

Evaluation of the Suitability of Rule-Based Systems for Melody Matcher

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Overview of Melody Matcher

Melody Matcher aims to replicate the human ability to identify lyrics in a song that are easily misheard. Lyrics can be misunderstood due to:

- Lyric/Music emphasis mismatch, due to:
 - Note intervals
 - Phrase emphases
 - Word emphases
- Word "cramming", due to
 - syllable lengths that exceed that of note length
 - Mouth movement delta time intervals
- Word misidentification, due to
 - Altered pronunciation of words
 - Phone similarity
 - Voicing (voiced vs. voiceless)
 - Beginning/end mouth positions
 - Type (Plosive, Fricative, affricate, nasal, lateral, approximant, semivowel)
 - Improper cognitive parsing of phone sequences
 - Phone sequences that can be parsed more than one way
 - Non-deterministic interpretations of phone sequences.
 - Phone sequences with multiple interpretations and/or tokenizations

Suitability of Current Implementations

Currently, Melody Matcher has two partial implementations. One is rule-based, using the CLIPS system, and one uses conditional equations embedded in an Excel Spreadsheet. In the following section, I explain the advantages and disadvantages of both. Ultimately I decided that, for the exploratory iteration of my project, a rule-based system is better than a purely equation-based one.

Benefits of a Rule-Based Approach

Easy Modification Due to Modularization

A rule-based approach using templates and facts allows for less-messy modification of all components. If an end user decides that they want a song to be deliberately ambiguous-sounding at a certain point, they can disable certain rules for that section. If I decide that the phone "jʊ" needs to be categorized as a syllabic

consonant instead of a semivowel, all I have to do is go into the fact that uses **phone** template to store the data about "**jυ**", and change it there.

Meaningful and educational results

By using rules to determine fitness, you can determine exactly where and why a lyric went wrong. The algorithm conveys and explains its "thought process" and rationale to the user, then the user can learn from that.

Downsides of a Rule-Based Approach

The only downside I really see to a rule-based approach is that there will be a **lot** of rules. Thought I won't be able to directly correlate a rule-based approach to lyrical suitability with the algorithms that determine instrumental suitability, that's not really my main goal (It's more of a "Wouldn't it be cool if...?" thing).

Benefits of an Equation-Based Approach

This is the approach that I started with, not so much because it was the best fit, but because it fit the medium I was using (Excel Spreadsheet). There are, however, several reasons that an equation-based approach might be preferred.

Parallels to instrumental composition

The construction of instrumental music is intrinsically algorithmic and/or mathematical. One of my side-goals with Melody Matcher was to discover a *complementary* algorithm to these for the composition musical **texts**.

By pursuing a math-based approach, I can parallel the way that instrumental compositions are structured, and maybe even eventually incorporate my work into algorithm-based music theory.

Uniform measurement of results

An equation will give me a concrete number that represents the fitness of a lyric. This allows for easier comparison, and perhaps an overall fitness score for the lyrical and instrumental structure of a composition.

Downsides of an Equation-Based Approach

There are several aspects of an equation-based approach that are less than desirable.

Lack of atomicity

With an equation-based approach, I either have to address all the factors that go into lyric fitness in one monster-mega-equation, or make a bunch of smaller equations, and combine their results after computation. Both of these are exceedingly hard to modify. If I come to the conclusion that the phone "**jυ**" needs to be categorized as a syllabic consonant instead of a semivowel, I have to figure out where in the equation I computed its value, and make sure I modify any parts of the equation that depend on "**jυ**" being a semivowel. Since I've still not yet nailed down all the intricacies of how the parts of a lyric interrelate and/or contribute to the fitness of a lyrics' structure, the lack of easy modification is kind of a dealbreaker.

Ambiguous interpretation of results

A single number can't accurately reflect all the nuances that go into why a lyric might not be structurally sound. For example, if Melody Matcher gave a song lyric a score of 1.33 out of 1.1, that means that it failed one or more fitness criteria. However, there's no way to know exactly what's wrong with it. This lack of explanation and/or reasoning makes it difficult to use Melody Matcher as a teaching tool, which is one of my ultimate goals.

Verdict on Rule-Based vs Equation-Based

Since Melody Matcher's fundamental concepts are still in constant revision, the easy modifiability provided by a rule-based approach makes it the optimal choice. Eventually, once I've nailed down all the intricacies of how a lyric is built and structured, I might want to move to an equation-based approach, so that I could maybe incorporate my work into a complement to Harmonic Theory. As things stand now, though, I don't have confidence that I've fully understood and quantified the structure of a song lyric. My equation-based approach is a spaghetti-like mess. You know the movie "Cloudy With A Chance Of Meatballs"? There's this spaghetti tornado. That's what my equations are like. They're a twisted and tangled together, and they get unneeded objects stuck in them. Okay, it's not a perfect metaphor. I'm just saying, it's not pretty.