

APCOMP 297r Capstone Project



Spotify®

Midterm presentation

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Recap: Generating “good” playlists



“curates mood and occasion specific playlists...created in part by algorithms and music experts”



Recap: Aspects of our project

**Data
Representation**



**Evaluation
Metrics**



**Playlist
Completion**



**User
Experience**



Recap: Timeline of our project

**Data
Representation**



**Initial
Pipeline**

Feb

**Playlist
Completion**



**Evaluation
Metrics**



March

**User
Experience**

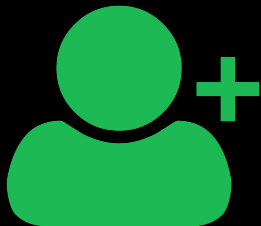


**Finalize
Model**

April

Evaluation:

What makes a playlist **good**?



The user has the **ultimate** say

- Genre
- Mix of popular/unknown
- Occasion
- Mood

Several **metrics**, not clear if they target these cover all desired qualities.

Evaluation:

One example, Diversity (L)

$$\frac{\sum_i \sum_{j \neq i} d(track_i, track_j)}{|L|(|L| - 1)}$$

Note: this depends on a distance function d , which depends on the data.

Evaluation:

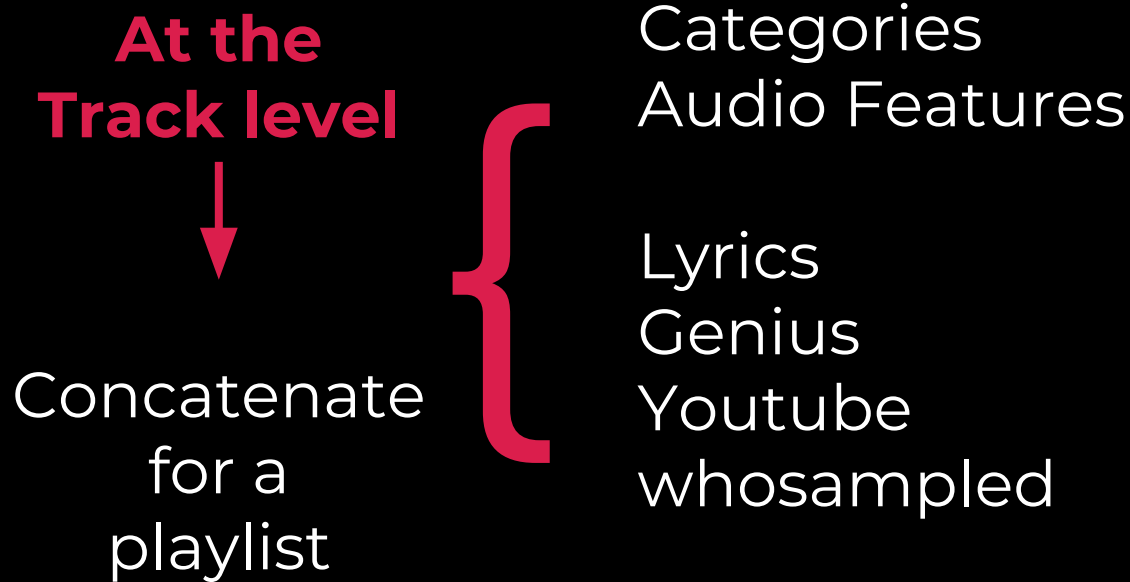
Another example, MAE

$$\frac{1}{|T|} \sum_{u,i \in T} |r_{u,i} - \hat{r}_{u,i}|$$

Note: this depends on ratings r from users and tracks.

Data Representation:

Using Million Playlist Dataset



TF-IDF
doc2vec
LDA

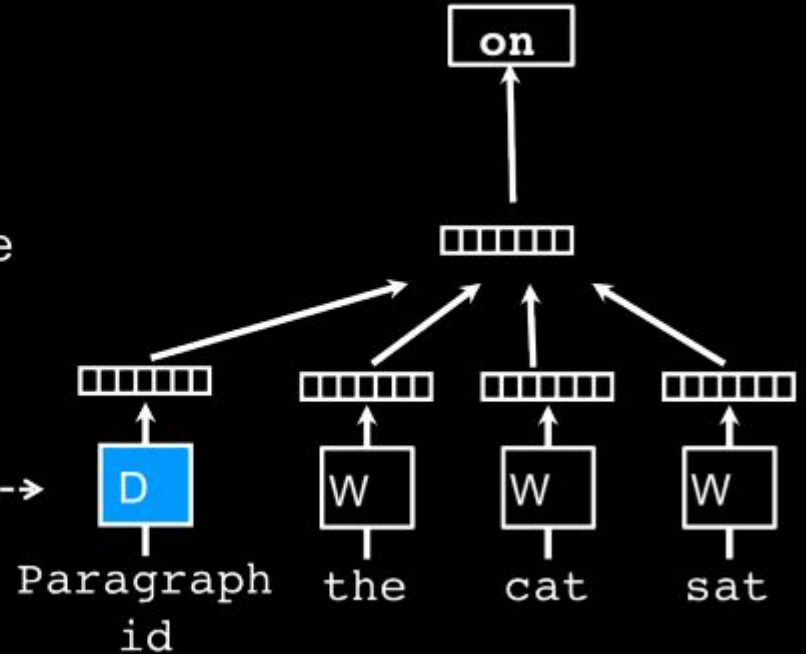
Data Representation: DOC2VEC



Classifier

Average/Concatenate

Paragraph Matrix----->



Data Representation: TF-IDF + LYRIC

<i>RANK</i>	<i>ARTIST</i>	<i>TITLE</i>	<i>COS-SIMILARITY</i>
1	BRITNEY SPEARS	TOXIC	1
2	A STATIC LULLABY	TOXIC	0.97
3	A DAY TO REMEMBER	BAD VIBRATION	0.43
4	THE MIGHTY MIGHTY BOSSTONES	TOXIC TOAST	0.41
5	GLEE CAST	TOXIC	0.26
6	GLEE CAST	TOXIC (SEASON 5)	0.26
7	ALL TIME LOW	TOXIC VALENTINE	0.25
8	THE STROKES	TAKEN FOR A FOOL	0.21
9	WE ARE THE IN CROWD	THE BEST THING	0.21
10	ALICE COOPER	POISON	0.2
11	VAULTS	POISON	0.19

Data Representation: DOC2VEC - LYRICS

<i>RANK</i>	<i>ARTIST</i>	<i>TITLE</i>	<i>COS-SIMILARITY</i>
1	BRITNEY SPEARS	TOXIC	0.99
2	A STATIC LULLABY	TOXIC	0.89
3	GLEE CAST	TOXIC (SEASON 5)	0.76
4	GLEE CAST	TOXIC	0.76
5	THE CARS	MAGIC	0.52
6	EAGLES OF DEATH METAL	NOW I'M A FOOL	0.49
7	ZAC BROWN BAND	BEAUTIFUL DRUG	0.48
8	MYSTERY SKULLS	MAGIC	0.48
9	ZAYN	DRUNK	0.48
10	NERO	SATISFY	0.47
11	BEYONCE	POISON	0.47

Data Representation: TFIDF vs DOC2VEC

- Britney Spears - Toxic
 - Finds songs that have the word 'toxic' or 'poison' appear multiple times.
 - Toxic: 11 times
 - Poison: 4 times
 - Almost like a string match and doesn't seem to care much about lyric understanding.
 - "Toxic Toast" - About alcohol.

DOC2VEC

TF-IDF

RANK	ARTIST	TITLE	COS-SIMILARITY	RANK	ARTIST	TITLE	COS-SIMILARITY
1	BRITNEY SPEARS	TOXIC	0.99	1	BRITNEY SPEARS	TOXIC	1
2	A STATIC LULLABY	TOXIC	0.89	2	A STATIC LULLABY	TOXIC	0.97
3	GLEE CAST	TOXIC (SEASON 5)	0.76	3	A DAY TO REMEMBER	BAD VIBRATION	0.43
4	GLEE CAST	TOXIC	0.76	4	THE MIGHTY MIGHTY BOSSTONES	TOXIC TOAST	0.41
5	THE CARS	MAGIC	0.52	5	GLEE CAST	TOXIC	0.26
6	EAGLES OF DEATH METAL	NOW I'M A FOOL	0.49	6	GLEE CAST	TOXIC (SEASON 5)	0.26
7	ZAC BROWN BAND	BEAUTIFUL DRUG	0.48	7	ALL TIME LOW	TOXIC VALENTINE	0.25
8	MYSTERY SKULLS	MAGIC	0.48	8	THE STROKES	TAKEN FOR A FOOL	0.21
9	ZAYN	DRUNK	0.48	9	WE ARE THE IN CROWD	THE BEST THING	0.21
10	NERO	SATISFY	0.47	10	ALICE COOPER	POISON	0.2
11	BEYONCE	POISON	0.47	11	VAULTS	POISON	0.19

Data Representation: TFIDF VS DOC2VEC

1. Glee Cast Version vs Original
 - a. Glee version with many lyric from original reused
 - b. Almost identical lyric storyline and thus ranked high
 - c. Doc2vec ranks Glee version higher than TFIDF
2. “The Cars” - Magic
 - a. Word ‘toxic’ or ‘poison’ don’t appear at all.
 - b. But context-wise, similar (romantic relationship).

HYPOTHESIS

1. DOC2VEC captures more lyric contextual information (not string match).
2. Not sure which embedding is better, but doc2vec seems to be more reliable.
 - a. Highly dependent on evaluation metric

Data Representation: DOC2VEC - GENIUS

<i>RANK</i>	<i>ARTIST</i>	<i>TITLE</i>	<i>COS-SIMILARITY</i>
1	BRITNEY SPEARS	TOXIC	1.00
2	USHER	MOVING MOUNTAINS	.46
3	GLEE CAST	SAG MY PANGS	.45
4	HOPSIN	E.T.	.45
5	KATY PERRY	HIGHER	.45
6	THE READY SET	FINAL SONG	.45
7	MO	THE CITY SLEEPS	.45
8	MC 900	OFF DA METER	.44
9	KEVIN GATES	SEASONS	.44
10	SHAGGY	LO MIEGO TODO	.44
11	JOAQUIN SABINA	CABARDE	.44

Data Representation: GENIUS CONS

- Does not really make much sense at the moment compared to lyric similarities at least...
- Not 100% sure what the similarities are based on because
 - Descriptions are quite arbitrary and unstructured.
 - So many criteria for a description all mixed up
 - EX) Background, lyric, tempo...

Data Representation: LDA - YOUTUBE

<i>TOPIC 18</i>	<i>TOPIC 26</i>	<i>TOPIC 28</i>	<i>TOPIC 18</i>	<i>TOPIC 26</i>	<i>TOPIC 28</i>
love	shit	esta	Ignition (Remix)	Groupies	Rhythm of Love
god	kill	lo	Believe It	Rolling(feat Propain, Slim Thug, Lil Keke & Tiaramy)	Halo
jesus	black	por			
horizon	bitch	cancion	Love in this Club	Superheroes	Unaccompanied Cello Suite 1
life	rap	los			
lord	ass	como	Joy	Boom Boom Pow	Tanz Mit Laibach
amazing	damn	para	Sweet Emotion	Uptown Funk	Welcome
world	yeah	una			
favourite	wanna	el			

Data Representation: LDA - YOUTUBE

- Some groups contain closely related words, especially
 - Topic 18 - contains love and worship words
 - Topic 26 - contains expletives
 - Topic 28 - contains all Spanish words
- Top topic for songs are very well matched

Data representation:

One naive approach for completion

- BASELINE
 - Given a Playlist of an arbitrary # of songs
 - Average vector representation (V_1) for every song in this playlist.
 - Find the closest song to V_1 in the vector space, and append to the playlist.

User Experience: Feedback

Trying to predict last song

1. Which song would you use for road?
2. Which out of 5 songs next?
3. What is a good survey to take?

Results

Playlist Completion

Ranking using lyrics



Top Suggestions:

'Why Can't We Be Friends?' by 'War'
'My House' by 'Pvris'
'Box Around The Sun' by 'MisterWives'
'Gente De Accionar' by 'Grupo Codiciado'
'The Fear' by 'Ben Howard'
'Hold Me Now' by 'Thompson Twins'
'Lump Sum' by 'Bon Iver'
'Insides Out' by 'Kid Cudi'
'Send It On' by 'D'Angelo'
'Shake' by 'MercyMe'

Playlist Completion

Pooling using word2vec



Pooling using word2vec



Documents \leftrightarrow Playlists
Words \leftrightarrow Songs

Playlist Completion

Pooling using Word2Vec



Top Suggestions:

'Imagine - 2010 - Remaster' by 'John Lennon'
'Hotel California - Remastered' by 'Eagles'
'Dust in the Wind' by 'Kansas'
'Knockin' On Heaven's Door - Remastered' by 'Bob Dylan'
'Come Together' by 'Aerosmith'
'Layla - 40th Anniversary Version / 2010 Remastered' by
'Derek & The Dominos'
'Free Bird' by 'Lynyrd Skynyrd'
'House Of The Rising Sun' by 'The Animals'
'Behind Blue Eyes' by 'The Who'
'Come Together' by 'Re Beatles'

Playlist Completion

Ranking songs in pool by lyrics



The screenshot shows the AutoGen2 app interface. At the top, there's a back arrow, the app name 'AutoGen2', and a menu icon. Below this is a playlist cover image with a 'SHUFFLE PLAY' button. A 'Download' toggle switch is on the right. The playlist contains five songs, each with a download icon, song title, and artist/album information.

AutoGen2

SHUFFLE PLAY

Download

Wish You Were Here
Pink Floyd • Wish You Were Here

Stairway To Heaven
Led Zeppelin • Led Zeppelin IV (Deluxe Edition)

All Along the Watchtower
Jimi Hendrix • Electric Ladyland

Riders On The Storm
The Doors • L.A. Woman

Come As You Are
Nirvana • Nevermind (Remastered)

Top Suggestions:



Dust in the Wind
Kansas



Knockin' On Heaven's Door - Remastered
Bob Dylan



Free Bird
Lynyrd Skynyrd



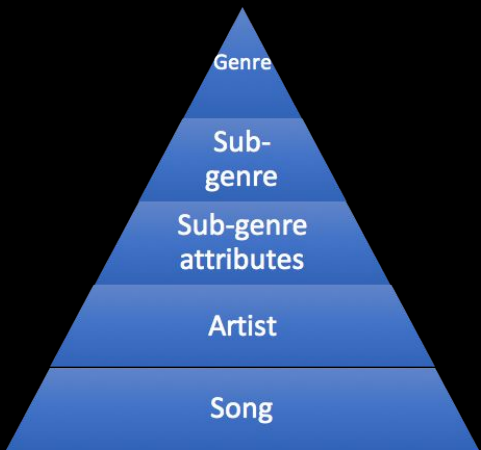
Hotel California - Remastered
Eagles

Playlist Completion

Next Steps: ranking models for different modalities

“Right” song can depend on varied information sources (user pattern, the beat of a song, song popularity, playlist purpose etc):

Hierarchical bayes model to get $P(\text{Song} \mid \text{Playlist}, \text{User})$



RNN, VAE or GANs:

- lyrics/text
- audio features

System for data collection

Collecting playlist ratings from Users

[Spandan-project-maganer.herokuapp.com](https://spandan-project-maganer.herokuapp.com)

DEMO

Summary

TASK: Given seed playlist: suggest next tracks + Evaluate playlists

PROBLEMS: 1) Very large database 2) Evaluation hard 3) Cold start

APPROACH:

- Pooling + Ranking framework
- Utilize multiple data sources.
- Incorporate User experience.

Current:

- Featurized data and prototype recommender
- Baselines models done: word2vec, doc2vec, TF-IDF, LDA
- UI for data collection set up

NEXT STEPS:

- Better ranking models (ex: Bayesian Hierarchical models and RNNs)
collect data using UI
- incorporate User Experience

Contact us if you want to get song
suggestions!

Thanks! Any questions?