Representing long texts for NLU

CS224U Spring 2019

Learning representations so far

- At the word or sentence level
- **Word similarity**: *(word1, word2) → distance*
- **Sentence**: *sentence → {positive, neutral, negative}*
- **NLI**: *(word1, word2) → {entails, not entails}*
    - Recall combining multiple words with vector_combo_func

Learning representations so far

- Fixed-dimensional representations useful for lots of downstream tasks
- Once we have an embedding, we can perform classification, clustering, etc.

Goal

How can we apply NLU methods to long texts? *(Think news articles, scientific papers, books, transcripts, etc.)*

Sample tasks

- Document classification
- Document similarity/clustering
- Reading comprehension (e.g. NewsQA)
- Summarization

Methods

Vector representations of words

- We’ve seen lots of methods for this
  - One-hot, PPMI, LSA, word2vec, GloVe, BERT
- How can we get from word vectors to paragraph/document vectors?

Good baseline methods

- Bag of word vectors (sum, mean, max-pool)
  - What are some drawbacks?

Good baseline methods

- Bag of word vectors (sum, mean, max-pool)
  - Loses sentence structure
- Combine using structure of parse trees [1]

[1] Socher, Richard, et al. "Parsing natural scenes and natural language with recursive neural networks." *Proceedings of the 28th international conference on machine learning (ICML-11)*. 2011.

Good baseline methods

- Bag of word vectors (sum, mean, max-pool)
    - Loses sentence structure
- Combine using structure of parse trees [1]
    - Relies on accurate parsing, does not work as well beyond single sentences

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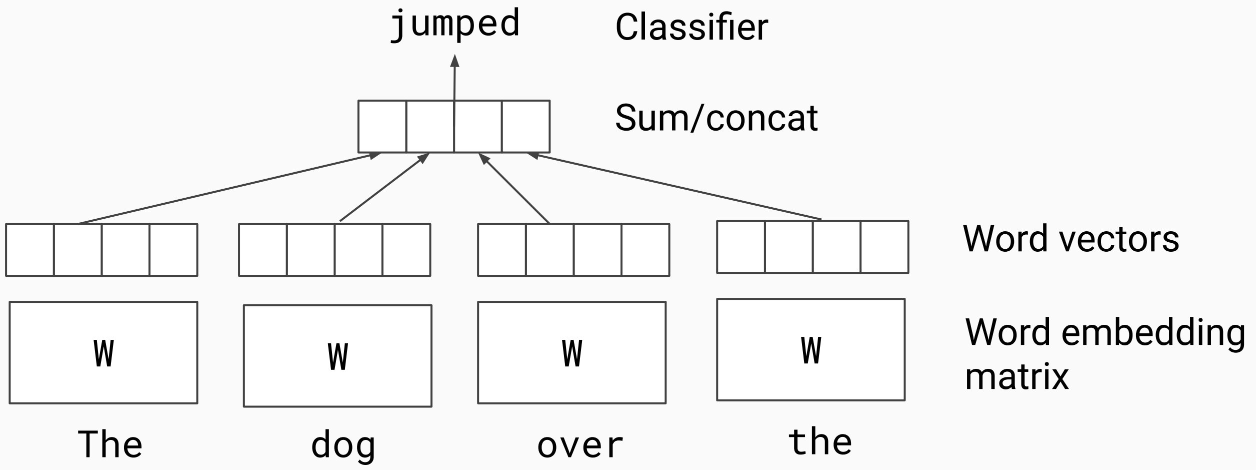
RNNs as document encoders

- Train an RNN as an autoencoder, or for your downstream task
- Use the output at the last timestep as a document embedding
- Length limitations: loses context information after many timesteps

Doc2vec [2]

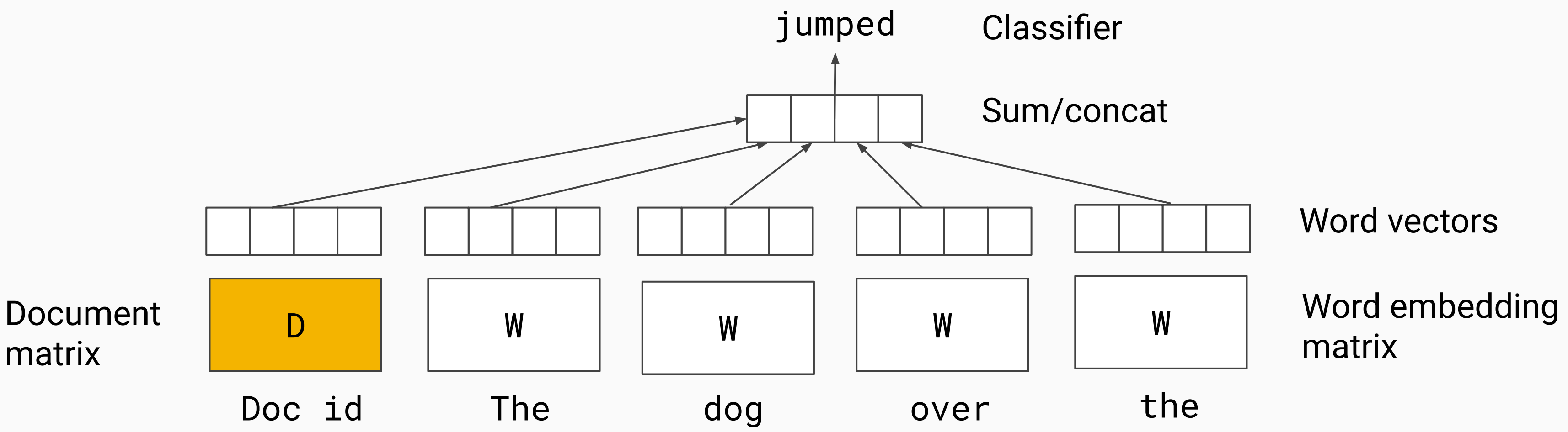
Continuous Bag of Words algorithm (word2vec [3])



[2] Le, Quoc, and Tomas Mikolov. "Distributed representations of sentences and documents." *International conference on machine learning*. 2014.
[3] Mikolov, Tomas, et al. "Distributed representations of words and phrases and their compositionality." *Advances in neural information processing systems*. 2013.

Doc2vec [2]

Paragraph Vector - Distributed Memory



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Doc2vec [2]

- Simultaneously learn a word vector for every word and document vector for every document
- Unsupervised training
- To get the vector for a new document, fix word matrix *W*, augment document matrix *D*, and train for few epochs
  - Careful: can yield different vectors for the same input!

[2] Le, Quoc, and Tomas Mikolov. "Distributed representations of sentences and documents." *International conference on machine learning*. 2014.

Resources

- Doc2vec
    - The gensim package provides an easy-to-use API
- General document embedding
    - The flair library allows for using and combining various embedding types (so far only supports pooling and RNN document embedders)

TODO: LM deep learning

- Transformer
- BERT -- call out limitations
- ELMo
- Etc
- Other encoder-decoder type approaches

Sentence encoders (to include?)

- Skip-thought (sentences)
- InferSent
- Google Universal Sentence Encoder (USE)