An Empirical Investigation of Word Representations for Parsing the Web

NAIST

Sorami Hisamoto, Kevin Duh, Yuji Matsumoto
Nara Institute of Science and Technology

Overview

- Parsing is difficult for unrestricted web text (accuracy: 90% WSJ -> 80% web).
- Word representation features obtained from large unlabeled data may combat data sparseness.
- We observed that word clusters/embeddings help most in the case of predicted part-of-speech (POS) tags.

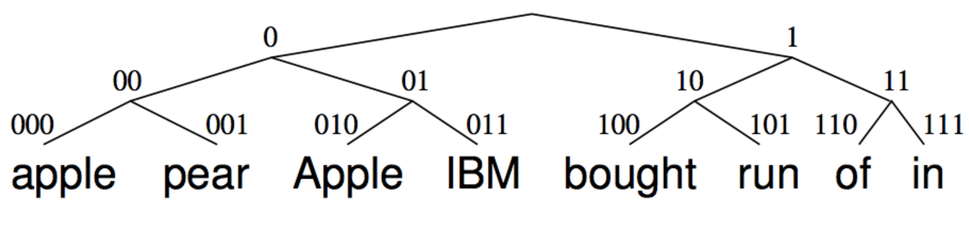
Dependency Parsing of Web Text

- Data: Google Web TreeBank from SANCL2012, containing 5 domains (*Answers*, *Emails*, *Newsgroups*, *Reviews*, *Weblogs*).
- Graph-based parser with arc-factored model.
- Extra word representations features are added on top of baseline features.

Brown Clustering

- Hierarchical clustering algorithm based on class-based bigram language model.
- It has been shown to improve accuracy.

An example of Brown clustering



* Figure from *Koo et al. 2006. "Simple Semi-supervised Dependency Parsing".*

- We used short bit-string prefixes of the hierarchy, combined with word forms or POS tags, as features.

Collobert & Weston Embedding

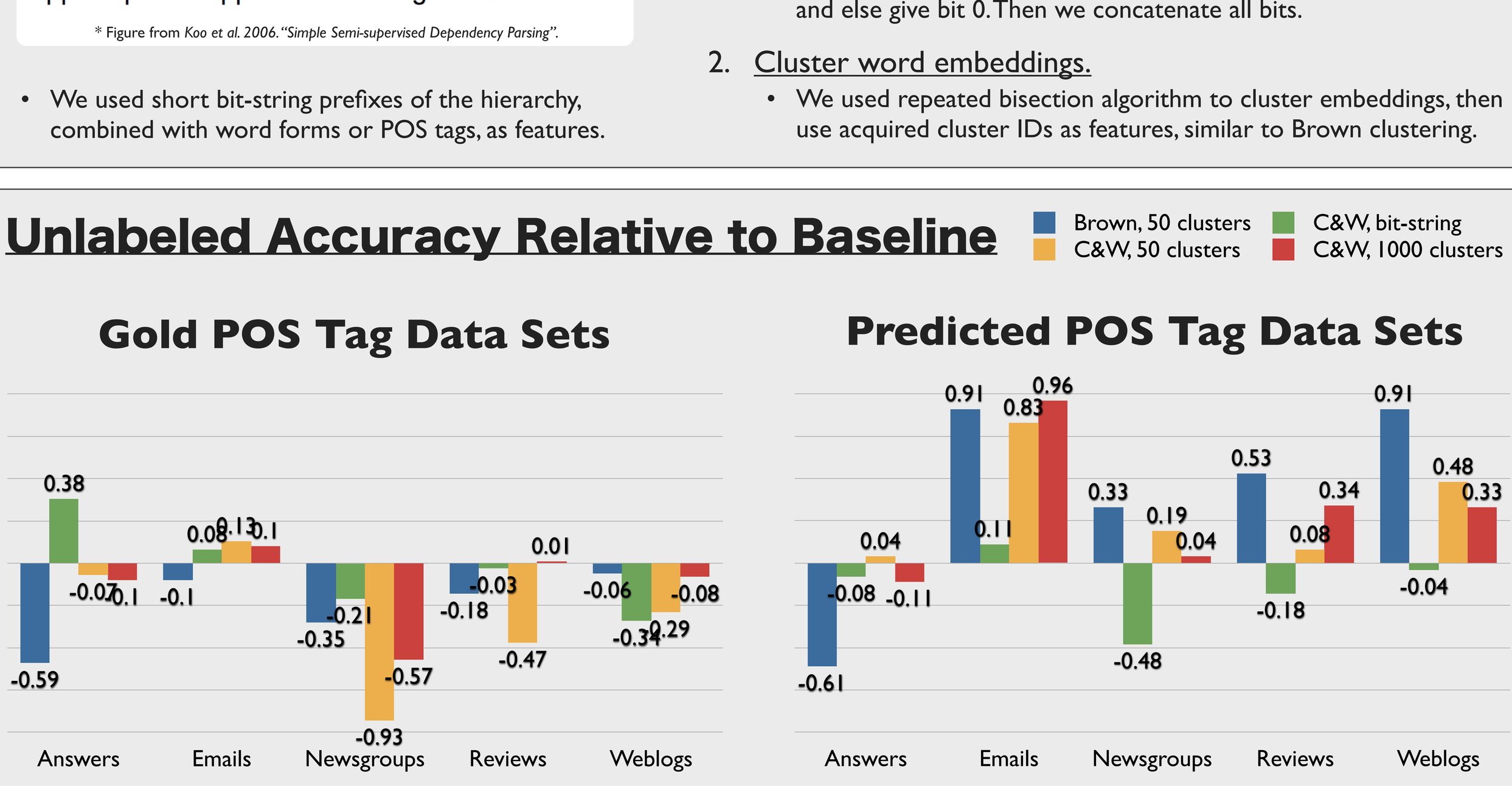
- Word Embedding: word represented in a dense low dimensional real value vector form, often induced from a neural language model.
- We constructed features in following 2 ways;

2D visualization of word embeddings

* Figure from Joseph Turian.

1. Convert an embedding into a bit-string.
   - For each real-value in vector, we give a bit 1 if the value is positive and else give bit 0. Then we concatenate all bits.
2. Cluster word embeddings.
   - We used repeated bisection algorithm to cluster embeddings, then use acquired cluster IDs as features, similar to Brown clustering.

Unlabeled Accuracy Relative to Baseline



Discussion

- Extra features improved results on experiments with predicted POS tag data sets, but not with gold POS tag data sets.
- Brown clustering features outperforms word embedding features.

Future Work

- Induce word embeddings on in-domain data sets.
- Try different ways to construct features.