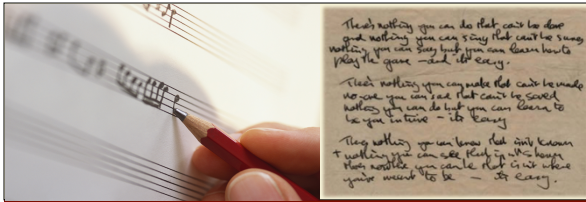


Lyric-Based Rhythm Suggestion

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Abstract

Which comes first – the lyrics or the music? Here I consider the lyrics-first approach to songwriting and seek to augment the process by developing a **creativity-support tool** which uses lyrics as a creative constraint for rhythm generation.

I propose a novel algorithm for **suggesting possible melodic rhythms** to complement the accent structure of a given set of lyrics. The algorithm is composed of three main components:

1. **Scoring heuristics** used to judge the relative success of candidate rhythms
2. **Database of English pronunciation** to determine syllable stress levels
3. **Search techniques** to find high-scoring rhythms in a large space of candidate rhythms.

Preliminary results are encouraging: given existing song lyrics, the “correct” human-composed rhythm is generally found high in the list of suggestions.

Method Overview

1. User input:

- Lyrics
- Total duration
- Time signature

2. **Define the space of all possible rhythms** matching the given number of syllables and total duration

3. **Define a scoring function**, based on the lyrics and time signature provided, for rhythms in this space

4. **Search this space** to find high-scoring rhythms

5. **Display a ranked list of rhythms** to user for browsing

1. User Input

“Some enchanted evening”

4/4 meter

1 measure duration

Pronunciation Dictionary and Rarity lookup:

SOME: rarity = 2.523, Stress pattern = [2]

en-CHAN-ted: rarity = 6.565, Stress pattern = [0-2-0]

EVE-ning: rarity = 4.085, Stress pattern = [2-0]

2. Define Possible Rhythms



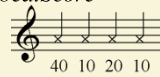
3. Define Scoring Function

$$f = f_1 + f_2 - f_3 - f_4$$

- f_1 : **Accented syllables on strong beats**
- f_2 : **Rare words beginning on strong beats**
- f_3 : **Long durations beginning on offbeats**
- f_4 : **Accented syllables of short relative duration**

$$f_1 = \text{stressLevel} \times \text{beatScore}$$

(0, 1, or 2)



$$f_2 = \text{wordRarity} \times \text{beatScore}$$

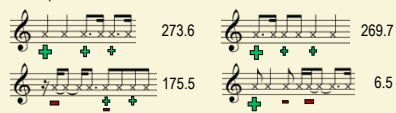
Scaled to range (0,2]

$$f_3 = \text{penalty} \times (\text{stressLevel} + \text{wordRarity})$$

- $\text{penalty}=10$ if onset is on 8th note offbeat and duration > 8th note
- $\text{penalty}=40$ if onset on the first 16th in a beat and duration > 8th, or if onset on final 16th in a beat and duration > 16th
- $\text{penalty}=0$ otherwise

$$f_4 = 1 \text{ Only if applicable. Otherwise, no penalty.}$$

Example scores:



Results

Lyric	Duration	Rank	# Rhythms	%
Green Finch and Linnet Bird	16	14	4282	99.7
Anyone can Whistle	16	164	4282	96.2
I Feel You, Johanna	72	731	6984	89.5
Something familiar	32	26	8572	99.7
The sun comes up	16	99	590	83.2
Nothing's gonna harm you	32	2605	49198	94.7
I Remember Sky	32	1450	8572	83.1
By the sea, Mister Todd	28	1527	35584	95.7
Here's to the ladies who lunch	24	1724	74369	97.7
Bit by Bit	16	22	136	83.8
Putting it together	24	2601	22333	88.4
Once upon a time(1)	12	3	576	99.5
Once upon a time(2)	20	764	3576	78.6
With so Little to be Sure	48	19354	487684	96.0
If there's anything at all	48	18481	487684	96.2
Some Enchanted Evening	16	14	4282	99.7
My Funny Valentine	32	12	49198	99.9
The Story of My Life	32	9165	49198	81.4
When I Think of Tom	32	444	8572	94.8
There is Nothing Like a Dame	32	32237	230196	86.0
It's a very ancient	32	3973	49198	91.9
We Kiss in a Shadow	32	2273	49198	95.4
We hide from the moon	32	1020	8572	88.1
He will not always say	32	1204	49198	97.6
Alone and awake	40	857	8131	89.5
I Have Dreamed	20	24	161	85.1
We've just been introduced	44	1586	64150	97.5
Shall We Dance?	24	19	171	88.9
The Face I See	40	52	787	93.4
Dreams, foolish dreams	28	10	1214	99.2

Rank and percentile of target rhythm for each input phrase with total phrase duration specified in 16th notes. The number of possible rhythms varies based on the number of syllables and the target duration.

Future Work and Applications

Future Work

Longer segments of input text

The current implementation limits text input to eight syllables at a time. Various heuristic search techniques (such as beam search) can be used to find the best rhythms for large numbers of syllables. However, issues of larger-scale musical form (such as the desire for repetition) must be addressed to generate quality results. This could be an interesting and deep problem.

Analysis of existing lyrics and rhythms

Parameters were selected by hand in the scoring function. A machine-learning approach could improve results if trained on an appropriate database of human-composed lyrics and rhythms.

Improved Scoring Heuristics

The four scoring function components were developed by human study of popular music. However, additional heuristics for rhythm generation would improve results. These might be developed using more human research or generated automatically using machine learning techniques.

Handling Syncopation/Melisma

The heuristics developed here penalize against syncopation, which is popular in certain genres and musical contexts. Additionally, each syllable is set to a single note; melisma cannot be generated. Both of these should be allowed if desired by the user.

Applications

Rhythm Browser: a Creativity Tool

The application implemented for this work provides a simple interface for browsing possible rhythms. A composer may use the rhythms directly or simply use them as inspiration for related rhythmic ideas.

Rhythm/Melody Suggestion in a “Composer’s Workbench”

A larger-scale application could provide useful tools for all aspects of music composition. Automatic generation of rhythms based on constraints (such as the lyrical constraint investigated here) would be a useful part of such a system. Furthermore, pitch suggestion is an obvious candidate for similar treatment using these methods.

Quantitative Study of Text-Setting Techniques

The heuristics used here to score rhythms could be used in musicological studies of the properties of lyrics of various songwriters (i.e. “How do Lennon and Harrison differ in text-setting?”)

Quantitative Study of Text-Setting Techniques

The scoring function could be used as a simple measure of lyric “quality”, providing an additional feature for use in music recommendation systems such as Pandora.

Acknowledgements

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Example Application

“I’m a Believer” (pitches and lyrics by Neil Diamond), with a new rhythm generated by browsing several suggestions for each of the word groups indicated. Each number indicates the rank order of the suggestion selected by the user. This example demonstrates the use of rhythm-browsing as a tool to aid human songwriters/composers.

