

# Music Retrieval Focusing on Lyrics Based on Shared Word-vectors

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1

## Background



- The listening style has changed a lot during the past decades
  - Subscription service is providing a "unlimited" music access
  - "Do something while listening music" become a ordinary style for us
- What will happen when MUSIC meets TOURISM?
  - It is fantastic for tourists to enjoy music that is similar to the atmosphere of tourist spot they are visiting
  - A method for evaluating the similarity between music and tourist spot is needed

2

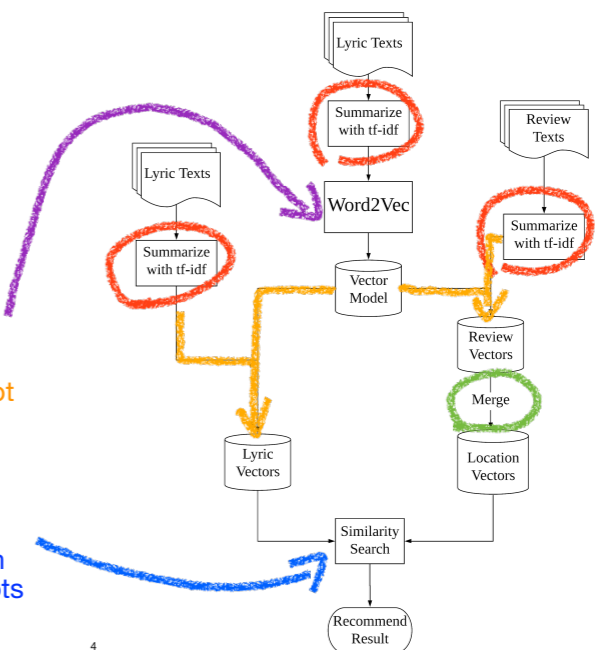
## Method Conception

- The GOAL: To recommend the music which is similar to the atmosphere of tourist spot.
  - Personality of Spots: Reviews on tourism website
  - Personality of Songs: Lyrics of the song
- Swift from reviews to (pseudo) lyric using distributed representation of words
  - The directly comparison between is difficult
  - Distributed representation model is built from lyric corpus
  - Review vectors generated from review texts but using distributed representation model built from lyrics corpus: An idea to deal reviews as pseudo lyrics
  - The similarity calculation between lyrics and pseudo lyrics is theoretically possible
- The lyric with the highest similarity to the spot reviews become the recommendation result

3

## Proposed Method

- **Summarization of Lyrics and Reviews with TF-IDF**
- **Word Distributed Representation Model**
- **Quantifying Lyrics and Tourist Spot Reviews to Vectors**
- **Merging Reviews Vectors to Spot Vectors**
- **Lyrics Recommendation based on Similarity between Lyrics and Spots**

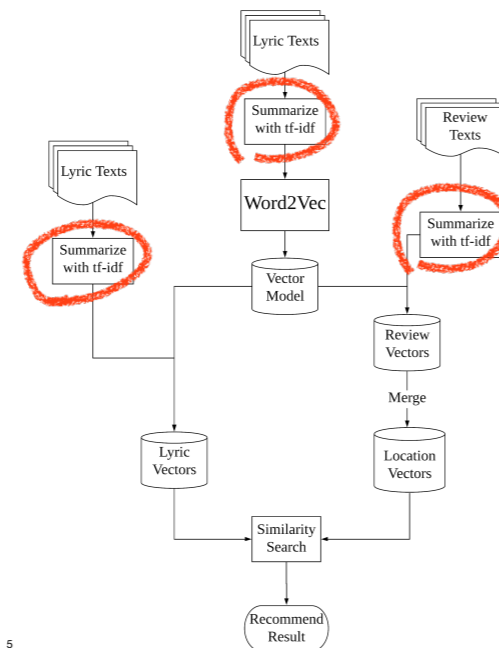


4

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5

## Summarization of Lyrics and Reviews

### General Description

- Make the “emotional and subjective expressions” in lyrics and reviews more clear.
- The TF-IDF value of each word is normalized to range from 0 to 1.
- The summarization threshold is set to 0.1, any word with a TF-IDF less than 0.1 will be cut off from documents of lyrics and reviews.
- The documents are divided into "common phrases" and "unique phrases".
- Word distributed representations will catch more emotional and subjective expressions.

6

## Summarization of Lyrics and Reviews Common & Unique

- Common Phrases: appear in most of documents
  - example: "We went in the morning on a weekday so not too crowded."
- Unique Phrases: only appear in a part of documents and express the personality of a lyric or a review
  - example: "Observing the guided tours, they were excellent with their customers and cute to see even grandmas being taken there with floats for when they tired."
- **When it comes to distributed representation of words**
  - Common phrases decrease the difference between vectors of each tourist spot and weaken the diversity of distributed representation of words.
  - The influence of common phrases is huge especially in some tourist spots sharing the same genre. (e.g. Museums)

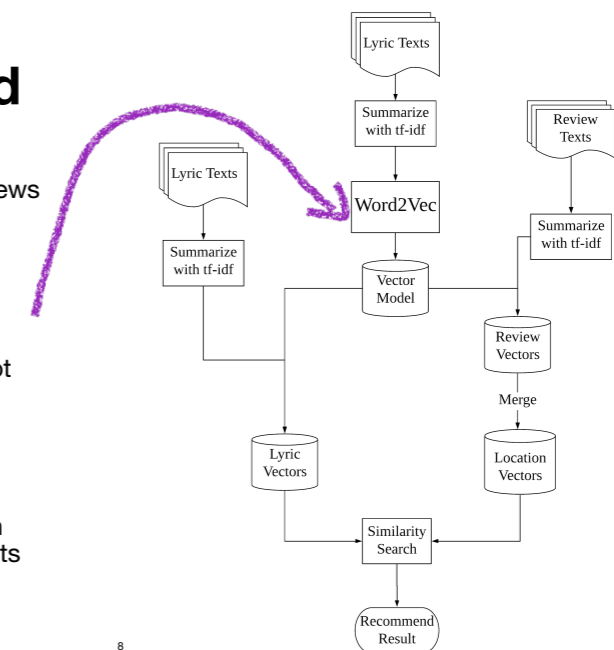
7

## Proposed Method

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8

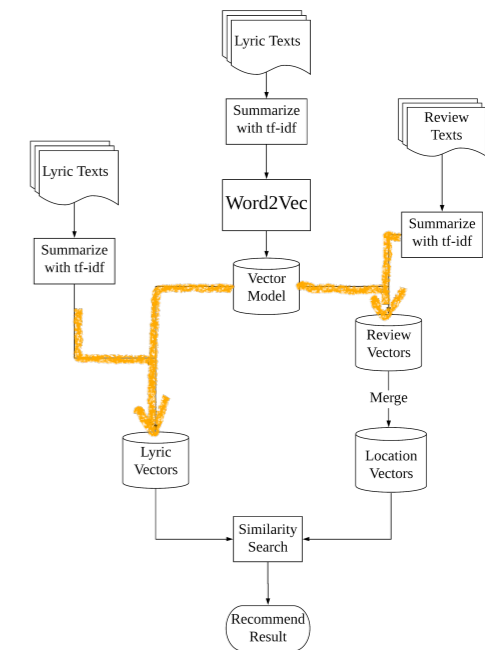
## Words Distributed Representations Model

- Words Distributed Representation: convert words to vectors with vector calculation supported
  - Article vector can be built from word vectors by vector calculation.
  - It is possible to build lyric vectors & review vectors using word distributed representation.
- Word distributed representations model built by Word2vec framework
  - Lyrics corpus of 94451 English songs fetched from [AZLyrics.com](http://AZLyrics.com)
  - Word2vec training parameters: size=300, window=10, min count=2, iter=10

9

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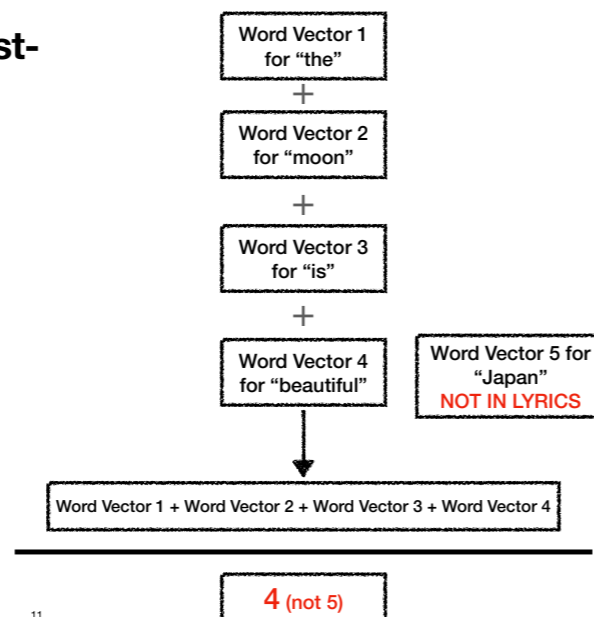
10

## Quantifying Lyrics and Tourist-spot Reviews to Vectors

- Fetch word vector from word distributed representations model
- Lyric/Review vector is the mean of all word vectors in its text.

$$\bar{V} = \frac{\vec{v}_1 + \dots + \vec{v}_n}{n}$$

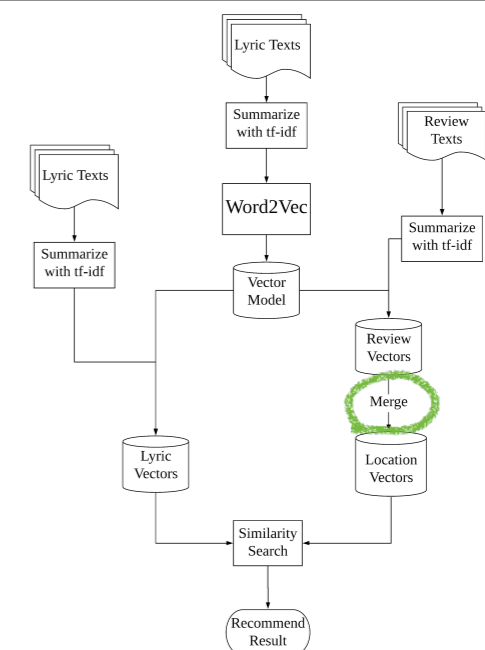
$\bar{V}$  is the vector of a lyric or a spot review  
 $\vec{v}_n$  is the vector of each word  
 $n$  is the number of words in a lyric or a spot review



11

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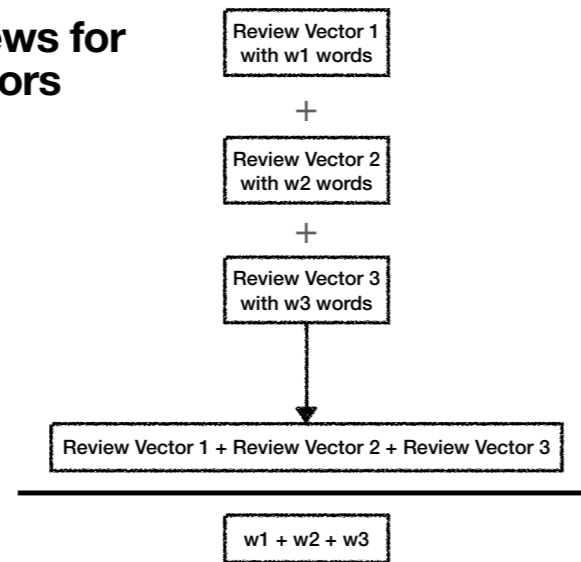
12

## Merging Vectors of Reviews for Tourist-spot to Spot Vectors

- The individuality and general property of each spot can be extracted by gathering the reviews from each visitor
- Review vectors is merged with a weighted arithmetic mean
- The more words, the more information, the more contribution, the more weight

$$\bar{X} = \frac{\omega_1 \vec{x}_1 + \dots + \omega_n \vec{x}_n}{\omega_1 + \dots + \omega_n}$$

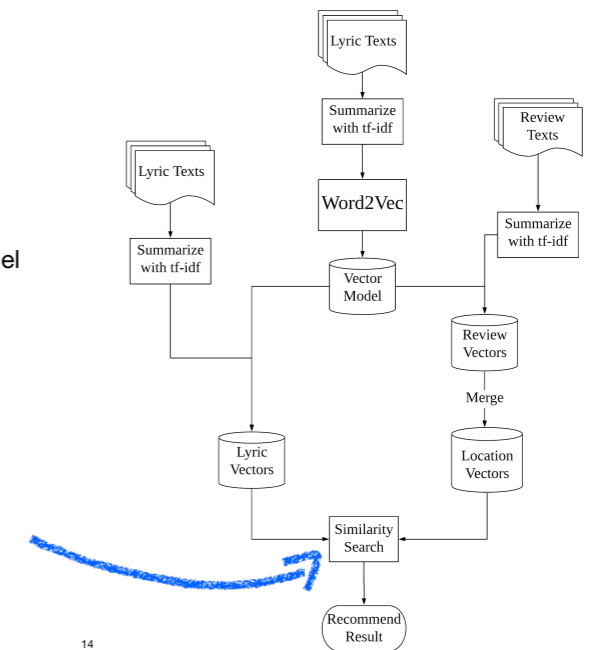
$\bar{X}$  is the vector of each spot  
 $\omega_n$  is the word number of  $n$ th review  
 $\vec{x}_n$  is the vector of  $n$ th review



13

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14

## Lyrics Retrieval Based on Similarity Between Lyrics and Spots

- For one spot, calculate the cosine similarity between this spot vector and every lyric vectors, then find the lyric vector with highest similarity
- The cosine similarity between spot vector and lyric vector is considered to be the emotional distance of the spot and the lyric
- The lyric with the highest cosine similarity to the spot will be the system output as the recommendation lyric for the spot

$$\cos(\vec{X}, \vec{V}) = \frac{\vec{X} \cdot \vec{V}}{|\vec{X}| \times |\vec{V}|}$$

$\vec{X}$  is the vector of spot  
 $\vec{V}$  is the vector of lyric

15

## Sample of System Output Result

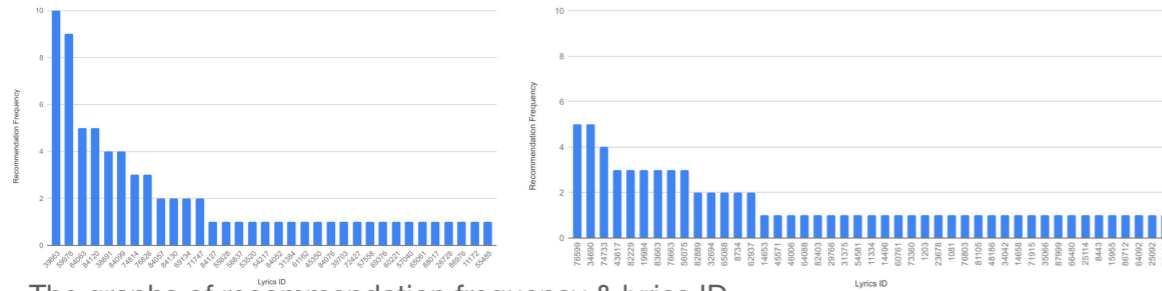
- Long Beach → Miles Between Us (Airplane Song)

When I saw my reflection in her eyes  
 That's when I knew that it was time  
 I leaned over and kissed her cheek  
 And softly said goodbye  
 Against the glass I heaved a sigh  
 Followed the fading of it's lights  
 Watched the plane begin it's flight  
 With my eyes into the night  
 And I know that I'm a coward  
 Who couldn't even tell her  
 As she begged me with those eyes  
 Give her a reason not to fly  
 And it haunts me on the highway  
 Headin back to my place  
 Why oh why oh why oh why oh why



16

## The Effect of Summarization The Overall of Recommendation Results



The graphs of recommendation frequency & lyrics ID.  
The LEFT is the results WITHOUT summarization, the RIGHT is the results WITH summarization.  
After summarization applied, the graph became flatter. That means less tourist spots matched with the same music and the diversity of recommendation expanded.

17

## The Effect of Summarization Recommendation Results of Tourist spots Sharing the Same Genre

### Results Without Summarization

Tourist spot	Genre	Recommended Music ID
Neue Galerie	Museum	59978
Solomon R Guggenheim Museum	Museum	59978
New York Historical Society Museum Library	Museum	59978
Museum of Arts and Design	Museum	59978

### Results with Summarization

Tourist spot	Genre	Recommended Music ID
Neue Galerie	Museum	82229
Solomon R Guggenheim Museum	Museum	83663
New York Historical Society Museum Library	Museum	82229
Museum of Arts and Design	Museum	59978

18

## Experiment Design

- There were 19 pairs of tourist spot & lyric used in the evaluation experiment.
- Two lyric options for each tourist spot:
  - the recommendation result from the proposed system
  - a lyric picked up randomly
- Two ways to evaluate the music: read the lyric or listen to the song
- Steps of experiment:
  - check the website of tourist spot on Tripadvisor, get how the spot feels like
  - read the two lyrics on [azlyrics.com](https://www.azlyrics.com) OR listen the two songs on Spotify
  - choose the lyric more similar to the image of the spot
- There were seven subjects in each experiment.

West Village \*  
觀光地URL : [https://www.tripadvisor.com/Attraction\\_Review-g60763-d5550170-Reviews-West\\_Village-New\\_York\\_City\\_New\\_York.html](https://www.tripadvisor.com/Attraction_Review-g60763-d5550170-Reviews-West_Village-New_York_City_New_York.html)

- <https://www.azlyrics.com/lyrics/abigailbreslin/christmasinnewyork.html>
- <https://www.azlyrics.com/lyrics/3doorsdown/stillalive.html>

United Nations Headquarters \*  
觀光地URL : [https://www.tripadvisor.com/Attraction\\_Review-g60763-d108686-Reviews-United\\_Nations\\_Headquarters-New\\_York\\_City\\_New\\_York.html](https://www.tripadvisor.com/Attraction_Review-g60763-d108686-Reviews-United_Nations_Headquarters-New_York_City_New_York.html)

- <https://www.azlyrics.com/lyrics/chiefkeef/adameve.html>
- <https://www.azlyrics.com/lyrics/furtherseemsforever/madisonprep.html>

Dizzy's Club \*  
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- <https://www.azlyrics.com/lyrics/bobbybare/youknowwho.html>
- <https://www.azlyrics.com/lyrics/asheroth/beright.html>

19

## Experiment Results

- Experiment results was summarized to 3 grades according to how many votes the recommendation result got:
  - Positive:** got 5~7 votes from 7
  - Neutrality:** got 3 or 4 votes from 7
  - Negative:** got 0~2 votes from 7
- Lyric-based evaluation showed a good result while in song-based evaluation the recommendation did not performed well.
- The influence of audio-based information (rhythm, voice, musical instruments etc) played a big role in influencing the feeling that people get from music.

### Distribution of Votes on Lyric-based Evaluation

Evaluation of Recommendation Results	Percentage
Positive	47%
Neutrality	53%
Negative	0%

### Distribution of Votes on Song-based Evaluation

Evaluation of Recommendation Results	Percentage
Positive	21%
Neutrality	63%
Negative	16%

20

## Conclusion

- We proposed a cross-domain lyrics recommendation method based on the distributed representation of words.
- The tourist-spot reviews are assumed as a type of lyrics (pseudo lyrics).
- The similarity between tourist-spots and music is obtained from cosine similarity of distributed representation vectors.
- Lyric-based evaluation showed a good result while in song-based evaluation the recommendation did not performed well.
- The experiment pointed out that the role of audio-based information also has its meaning in the swift from "lyrics recommendation" to "music recommendation".

21

**Thank you for your listening!**

22