A Method for Automatically Determining Stresses for English Chants in Second Language Learning

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1 Introduction

Chants, also called *Jazz Chants*, are useful for mastering the rhythm of English in language learning and teaching[2]. This is especially true for non-native children, who are in early stages of second language learning where written materials such as grammar books are not suitable yet. A chant is the rhythmic expression of standard American English - the rhythm, stress and intonation pattern of what children would hear from an educated native speaker in natural conversation. An example chant would be:

* * * *
Frank, Hank, walk to the bank.

* * * *
Jill, Phil, run up the hill.

where the asterisks denote the stressed syllables. Teachers and children can read chants aloud clapping along the stresses.

According to the textbook[2], the use of chants has the following three advantages in using chants:

1. Rhythm and intonation
   Chants can be used for developing an ear for the correct stress and intonation patterns of English.
2. Memorization
   Using rhythm to introduce new vocabulary offers children a very fast truck for learning. Enjoyment in doing chanting also aids memorization.
3. Grammar and vocabulary
   Chants can be used to even reinforce grammar, to develop and practice vocabulary, and to practice the pattern of everyday conversation.

Although chants have been shown to be effective in language learning and teaching[1], there is a major problem in exploiting them. In second language learning and teaching, stresses in chants must be explicitly indicated as in the example chant above so that non-native speakers of English including teachers and students understand where to have stresses. Unfortunately, however, most teaching materials do not indicate stresses explicitly because native speakers of English have no difficulty in determining where to have stresses. If non-native teachers of English try to tag chants with stresses by themselves, they often make mistakes[1]. A typical example would be:

* * * * * *
Frank, Hank, walk to the bank.

Namely, they tend to mistakenly put a stress on every single word.

The purpose of this study is to propose a method for automatically tagging English sentences with stresses for chants. This paper reports how to automatically tag English sentences with stresses for chants. It also reports its performance. It further discusses several ideas for improvement.

2 Proposed Method

The basic idea of the proposed method is to solve the stress-tagging problem as the POS (Part-Of-Speech) tagging problem. To illustrate this, let us consider the following example:

Frank, Hank, walk to the bank.

This example sentence would have the stresses:

* * * *
Frank, Hank, walk to the bank.

or, equivalently would be expressed as:

Frank/S ,/N Hank/S ,/N walk/S to/N the/N bank/S ./N

where S and N denote stress and not-stress, respectively. On the other hand, it would be POS-tagged as:

Frank/NN ,/, Hank/NN ,/, walk/VB to/PP the/DT bank/NN ./.

where NN, VB, PP, and DT denote noun, verb, preposition, and determiner, respectively. Looking at these examples, the stress-tagging problem is very similar to the POS tagging problem. This is why this study solves the stress-tagging as the POS tagging problem.

The proposed method uses a Hidden Markov Model (HMM) which has been shown to be effective in POS tagging. This paper proposes two HMM-based methods. The first one is based on a HMM whose input and output (i.e. hidden state) are words and S or N, respectively (HMM-Words). An example of the input and output of HMM-Words would be as:

input: Frank, Hank, walk to the bank.
output: Frank/S ,/N Hank/S ,/N walk/S to/N the/N bank/S ./N

The HMM is trained on chants manually annotated with stresses. The other has three steps using HMM two times (HMM-POS). The input for the first HMM is words as in HMM-Words. The hidden state corresponds to POS. This means in turn that the input for the second HMM is POS tags. The hidden state corresponds S or N. To illustrate HMM-POS, let us consider the following example. The first HMM example would be as:

input: Frank, Hank, walk to the bank.
output: Frank/NN ,/, Hank/NN ,/, walk/VB to/PP the/DT bank/NN ./.

For the second HMM input, we remove words from the first HMM output. The second HMM example would be:

input: NN , NN , VB PP DT NN .
output: NN/S ,/N NN/S ,/N VB/S PP/N DT/N NN/S ./N

Finally, we merge the first input and the S or N tags into one to give the final output:

output: Frank/S ,/N Hank/S ,/N walk/S to/N the/N bank/S ./N

The training of the HMMs is done in the same manner as HMM-Words.

3 Experiments and discussion

3.1 Environment of experiments

For the experiments, 17 chants were extracted from the textbook[2] (153 sentences, 627 words). We prepared two other methods as baselines for comparison as well as the proposed methods. In the first baseline, all words are tagged as S (Baseline1). In the second baseline, all content words are tagged as S (Baseline2). We used the tri-gram HMM with the interpolation of unigrams and bigrams. We used an in house POS-tagger which has 44 POS tags based on the Penn Treebank tag set. As the evaluation measure, we used recall, precision, F-measure, and accuracy with the leave-one-out (a chant was left out at a time).

3.2 Results and discussion

Table 1 summarizes the experimental results. Table 1 reveals that HMM-POS outperforms HMM-Words as we expected. The reason for this is that the experimental data are sparse. In other words, unknown words often appeared and affected the performance of HMM-Words. Especially, proper nouns were problematic in HMM-Words. This implies also that collapsing some classes of POSs into one is likely to improve the performance. For example, there were four types of noun POS (NN: singular noun; NNS: plural noun; NNP: singular proper noun; NNPS: plural proper noun) in the POS tagger used in the experiments. The differences in these nouns are not so informative for determining stresses for chants. Considering, it is likely that collapsing them into one such as NN will improve the performance.

Table 1: Experimental results

Method	R	P	F	A
Baseline1	**1.00**	0.344	0.507	0.344
Baseline2	0.685	0.750	0.716	0.659
HMM-Words	0.739	0.746	0.742	0.678
HMM-POS	0.832	**0.777**	**0.804**	**0.745**

At the same time, we have found that words are more effective than POSs in some cases. For example, both *you* and *it* are tagged as PRP by the POS tagger. However, *you* tend to have a stress more often than *it*. This example suggests that some POS tags are too crude. In other words, certain words such as *you* and *it* should be treated as POSs to achieve a better performance.

A common defect to all the methods is that they do not consider that chants should satisfy a constraint. Namely, the number of stresses in a chant is normally constructed to be divisible by four. The proposed methods obviously do not consider the constraint. We expect more improvement by considering the constraint in HMM-POS.

4 Conclusions

We proposed methods for automatically tagging English sentences with stresses for chants. We solved the stress-tagging problem as the POS-tagging problem using HMMs. The proposed method achieved an F-measure of 80.4% and an accuracy of 74.5% in the experiments. We found some ideas for improvement. In the future work, we will investigate how to implement the ideas.

References

[1] C. Arima, "Study on the application of jazz chants to english language teaching in primary school (in japanese)," Master's thesis, Hyogo University of Teacher Education, March 2008.

[2] C. Graham, Creating Chants And Songs, OXFORD, 2006.