Diachronic Word Sense Change Identification

Bass: fish

???

Bass: instrument

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Problem Statement

- To devise an unsupervised approach to identify words which have semantically changed over time.
- Perform the task on multiple epoches in multiple languages. – English, Hindi and Mandarin if possible

Motivation

- Time sense disambiguation is highly instrumental in *culturonomics*, *etymology*.
- Important for people working with historical texts, such as librarians, historians and linguists.
- It is also helpful to lexicographers and design engineers in a variety of NLP/IR tasks.

Examples

- ‘Gay’ - Noble person (early 20th century)
  - Homosexual (21st century)

- ‘Artificial’ - positive sense (early 20th century)
  - negative sense (current decade)

- ‘Sick’ - illness (20th & 21st century)
  - crazy or cool (21st century)

- ‘Bachelor’ - young knight (Long ago)
  - University affiliated (21st Century)

- ‘Flirt’ - jerky motion (500 years ago)
  - ……………. (21st Century)

Existing Approaches

- *Haim Dubossarsky et al.*– Word2vec trained on Google books, initializing with word vectors of prev. epoch. Change in distance from centroid of K means clusters => sense change. [1]

- *Adam Jatowt et al.* - measured cosine similarity of word vectors created using frequency of co-occuring word on Google books 5-grams model. [2]

- *Sunny Mitra et al.* - Chinese Wispers over a co-occurence graph vectors from distributed thesaurus (Riedl and Biemann, 2013), then compare clusters for birth, death, merge or split. [3]

Our Approach

- Adapted from work of **Shashwat Chandra**. [4]

$$W_t = M \cdot W_s + b$$

- Used to transform and align vectors trained on two different datasets

W_t - transformed word vector

M - transformation matrix (train.set1 to train.set2)

W_s - word vector from first set

b - bias term for translation

$$\begin{bmatrix} W_t \\ 1 \dots 1 \end{bmatrix} = \left[\begin{array}{c|c} M & b \\ 0 \dots 0 & 1 \end{array}\right] \cdot \begin{bmatrix} W_s \\ 1 \dots 1 \end{bmatrix}$$

Our Approach ..

- *M* and *b* ??
  - Use words whose meaning has not changed over the two datasets and find an estimate

- *minimize* $||M \cdot W_s - W_t||_F$

- *Least square solution helps*

$$\left[\begin{array}{c|c} M & b \\ 0\ldots0 & 1 \end{array}\right] = \left[\begin{array}{c} W_t \\ 1\ldots1 \end{array}\right] \cdot \left[\begin{array}{c} W_s \\ 1\ldots1 \end{array}\right]^{+}$$

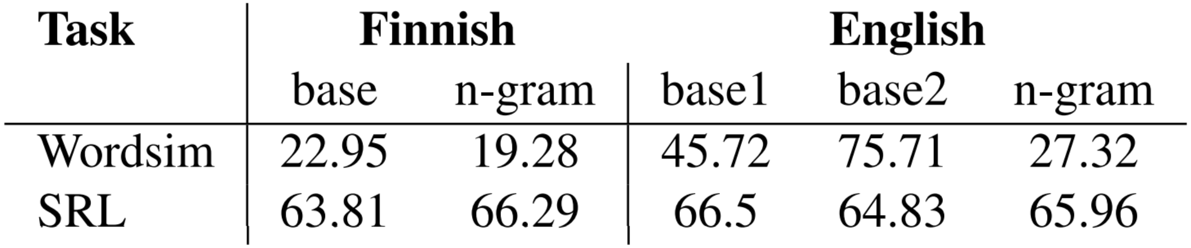
$$A^{+} = A^{T}(AA^{T})^{-1}$$

Our Problem fits..

- Build datasets corresponding to different epoches
- Train Word2Vec over each epoch individually.
- Find transformation matrices for all pairs/ convert all into one frame
- Vectors can then be compared between time epoches, once we have them in the same frame.

Challenges

- Filip Ginter et al. [5] –



Task	Finnish		English		
	base	n-gram	base1	base2	n-gram
Wordsim	22.95	19.28	45.72	75.71	27.32
SRL	63.81	66.29	66.5	64.83	65.96

- Dataset Collection
  - No directly available dataset with diachronic tags
  - Dataset corresponding to different languages was to be generated

- Handle existing polysemy within a time epoch.

HEY! WHAT YOU TRYING PULL? THAT NOT A WORD YET!
Scrabble
CARTOONSTOCK .com
Search ID: shl080417
©Scott Hilburn/Distributed by Universal Uclick via CartoonStock.com

Progress so far..

- Collected out the British parliament debate dataset, distributed over the span of 1890 to 2007
  - Had to scrape out over 1500 links and extract xml text ~8gb
  - Process the xml files extracted for specific parts
- Collected Hindi stories, fiction, and novels from *hindisamay.com.*
  - Around 250 fiction, 500 stories spread over 250 years
- Transformation matrix code done. WordVec training code done. Training and all pair comparision needs to be done.

Further Thoughts..

- Train and test over *Peoples daily* (simplified Chinese).
- Handle polysemy within one epoch and appropriately train word2vec separately for different words within an time epoch; propose birth, death merge or split of a sense.
- Use of Distributed thesaurus to train word2vec over Google 5-grams

References

- [1] A bottomup approach to category mapping and meaning change. Haim Dubossarsky.
- [2] A Framework for Analyzing Semantic Change of Words across Time, Adam Jatowt and Kevin Duh.
- [3] That's sick dude!:Automatic identification of word sense change across different timescales.Sunny Mitra, Ritwik Mitra, Martin Riedl, Chris B ie mann, Animesh Mukherjee, Pawan Goyal.
- [4] Aligned Word Vector Spaces and Document Vectors, Shashwat Candra.
- [5] Fast Training of word2vec Representations Using N-gram Corpora. Filip Ginter, Jenna Kanerva.