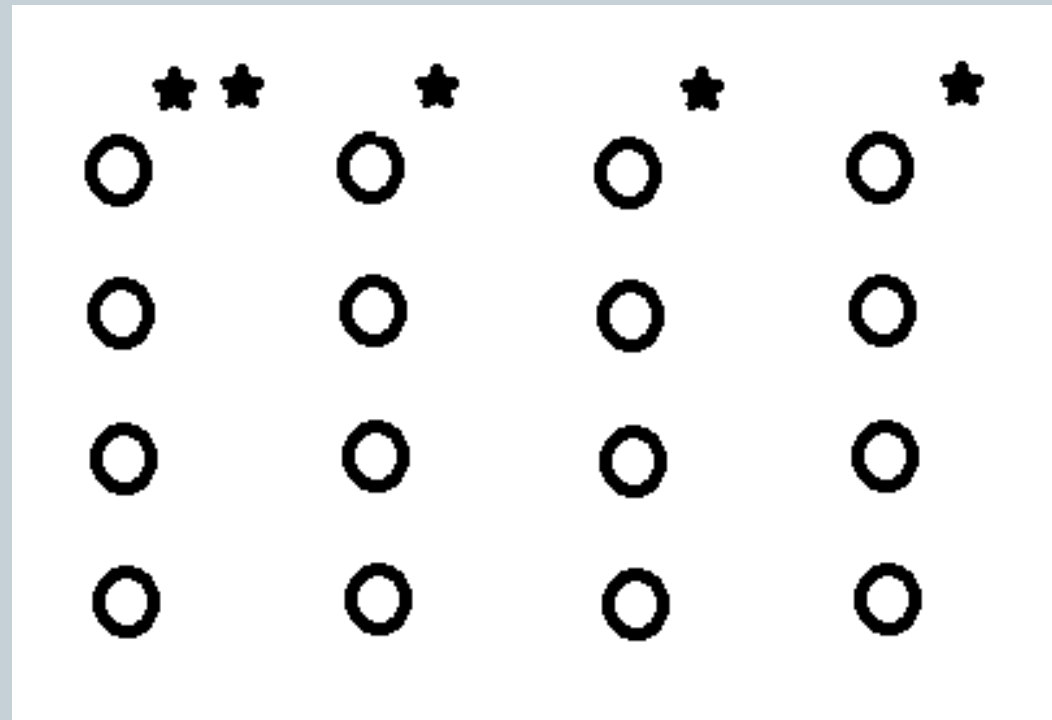
- **Divide dataset into G groups**

- ▮ Each group contains element for inter-group distance calculation
- ▮ Each group contains element for intra-group distance calculation
- ▮ Kept as same in implementation

Song Selection Methodology



- An example of level 1 and level 2 (as shown for the first group of elements from the left) *highlights*.



Song Selection Methodology



- *Dissimilarity* used to measure distance

$$Dissimilarity = \frac{1}{(Similarity + Similarity_{Min})}$$

- $Similarity_{Min}$ added for mathematical convenience
- *Pheromone* used to track history
 - Less repetition

Song Selection Methodology



- **Feedback**

- May be positive or negative
- Range from +1 to -1
- If feedback is 1, we use suggested song as next reference
 - ▮ Songs similar to a song not always similar to each other

Song Selection Methodology



- System Modification

- Weight Modification

- ▮ Specific to each attribute

- ▮ Positive feedback

- Attributes with more difference in values given less weight

- These are less important attributes for the user

- ▮ Negative feedback

- Attributes with more difference in values given more weight

- These are more important attributes for the user

Song Selection Methodology



- System Modification
 - Pheromone Modification
 - ▮ Evaporation after each iteration
 - ▮ Exponential decay

Evaluation




- Evaluation using precision
 - Fraction of songs suggested that suit given context
 - Songs grouped using fuzzy sets
 - Precision calculated per iteration
 - ▮ +1 if suggestion has certain membership value in fuzzy set corresponding to base song
 - ▮ -1 otherwise

Evaluation

● Results

Precision values for song suggestion over 10 runs of the algorithm. It should be noted that the systems were taken from their initial state where nothing has been learned



Run	Exhaustive Algorithm Precision	Deterministic Algorithm Precision
1	0.7	0.5
2	0.8	0.5
3	0.7	0.5
4	0.8	0.5
5	0.7	0.5
6	0.8	0.5
7	0.7	0.5
8	0.8	0.5
9	0.7	0.5
10	0.8	0.5

Evaluation



- Discussion
 - Fluctuation of base system attributed to system modifications
 - System degrades precision
 - Due to simplistic nature of modifications
- Future Work
 - Selection of group representation element may be more intelligent
 - Currently random
 - Modifications may be made complex

Related Work



- **Alternative version uses probabilistic method**
 - Only few candidates considered for suggestion
 - Calculation reduced
 - Produced lower precision values than current system

Conclusion



- Algorithm for playlist generation proposed
- User specific customization
 - Sensitivity to attributes
- Much reduction in computation
 - Loss in precision
- System must be enhanced for better performance

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