

Topological Data Analysis on Music Data

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Background and Motivation

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- Music in general is rich in structures. Songs can be viewed as combination of different channels and each channel can be considered as a combination of notes.
- If one looks at the sequence of notes that make up a song, one can usually find repeating patterns, for instance, verses will often have exactly the same tune. Observing carefully, it can be observed that certain phrases (or shorter sequence of notes) occur more frequently.
- Notes can be perceived as lying on a circle. Distance between the notes is defined by finding the distances between equivalent nodes (in terms of frequencies).

Background and Motivation

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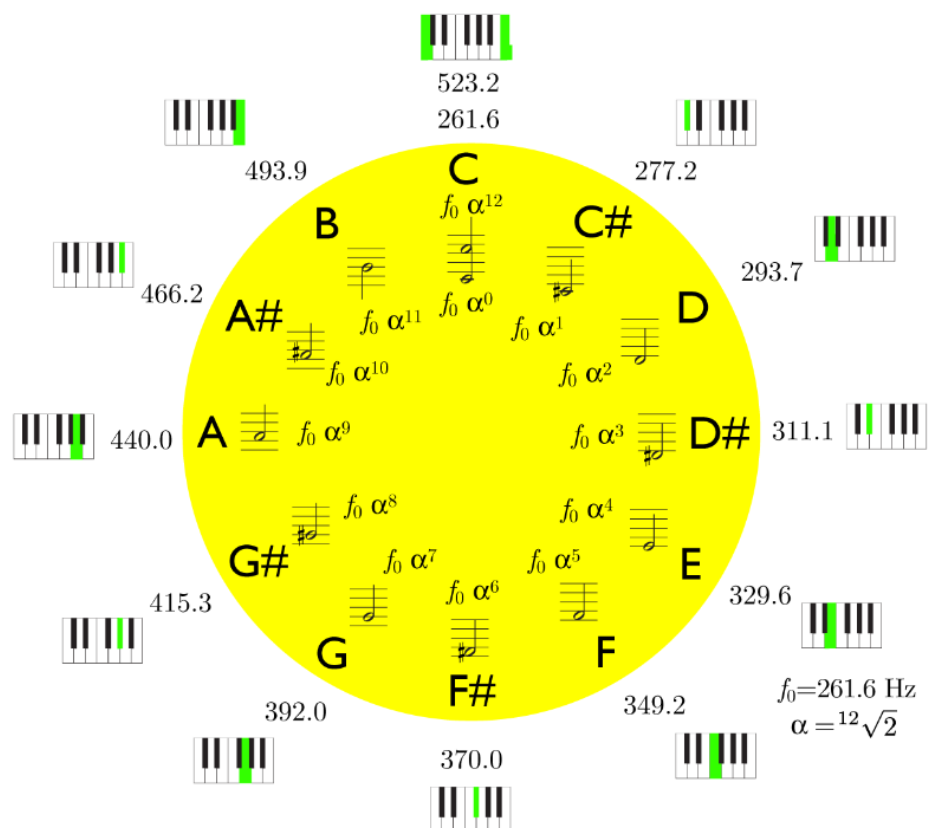


Fig. 1: Circle of Notes*

*Source: Sethares et al., Topology of Musical Data

Proposed Tasks

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- Explore topological structures of data.
- Identification of 4-chord progression
- Genre Classification
- Artist Identification
- Comparison of Musical Styles. Ex. Classical vs Pop.

Work done so far..

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- Significant progress in Data collection pipeline. It includes downloading the required midi version of a song and extracting appropriate channels from it.
- Point cloud extraction: Single-note embedding (extract a set of all the notes in the song) and time-series embedding (extract a set of all note sequences of length N).
- Compute the distance matrix for the specific class of point-cloud being used, as input to ripser for computation of persistence diagrams/barcodes.
- Apply Bottleneck and Wasserstein distance measures to compute the distance similarity between the persistence diagrams and plotting them using TSNE.

Procedure: Data Collection Pipeline

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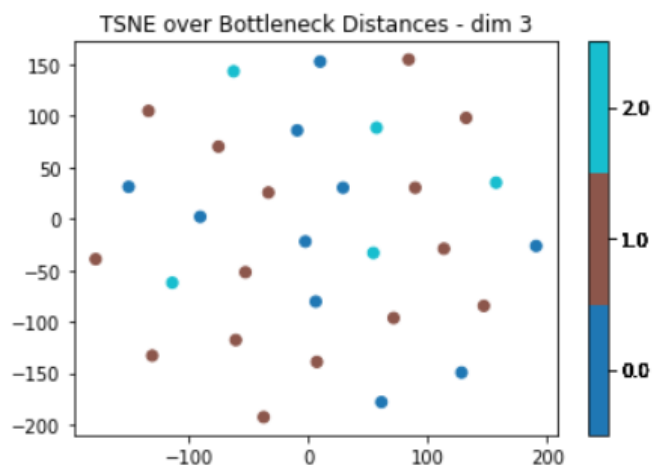
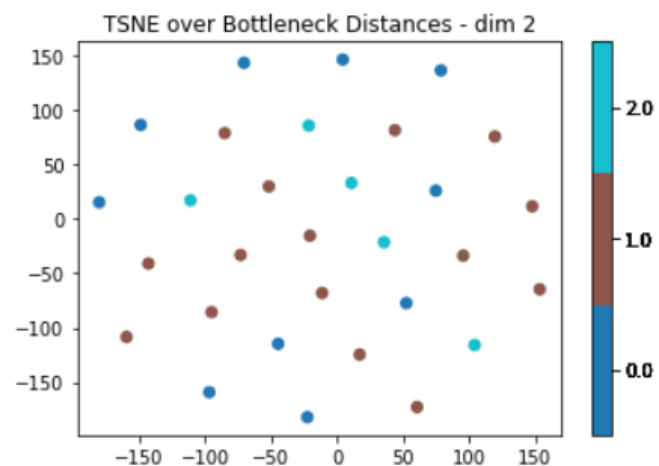
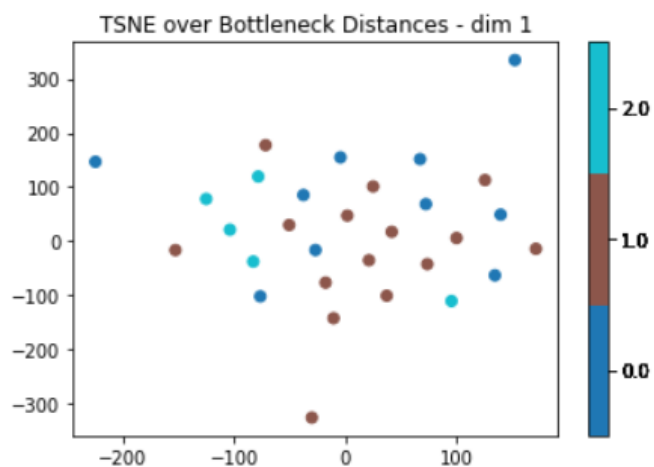
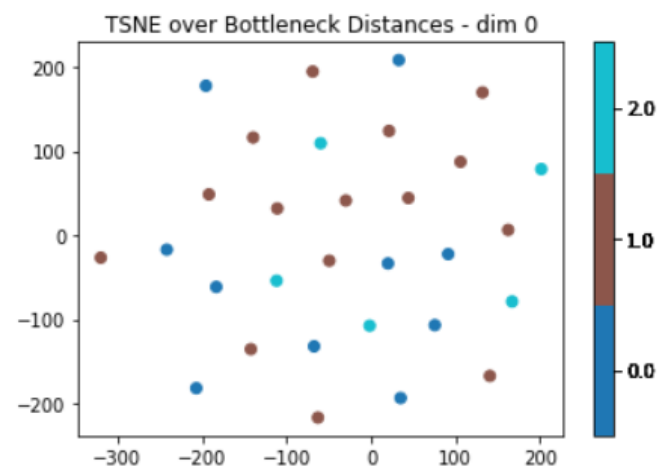
100% Page View Concert Pitch

Untitled Coldplay - The Scientist coldplay-a_sky_full_of_stars Red Hot Chili Peppers - Californication

	Import	Channel	Staff name	Sound	MuseScore instrument	Max. quantization	Max. voices	Tuplets	Is human performance	Split staff	Clef changes	Simplify durations	Show staccato	Dotted notes	Show tempo text	Recognize pickup measure	Detect swing
All						16th ▾	4 ▾	3, 4, 5, 7, 9 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	None (1:1) ▾
1	<input type="checkbox"/>	1	Red Hot Chilli Peppers	Jazz Guitar	Acoustic Guitar ▾	16th ▾	4 ▾	3, 4, 5, 7, 9 ▾		<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾
2	<input checked="" type="checkbox"/>	2	Californification	Clean Guitar	Electric Guitar ▾	16th ▾	4 ▾	3, 4, 5, 7, 9 ▾		<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾
3	<input type="checkbox"/>	10		Percussion	Drumset ▾	16th ▾		3, 4, 5, 7, 9 ▾		<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾
4	<input type="checkbox"/>	10	Sequenced by TOPLIST TEAM	Percussion	Drumset ▾	16th ▾		3, 4, 5, 7, 9 ▾		<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾
5	<input type="checkbox"/>	3	by Aydin Can Bekoglu & Daniel Sandnes Stien	Fingered Bass	Electric Bass ▾	16th ▾	4 ▾	3, 4, 5, 7, 9 ▾		<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾
6	<input type="checkbox"/>	4		Ocarina	Sine Synthesizer ▾	16th ▾	4 ▾	3, 4, 5, 7, 9 ▾		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾
7	<input type="checkbox"/>	7		Calliope	Effect Synthesizer ▾	16th ▾	4 ▾	3, 4, 5, 7, 9 ▾		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			None (1:1) ▾

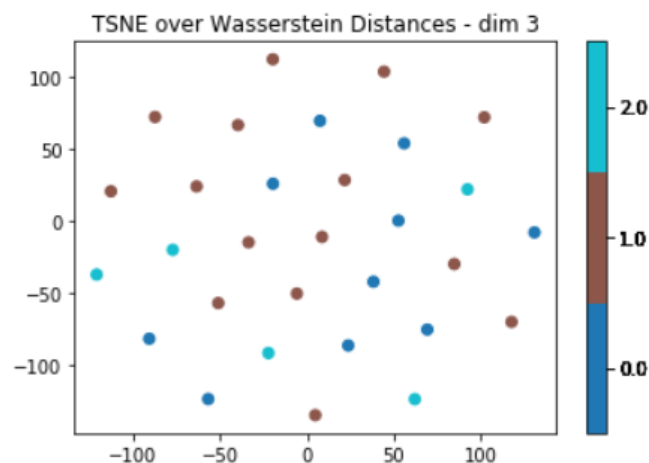
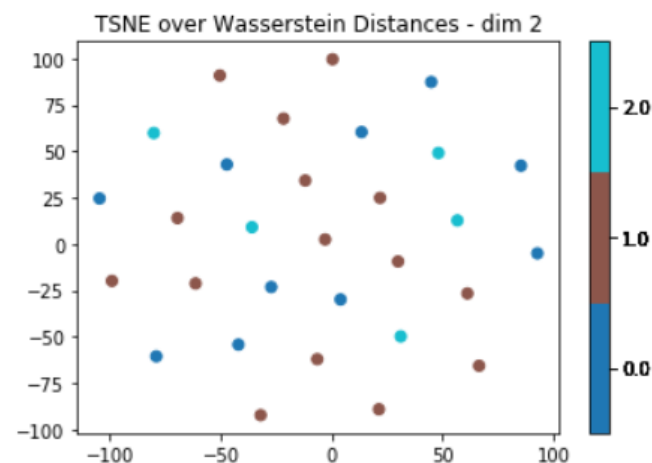
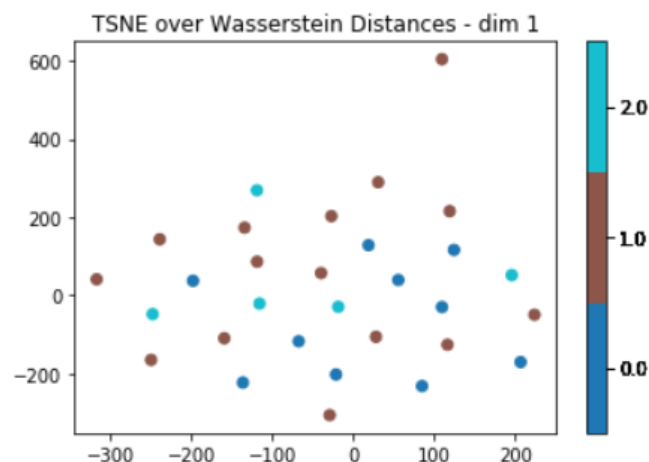
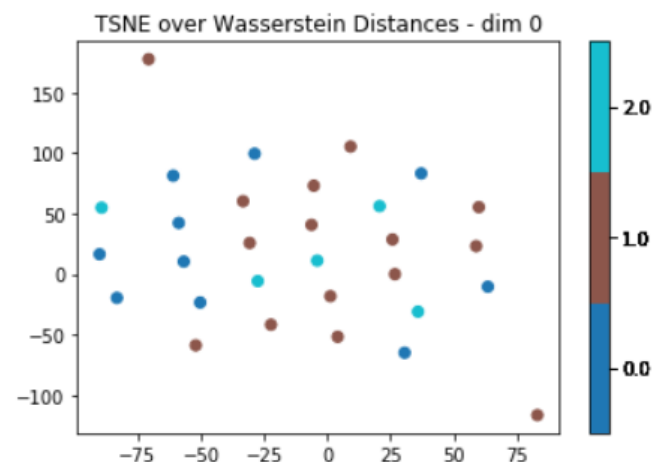
Results: Persistence Diagram Distances

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Results: Persistence Diagram Distances

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Upcoming Milestones

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- Finish data collection pipeline.
- Implement chord-class (i.e. extract the set of all chords in the track) and chord-sequence embedding (i.e. extract the set of all sequences of chords of length N).
- Formulating the distance measure for the above two embeddings.
- Use machine learning algorithms along with neural networks for the artist and genre classification based on the songs.
- Identifying the common chord progressions in popular music

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Thank you!

Questions?

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