Word Embeddings

Recitation 3

CS273B : Deep Learning in Genomics and Biomedicine

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Overview

1. Word Embeddings
2. Motivation
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4. Visualization

Word Embeddings

Refers to the technique of language modelling where words or phrases form vocabulary are mapped to vectors of real numbers

Motivation

- A computer can understand only numbers
- Just encoding/assigning id for each word, doesn't help in understanding the relationship with different words
- This is unlike the case of image/audio data
- The raw pixels/signals provide meaningful information

Motivation

- For ex: cat - 01 and dog - 02. Using this encoding, little can be understood about the relationship between cat and dogs (like they are both animals, 4 legged, etc).
- Word embedding is a way to resolve this issue of representation of text data as vectors such that the relationship among different words and their context are captured.

Word2Vec

- Computationally efficient predictive model for learning word embeddings from raw text
- 2 flavours - CBOW and Skip-gram
- CBOW - predict target word from context
- Skip-gram - do the inverse operation of CBOW - predict context words from target words

CBOW

- CBOW - Continuous Bag of Words
- Before going to this, let's consider a simpler model

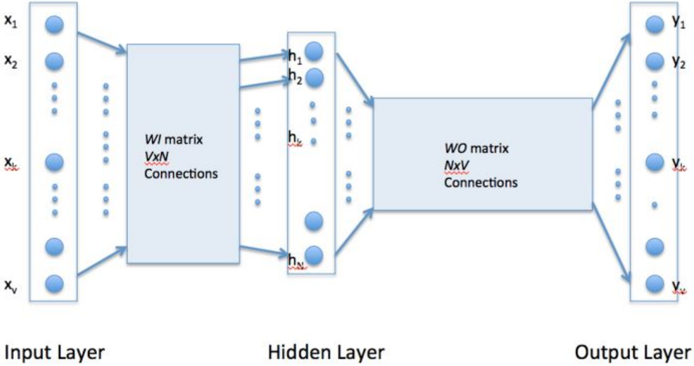


Figure: Simple word2vec [1]

CBOW

- Single hidden layer fully connected neural network
- Hidden layer size = dimensionality of word vector
- Output layer size = input layer size
- Ex: Cat climbed the wall
- The goal of the network is to predict the target word given a context word as input. For example, if "cat" is referred to as the context word, we want the network to show a high prob for "climbed" as "cat" and "climbed" are more likely to occur together.

CBOW

- Now onto CBOW
- Given multiple (say C) context words, need to determine the target word
- Idea : Replicate hidden layer C times

CBOW

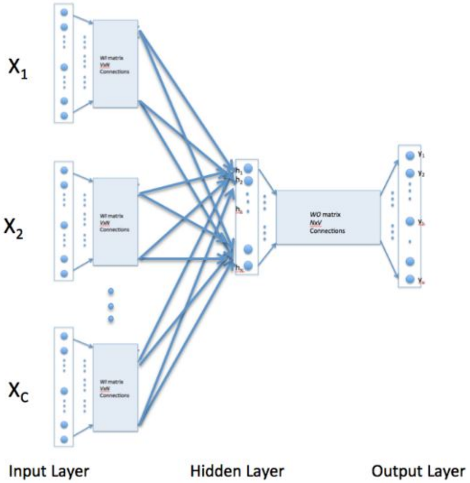


Figure: CBOW [1]

Skip-gram

- Let's do by example
- The quick brown fox jumped over the lazy dog
- Using a window of size 1 (this can be varied), we have ([the, brown], quick), ([quick, fox], brown), ([brown, jumped], fox), ... as (context, target) pairs
- Task : Given the target, need to predict the context words

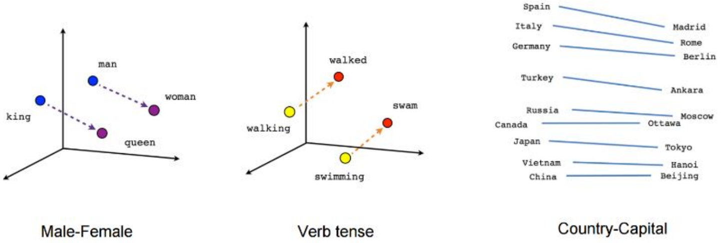
Skip-gram

- Create the training dataset as (quick, the), (quick, brown), (brown, quick), (brown, fox), ...
- You can use popular methods like GD, SGD to train
- Make the network learn the embedding and thereby relation between words
- Alternatively you can make the network produce two outputs which would form the pair of context words for the input and sum the errors for backprop training

Word2Vec

- These models can learn semantic relationships between words
- Skip-gram: works well with small amount of the training data, represents well even rare words or phrases [4]
- CBOW: several times faster to train than the skip-gram, slightly better accuracy for the frequent words

Visualization



Male-Female

Verb tense

Country-Capital

Figure: Word embeddings projected onto 2D [3]

Visualization

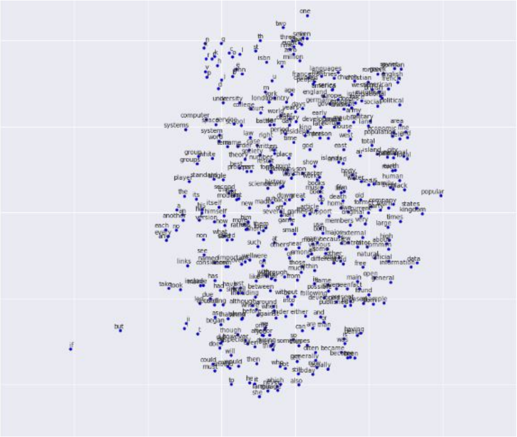


Figure: Word embeddings projected onto 2D [3]

References

Word2vec
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Word Embedding
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Tensor Flow
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Word2Vec
https://www.quora.com/What-are-the-continuous-bag-of-words

Thank You