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A BIPARTITE GRAPH APPROACH TO MUSIC ANALYSIS

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Abstract:

Any piece of music or song can be described as a graph, where nodes stand in for individual pitch-duration tuples and edges for several notes occurring simultaneously. Set graph can be used to produce a set of features that can be applied to various classification techniques. The idea of applying machine learning to quicken, enrich, or speed up the process of classifying music according to genre is not a new one. In the past, melodic similarity has been determined using graph representations of music. Musical graph representations offer a wealth of information and harmonic sorts of information that may be obtained or retrieved. The matching conditions of music are modeled as musical graphs, which are undirected graphs. The appendix contains the graph theory notation and a synopsis. The relationship between two musical notes is represented by an edge, and each musical note is a vertex. An event is a vertex in the stream segregation model and a pair-wise relationship between events is an edge. Comparisons are drawn between the patterns found by the musicologists and those found by the graph-theoretical approach.

1. Introduction:

Analysis of post-classical music-art that originated in India in the late 20th century and whose notable composers include Clarence Barlowe, L. Subramanian, Sandeepagavathi, Reena Esmail, Vijay Iyer, R. D. Burman, Ilayaraja, and Rudhra Mahanthappa-involves figuring out how this music functions by identifying the fundamental elements that serve as a work's unifying cells. These musical motifs can be represented as a pattern matching issue.

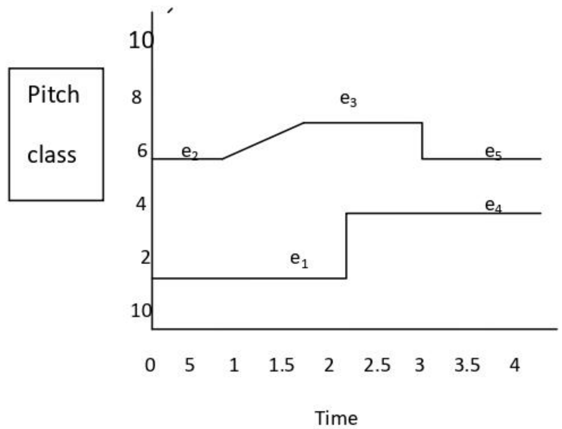
This paper focuses on the pitch-class based pattern matching issue in post- classical music analysis. The best musical graph theory examples are the beginnings of R.D. Burman tunes. However, Ilayaraja, regarded as the living Thyagaraja, composed a number of melodic and harmonic as well as typical notes. The collection of notes in numerous songs is viewed from the angle of pitch-class graph theory. Indian composers of the 20th century had more freedom to experiment with techniques to combine music creation and pitch class graph theory. Musicologists have conducted numerous research projects on musical graph analysis.

This paper is organized as follows. Section 2 briefly explains music representation and this information is the foundation of representing music as a graph which is also discussed. Pattern matching conditions proposed in section 3. The music representation algorithm is identified in section 4.

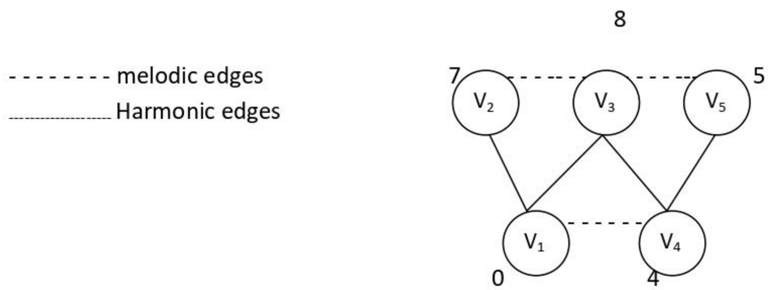
2. Music Representation:

A process of representation includes using models to organize record and communicate mathematical ideas. According to Pythagoras (a Greek philosopher who made important developments in mathematics and the theory of music), anyone can teach mathematics through music based on musical graph. The concept of using machine learning to expedite, improve or enhance the ability to assign genre classification to music is not a new one. In the past, graph representations of music have been used to derive melodic similarity. Many information and harmonious types of information that could potentially be extracted or derived from musical graph representation. The musical graph of the five-event example is given below. A vertex vi corresponds to the event ei. Dotted lines represent melodic edges; while solid lines denote harmonic edges.

Integer Name	Pitch-Class Content	Integer Name	Pitch-Class Content
0	Re#, sa, Ni bb	5	Tha#,pa,Ma bb
1	Sa#, Ni b	6	Pa#, Ma b
2	Sa*, Ni, Tha bb	7	Pa*,Ma,Ga bb
3	Ni # , Tha b	8	Ma #, Ga b
4	Ni* , Tha , Pa b	9	Ma*,Ga,Re bb



The set of all vertices melodically near by a vertex v is indicated by Adjm(v). The set of all vertices harmonically adjacent to a vertex v is indicated by Adjh(v). Two events cannot be both sequential and simultaneous. Hence, a vertex cannot be both melodi- cally adjacent and harmonically adjacent to another vertex, thus Adjm(v) ∩ Adjh(v) = φ.



3. Matching Rubrics:

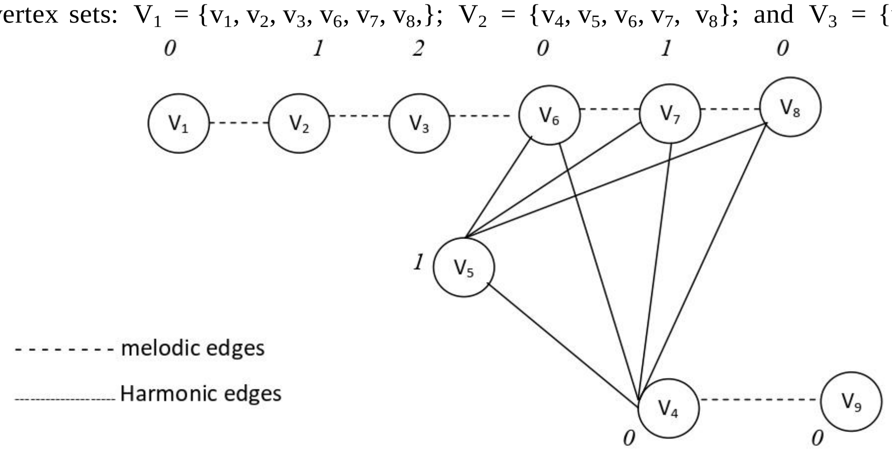
Scholars of mathematics claim that post-classical music analysis lacks appropriate matching criteria. Most musicologists concur that the harmonic and melodic relationships between musical notes in a matched pattern are important. We suggest the following musical graph and a pitch class set query in order to preserve the melodic and harmonic link between musical notes in a matched pattern..Through this ,we get an answer is a complete harmonic-edged *r*-partite sub graph, in which the vertices in each partition class form a melodic path, and the set of pitch classes in the sub graph equal to the pitch- class. This implies that given any two notes in an answer, they are either connected by harmonic edge or melodic edge. To convey formally, the following definition is needed.

Definition 1:

A graph G = (V,E) is a complete r- partite CRP graph $r \geq 1$ if for any two vertices v and w in V, if v w then vw ϵ E_h ; if v ~ w, then there exists a melodic path j =(P,F) such that J =(P,F) such that J ⊆ G, F ⊆ E_m and v, w ϵ P.

Example 1:

The following musical graph is identified that there are three maximal CRP graphs constructing from the following vertex sets: $V_1 = \{v_1, v_2, v_3, v_6, v_7, v_8,\}$; $V_2 = \{v_4, v_5, v_6, v_7, v_8\}$; and $V_3 = \{v_4, v_9\}$.



Musicologists can more easily evaluate the results because the answers are undoubtedly related to one another because they share some vertices. Two approaches are required to solve the classical music analysis problem using the graph theoretical approach as follows: 1) A bipartite and a musical graph both have maximally matched CRP subgraphs. 2) Margine these subgraphs until no two subgraphs have a vertex in common.

4. Algorithm:

Finding matched CRP graphs is a combinatorial search problem. Shown example a musical graph mentioned as G and bipartite graph mentioned as Q, the problems are solved of finding all maximal matched sub graphs and merging the sub graphs. By the following steps.

- The pitch class in U - Q, U = (0, 1,2 . . . . 9) and Q are retained. The new reduced graph is $G^* = (V^*, E^*)$.
- Find all matched CRP sub graphs to Q in $G*$.
- Merge these sub graphs until no two different new sub graphs share the same vertex.
- find all CRP sub graphs
- the KS-algorithm and adopts its notation. The CRP subgraphs the reduced graph $G^* = (V^* , E^*)$
- Propose a scheme to compute the choice set C_t .
- A partial solution is a sequence $X = (x_1, x_2, ... , x_t)$ vertices, Such that $\{ x_1, x_2, ... x_t \}$ CRP graph

We write

$X_{1;t} = \{ x_1, x_{2. . . . .} , x_t \}$
The extension $x_{1:t}$
Any extension $X_{1:t}$
The harmonic choice set C_t^h
The melodic choice set C_t^m
Vertices in $X_{1:t-1}$ harmonic edges
$C_t^h = \{V\epsilon(V^* - x_{1:t-1}) \quad vx \epsilon E_h^x$ for $x \epsilon X_{1:t-1}\}$
Terms of C^h_{t-1}
$C^h_t = \{v \epsilon (C^h_{t-1} – \{ x_{t-1} \}) \quad vx_{t-1} \epsilon E_h^* \}$
The melodic path in P => $P = P\ p_1, p_{2\,,\,.} . . . . . p_k\}$
Sub graph by $\{P_1, P_2, . . . P_i \}$
Such that
$P_i \underline{C}\ P_i \{X1:t_{-1} = P_1 \cup P_2 \cup . . . . , P_i \}$ and $P_x \cap P_y = \varphi$
For $i_x \neq i_y$
Path Adj $(X_{1:t-1}) = \{ v \epsilon (V^* - X_{1:t-1}) \ v\ x \epsilon E_m^*$ for some $x \epsilon X_{1:t-1} \}$
IF $X_{1:2} = \{v_4 ,v_7\}$, $X_{1:2} = \{v_6 ,v_8 ,v_9 \}$.
Melodic choice
$C_t^m =\{ v \epsilon$ path Adj $(X_{1:t-1}) \quad v\ x \epsilon E_h^*$ for each $x \epsilon (X_{1:t-1} –$ path $(x))\}$
Harmonically adjacent vertices
$(X_{1:t-1} –$ path$(x))\}$
It calculation C^m_{t-1}
The vertex set calculation of C_t^m
So, The melodic choice C_t^m
The harmonic choice set C_t^m
$C_t = C_t^h \cup C_t^m$

Conclusion:

In order to speed up music analysis using bipartite theory, the musical graph - theoretical approach is proposed in this study. Using a musical analysis as a matching-rubrics problem, all patterns in the music database are sought after. The pitch class hypothesis is used to create the matching rubrics. This work focuses on the issue of music analysis with bipartite theory. Each musical note is portrayed as a vertex and as an edge in a graph model of a piece of music, and there are two types of edges: variable melodic edge and harmonic edge.

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