Autoencoder with Word2Vec

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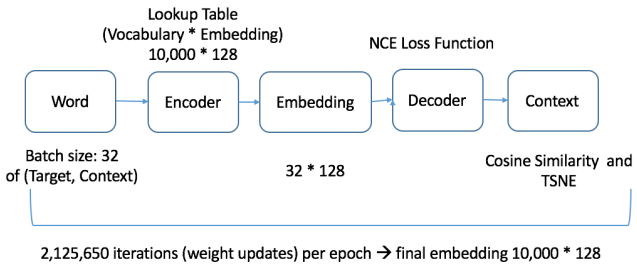
1. Abstract

Using the "skipgram" model, Autoencoder is implemented with layers of an encoder, embeddings and decoder. For visualization, not only do nearest words are generated with cosine similarity, but also t-distributed stochastic nearest embedding("tsne") is used

2. Introduction

The <Figure1> is shown for our Autoencoder with: 1) as input 32 batch size consisting of a pair of (target, context), an encoder using a lookup table, embedding, the NCE (Noise-Contrastive Estimation) loss function as a decoder, producing final embedding 10,000 * 128 matrix and finally, a result using the cosine similarity and TSNE (t-Distributed Stochastic Nearest Embedding).

<Figure1>



3. Data Preprocessing

The input data is downloaded from http://mattmahoney.net/dc/ and it is a number of 17,005,207 words as a corpus. The vocabulary size is set to 10,000 that occurred most frequently in the corpus. Thus, most common words are [['UNK', 1,737,307], ('the', 1,061,396), ('of', 593,677), ('and', 416,629), ('one', 411,764)] (UNK includes words not in the vocabulary). For the skipgram model, 5 of a skip window that is how many words to consider left and right from target word, 4 of number of skips that is how many times to reuse an input to generate. Based on the above parameters, as an example of a pair of input and output as a label, the following pairs are generated: originated -> anarchism, originated -> as, as -> a, as -> originated, a -> as, a -> term, term -> a, term -> of. The batch size is 32 so that a number of iterations per an epoch is used with 2,125,650 = 17,005,207 * 4 / 32 (data size * number of skips / batch size). Five epochs are used and embedding size is 128.

4. Training

The NCE (Noise-Contrastive Estimation) loss function is used. I use five epochs so that 10,628,000 iterations are repeated for updating weights that is a size of embedding, 10,000 * 128. The final iteration is shown as follows:
Elapsed: 10628000 batches, Cost = 4.739091682

5. Result

The <Figure2> shows one of the results that is using the cosine similarity. The word 'later' 's nearest words are 'eventually', 'then', 'before', 'subsequently', 'several', 'after', 'first' and 'he'. The word 'July' shows accurately month's word such as 'august', 'april', 'january', 'december', 'june', 'november', 'october'.

<Figure 2>

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Nearest neighbor of numbers: number, arithmetic, points, elements, together, correspondence, chaucer, astrology
Nearest neighbor of war: battle, ii, during, bombing, wars, period, victory, foster
Nearest neighbor of later: eventually, then, before, subsequently, several, after, first, he
Nearest neighbor of july: august, april, january, december, june, november, september, october
Nearest neighbor of terms: second, words, third, every, often, both, UNK, value
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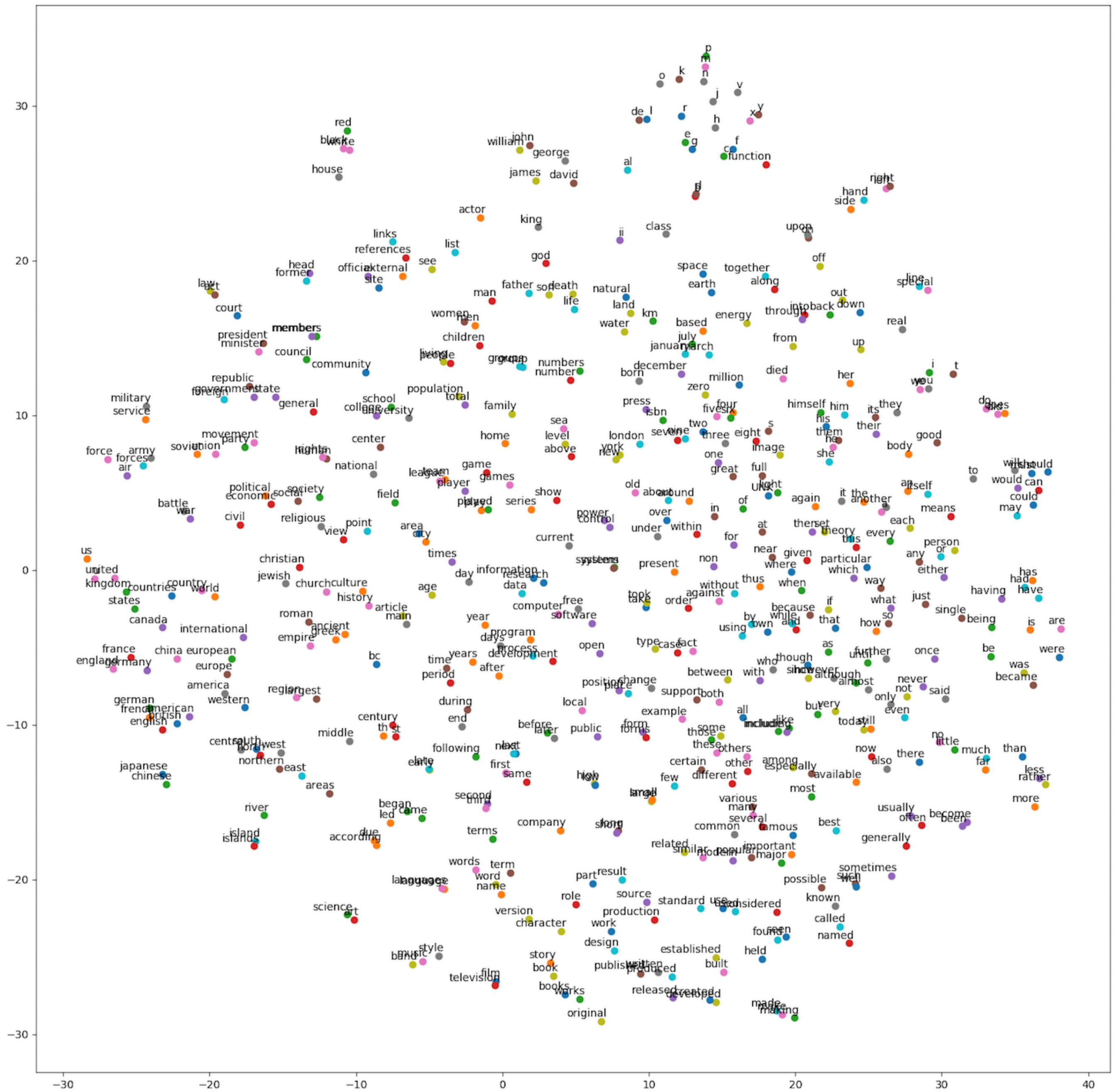
The <Figure3> shows 2-dimensional vector space of words. From the final embeddings of 10,000 * 128, TSNE reduces to 10,000 * 2 so that each word is represented by (x, y) coordinate. As an example in the <Figure3> showing 500 words out of 10,000, the word 'data' is displayed roughly in (0, 0). Its nearest word is 'information', 'research' and 'computer'.

6. References

[1] Nikhil Buduma (2017). Fundamentals of deep learning. Sebastopol, CA: O'Reilly Media

< Figure 3>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