ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
CAMPUS DI FORLÌ

91258 / B0385
Natural Language Processing

Lesson 13. Hands on Word Embeddings

Alberto Barrón-Cedeño
a.barron@unibo.it

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Previously

- Skip-gram
- CBOW

Table of Contents

Chapter 6 of Lane et al. (2019)

Pre-Trained Models

Some Pre-Trained Models

Model	Provider	Description
word2vec	Google	300D from English Google News articles[1]
fastText	Facebook	157 languages from Wikipedia and Common Crawl[2]
word2vec/GloVe	CNR	Italian embeddings from the Wikipedia
word2vec	UCampania	Italian embeddings[3]

There are many pre-trained models and diverse libraries to handle them.

Just query your favorite search engine

[1] `https://drive.google.com/file/d/0B7XkCwpI5KDYNlNUTTlSS21pQmM`
[2] `https://fasttext.cc`
[3] `https://mlunicampania.gitlab.io/italian-word2vec/`

Gensim

Gensim

- Scalable, open source, and efficient Python library
- It includes many resources, including word2vec, doc2vec, FastText, LDA, and more
- All information, including (very nice) documentation at `https://radimrehurek.com/gensim/`

Let us see

Gensim

Most similar items

`word_vectors.most_similar()`

Among the most interesting parameters:

- **positive** list of vectors to be added together before looking for the neighbours
- **negative** subtraction (or exclusion) of the elements
- **topn** number of elements to retrieve

Let us see

Gensim

Least similar items (closed set)

`word_vectors.doesnt_match()`

It returns the element from the input list with the lowest similarity with respect to the rest

Let us see

Gensim

More operations

Adding and Subtracting

We can use `most_similar()` again, this time with the negative parameter

Let us see

Computing similarities

`word_vectors.similarity()`

Let us see

Gensim

Getting the Vectors

Gensim (and other libraries) have implemented these interfaces to perform some *standard* operations

To go beyond, one needs to get access to the actual vectors

`word_vectors[word]`

Let us see

Model Construction

Model Construction

Considerations

- If you are working in other language than English, Google's provided word2vec is not an option (FastText might be)
- Google's word2vec is built on news; fastText has versions built on the Wikipedia and on common crawl...
  analysing scientific papers or literature?
  Probably not
- You want to work on COVID-19 or any other recent topic?
  Many relevant terms wont appear

Alternatives

- Opting for some of the previous representations
- Build your own model

Model Construction

Pre-Processing

Typical pre-processing pipeline

- Tokenisation
- Lowercasing (optional)
- Sentence splitting

Input Embedded list of tokenised sentences

$$[[w_{0,0}\ w_{0,1}\ w_{0,2}\ \dots\ w_{0,k}], [w_{1,0}\ w_{1,1}\ w_{1,2}\ \dots\ w_{1,l}], \dots [w_{x,0}\ w_{x,1}\ \dots\ w_{x,m}]]$$

Model Construction

Training

Training a word2vec model with gensim

Tutorial: `https://rare-technologies.com/word2vec-tutorial/`

Let us see

Considerations

- Training on relatively large corpora might take some time
  (Brown is small and took me a bit less than 1 minute on a 2.5GHz Quad-Core i7, 16GB RAM)
- Large corpora (e.g., the Wikipedia) can require a significant amount of time/memory

Model Construction

Trimming and Saving

Reminder We do not care about the output

`model.init_sims(replace=True)`

- Freezes the model
- Stores the hidden-layer weights
- Discards the output-layer weights

not necessary since gensim 4.0

Now we simply have to save the model with `model.save()`
Let us see

GloVe

GloVe

Global Vectors (Pennington et al., 2014)[4]

- It uses a global word-word co-occurrence matrix
- Learning objective: word vectors such that their dot product equals the logarithm of the words' probability of co-occurrence

- It produces similar matrices to word2vec
- It converges, even with smaller corpora
- It is more accurate with the same amount of data

[4] https://nlp.stanford.edu/projects/glove/

GloVe

GloVe vs word2vec

RaRe Technologies comparison[5]

Settings: 600 dims • context window of 10 • 1.9B words of *en* Wikipedia.

Algorithm	acc (word analogy)*	wallclock time	peak RAM (MB)
I/O only	–	3m	25
GloVe, 10 epochs, lr 0.05	67.1	4h12m	9,414
GloVe, 100 epochs, lr 0.05	67.3	18h39m	9,452
word2vec, hierarchical skip-gram, 1 epoch	57.4	3h10m	266
word2vec, negative sampling (10 samples), 1 epoch	68.3	8h38m	628
word2vec, Google 300d	55.3	–	–

* *a* is to *b* as *c* is to ?

[5] rare-technologies.com/making-sense-of-Word2vec/#glove_vs_word2vec

fastText

fastText

Predicts the surrounding character [2, 3]-grams rather than the surrounding words (Bojanowski et al., 2017)[6]

- Pre-trained models available in 250+ languages
- Built on Wikipedia editions (variable quality)
- Built on common crawl

Models available at `https://github.com/facebookresearch/fastText/blob/master/docs/crawl-vectors.md`

Let us see

[6] `https://github.com/facebookresearch/fastText`

Some Remarks

LSA is a better (faster) option for long documents e.g., for clustering

Online learning An existing model can be *adapted* (but new words cannot be added)

doc2vec possible representation based on linear combinations of word2vec

References

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