Showing 1–21 of 21 results for all: Word vectors bias

1. arXiv:1904.08783 [pdf, other] cs.CL cs.LG

Evaluating the Underlying Gender Bias in Contextualized Word Embeddings

Authors: Christine Basta, Marta R. Costa-jussà, Noe Casas

Abstract: Gender **bias** is highly impacting natural language processing applications. **Word** embeddings have clearly been proven both to keep and amplify gender biases that are present in current data sources. Recently, contextualized **word** embeddings have enhanced previous **word** embedding techniques by computing **word vector** representations dependent on the sentence they appear in. In this paper, we study the impact of this conceptual change in the **word** embedding computation in relation with gender **bias**. Our analysis includes different measures previously applied in the literature to standard **word** embeddings. Our findings suggest that contextualized **word** embeddings are less biased than standard ones even when the latter are debiased. △ Less

Submitted 18 April, 2019; **originally announced** April 2019.

2. arXiv:1904.03310 [pdf, other] cs.CL

Gender Bias in Contextualized Word Embeddings

Authors: Jieyu Zhao, Tianlu Wang, Mark Yatskar, Ryan Cotterell, Vicente Ordonez, Kai-Wei Chang

Abstract: In this paper, we quantify, analyze and mitigate gender **bias** exhibited in ELMo's contextualized **word vectors**. First, we conduct several intrinsic analyses and find that (1) training data for ELMo contains significantly more male than female entities, (2) the trained ELMo embeddings systematically encode gender information and (3) ELMo unequally encodes gender information about male and female entities. Then, we show that a state-of-the-art coreference system that depends on ELMo inherits its **bias** and demonstrates significant **bias** on the WinoBias probing corpus. Finally, we explore two methods to mitigate such gender **bias** and show that the **bias** demonstrated on WinoBias can be eliminated. △ Less

Submitted 5 April, 2019; **originally announced** April 2019.

3. arXiv:1901.07656 [pdf, other] cs.CL

Attenuating Bias in Word Vectors

Authors: Sunipa Dev, Jeff Phillips

Abstract: **Word vector** representations are well developed tools for various NLP and Machine Learning tasks and are known to retain significant semantic and syntactic structure of languages. But they are prone to carrying and amplifying **bias** which can perpetrate discrimination in various applications. In this work, we explore new simple ways to detect the most stereotypically gendered **words** in an embedding and remove the **bias** from them. We verify how names are masked carriers of gender **bias** and then use that as a tool to attenuate **bias** in embeddings. Further, we extend this property of names to show how names can be used to detect other types of **bias** in the embeddings such as **bias** based on race, ethnicity, and age. △ Less

Submitted 22 January, 2019; **originally announced** January 2019.

Comments: To appear in AIStats 2019

4. arXiv:1812.10424 [pdf, other] cs.CL cs.LG stat.ML

An Unbiased Approach to Quantification of Gender Inclination using Interpretable Word Representations

Authors: Navid Rekabsaz, Allan Hanbury

Abstract: Recent advances in **word** embedding provide significant benefit to various information processing tasks. Yet these dense representations and their estimation of **word**-to-**word** relatedness remain difficult to interpret and hard to analyze. As an alternative, explicit **word** representations i.e. **vectors** with clearly-defined dimensions, which can be **words**, windows of **words**, or documents are easily interpretable, and recent methods show competitive performance to the dense **vectors**. In this work, we propose a method to transfer word2vec SkipGram embedding model to its explicit representation model. The method provides interpretable explicit **vectors** while

keeping the effectiveness of the original model, tested by evaluating the model on several **word** association collections. Based on the proposed explicit representation, we propose a novel method to quantify the degree of the existence of gender **bias** in the English language (used in Wikipedia) with regard to a set of occupations. By measuring the **bias** towards explicit Female and Male factors, the work demonstrates a general tendency of the majority of the occupations to male and a strong **bias** in a few specific occupations (e.g. nurse) to female. △ Less

Submitted 13 December, 2018; **originally announced** December 2018.
Comments: arXiv admin note: text overlap with arXiv:1707.06598

5. arXiv:1811.11002 [pdf, other] cs.CL cs.LG stat.ML

Correcting the Common Discourse Bias in Linear Representation of Sentences using Conceptors

Authors: Tianlin Liu, João Sedoc, Lyle Ungar

Abstract: Distributed representations of **words**, better known as **word** embeddings, have become important building blocks for natural language processing tasks. Numerous studies are devoted to transferring the success of unsupervised **word** embeddings to sentence embeddings. In this paper, we introduce a simple representation of sentences in which a sentence embedding is represented as a weighted average of **word vectors** followed by a soft projection. We demonstrate the effectiveness of this proposed method on the clinical semantic textual similarity task of the BioCreative/OHNLP Challenge 2018. △ Less

Submitted 17 November, 2018; **originally announced** November 2018.
Comments: Accepted by the BioCreative/OHNLP workshop of ACM-BCB 2018

6. arXiv:1811.04599 [pdf] cs.CL

The Hidden Shape of Stories Reveals Positivity Bias and Gender Bias

Authors: Huimin Xu, Da Xiao, Lingfei Wu, Cheng-Jun Wang

Abstract: To capture the shape of stories is crucial for understanding the mind of human beings. In this research, we use **word** emdeddings methods, a widely used tool in natural language processing and machine learning, in order to quantify and compare emotional arcs of stories over time. Based on trained Google News word2vec **vectors** and film scripts corpora (N =1109), we form the fundamental building blocks of story emotional trajectories. The results demonstrate that there exists only one universal pattern of story shapes in movies. Furthermore, there exists a positivity and gender **bias** in story narratives. More interestingly, the audience reveals a completely different preference from content producers. △ Less

Submitted 12 November, 2018; **originally announced** November 2018.

7. arXiv:1809.04262 [pdf, ps, other] cs.LG cs.IR stat.ML

Extracting Fairness Policies from Legal Documents

Authors: Rashmi Nagpal, Chetna Wadhwa, Mallika Gupta, Samiulla Shaikh, Sameep Mehta, Vikram Goyal

Abstract: Machine Learning community is recently exploring the implications of **bias** and fairness with respect to the AI applications. The definition of fairness for such applications varies based on their domain of application. The policies governing the use of such machine learning system in a given context are defined by the constitutional laws of nations and regulatory policies enforced by the organizations that are involved in the usage. Fairness related laws and policies are often spread across the large documents like constitution, agreements, and organizational regulations. These legal documents have long complex sentences in order to achieve rigorousness and robustness. Automatic extraction of fairness policies, or in general, any specific kind of policies from large legal corpus can be very useful for the study of **bias** and fairness in the context of AI applications. We attempted to automatically extract fairness policies from publicly available law documents using two approaches based on semantic relatedness. The experiments reveal how classical Wordnet-based similarity and **vector**-based similarity differ in addressing this task. We have shown that similarity based on **word vectors** beats the classical approach with a large margin, whereas other **vector** representations of senses and sentences fail to even match the classical baseline. Further, we have presented thorough error analysis and reasoning to explain the results with appropriate examples from the dataset for deeper insights. △ Less

Submitted 12 September, 2018; **originally announced** September 2018.

8. arXiv:1808.07235 [pdf, other] cs.CL

Finding Good Representations of Emotions for Text Classification

Authors: Ji Ho Park

Abstract: It is important for machines to interpret human emotions properly for better human-machine communications, as emotion is an essential part of human-to-human communications. One aspect of emotion is reflected in the language we use. How to represent emotions in texts is a challenge in natural language processing (NLP). Although continuous **vector** representations like word2vec have become the new norm for NLP problems, their limitations are that they do not take emotions into consideration and can unintentionally contain **bias** toward certain identities like different genders. This thesis focuses on improving existing representations in both **word** and sentence levels by explicitly taking emotions inside text and model **bias** into account in their training process. Our improved representations can help to build more robust machine learning models for affect-related text classification like sentiment/emotion analysis and abusive language detection. We first propose representations called emotional **word vectors** (EVEC), which is learned from a convolutional neural network model with an emotion-labeled corpus, which is constructed using hashtags. Secondly, we extend to learning sentence-level representations with a huge corpus of texts with the pseudo task of recognizing emojis. Our results show that, with the representations trained from millions of tweets with weakly supervised labels such as hashtags and emojis, we can solve sentiment/emotion analysis tasks more effectively. Lastly, as examples of model **bias** in representations of existing approaches, we explore a specific problem of automatic detection of abusive language. We address the issue of gender **bias** in various neural network models by conducting experiments to measure and reduce those biases in the representations in order to build more robust classification models. △ Less

Submitted 22 August, 2018; **originally announced** August 2018.
Comments: HKUST MPhil Thesis, 87 pages

Journal ref: HKUST MPhil Thesis, 2018

9. arXiv:1805.11295 [pdf] cs.CL

Unsupervised detection of diachronic word sense evolution

Authors: Jean-François Delpech

Abstract: Most **words** have several senses and connotations which evolve in time due to semantic shift, so that closely related **words** may gain different or even opposite meanings over the years. This evolution is very relevant to the study of language and of cultural changes, but the tools currently available for diachronic semantic analysis have significant, inherent limitations and are not suitable for real-time analysis. In this article, we demonstrate how the linearity of random **vectors** techniques enables building time series of congruent **word** embeddings (or semantic spaces) which can then be compared and combined linearly without loss of precision over any time period to detect diachronic semantic shifts. We show how this approach yields time trajectories of polysemous **words** such as amazon or apple, enables following semantic drifts and gender **bias** across time, reveals the shifting instantiations of stable concepts such as hurricane or president. This very fast, linear approach can easily be distributed over many processors to follow in real time streams of social media such as Twitter or Facebook; the resulting, time-dependent semantic spaces can then be combined at will by simple additions or subtractions. △ Less

Submitted 30 May, 2018; **v1** submitted 29 May, 2018; **originally announced** May 2018.

Comments: 10 pages, 1 figure, 10 tables

10. arXiv:1803.11175 [pdf, other] cs.CL

Universal Sentence Encoder

Authors: Daniel Cer, Yinfei Yang, Sheng-yi Kong, Nan Hua, Nicole Limtiaco, Rhomni St. John, Noah Constant, Mario Guajardo-Cespedes, Steve Yuan, Chris Tar, Yun-Hsuan Sung, Brian Strope, Ray Kurzweil

Abstract: We present models for encoding sentences into embedding **vectors** that specifically target transfer learning to other NLP tasks. The models are efficient and result in accurate performance on diverse transfer tasks. Two variants of the encoding models allow for trade-offs between accuracy and compute resources. For both variants, we investigate and report the relationship between model complexity, resource consumption, the availability of transfer task training data, and task performance. Comparisons are made with baselines that use **word** level transfer learning via pretrained **word** embeddings as well as baselines do not use any transfer learning. We find that transfer learning using sentence embeddings tends to outperform **word** level transfer. With transfer learning via sentence embeddings, we observe surprisingly good performance with minimal amounts of supervised training data for a transfer task. We obtain encouraging results on **Word** Embedding Association Tests (WEAT) targeted at detecting model **bias**. Our pre-trained sentence encoding models are made freely available for download and on TF Hub. △ Less

Submitted 12 April, 2018; **v1** submitted 29 March, 2018; **originally announced** March 2018.

Comments: 7 pages; fixed module URL in Listing 1

11. arXiv:1712.04762 [pdf] cs.CL

Social Media Writing Style Fingerprint

Authors: Himank Yadav, Juliang Li

Abstract: We present our approach for computer-aided social media text authorship attribution based on recent advances in short text authorship verification. We use various natural language techniques to create **word**-level and character-level models that act as hidden layers to simulate a simple neural network. The choice of **word**-level and character-level models in each layer was informed through validation performance. The output layer of our system uses an unweighted majority vote **vector** to arrive at a conclusion. We also considered writing **bias** in social media posts while collecting our training dataset to increase system robustness. Our system achieved a precision, recall, and F-measure of 0.82, 0.926 and 0.869 respectively. △ Less

Submitted 26 December, 2017; **v1** submitted 11 December, 2017; **originally announced** December 2017.

Comments: 11 pages

12. arXiv:1710.07045 [pdf, other] cs.CL

Unsupervised Context-Sensitive Spelling Correction of English and Dutch Clinical Free-Text with Word and Character N-Gram Embeddings

Authors: Pieter Fivez, Simon Šuster, Walter Daelemans

Abstract: We present an unsupervised context-sensitive spelling correction method for clinical free-text that uses **word** and character n-gram embeddings. Our method generates misspelling replacement candidates and ranks them according to their semantic fit, by calculating a weighted cosine similarity between the **vectorized** representation of a candidate and the misspelling context. To tune the parameters of this model, we generate self-induced spelling error corpora. We perform our experiments for two languages. For English, we greatly outperform off-the-shelf spelling correction tools on a manually annotated MIMIC-III test set, and counter the frequency **bias** of a noisy channel model, showing that neural embeddings can be successfully exploited to improve upon the state-of-the-art. For Dutch, we also outperform an off-the-shelf spelling correction tool on manually annotated clinical records from the Antwerp University Hospital, but can offer no empirical evidence that our method counters the frequency **bias** of a noisy channel model in this case as well. However, both our context-sensitive model and our implementation of the noisy channel model obtain high scores on the test set, establishing a state-of-the-art for Dutch clinical spelling correction with the noisy channel model. △ Less

Submitted 19 October, 2017; **originally announced** October 2017.

Comments: Appears in volume 7 of the CLIN Journal, http://www.clinjournal.org/biblio/volume

Journal ref: CLIN Journal, Volume 7, 2017

13. arXiv:1705.10503 [pdf] cs.LG cs.IT

Quantum Low Entropy based Associative Reasoning or QLEAR Learning

Authors: Marko V. Jankovic

Abstract: In this paper, we propose the classification method based on a learning paradigm we are going to call Quantum Low Entropy based Associative Reasoning or QLEAR learning. The approach is based on the idea that classification can be understood as supervised clustering, where a quantum entropy in the context of the quantum probabilistic model, will be used as a "capturer" (measure, or external index), of the "natural structure" of the data. By using quantum entropy we do not make any assumption about linear separability of the data that are going to be classified. The basic idea is to find close neighbors to a query sample and then use relative change in the quantum entropy as a measure of similarity of the newly arrived sample with the representatives of interest. In other **words**, method is based on calculation of quantum entropy of the referent system and its relative change with the addition of the newly arrived sample. Referent system consists of **vectors** that represent individual classes and that are the most similar, in Euclidean distance sense, to the **vector** that is analyzed. Here, we analyze the classification problem in the context of measuring similarities to prototype examples of categories. While nearest neighbor classifiers are natural in this setting, they suffer from the problem of high variance (in **bias**-variance decomposition) in the case of limited sampling. Alternatively, one could use machine learning techniques (like support **vector** machines) but they involve time-consuming optimization. Here we propose a hybrid of nearest neighbor and machine learning technique which deals naturally with the multi-class setting, has reasonable computational complexity both in training and at run time, and yields excellent results in practice. △ Less

Submitted 30 May, 2017; **originally announced** May 2017.

14. arXiv:1608.08738 [pdf, ps, other] cs.CL

A Dictionary-based Approach to Racism Detection in Dutch Social Media

Authors: Stéphan Tulkens, Lisa Hilte, Elise Lodewyckx, Ben Verhoeven, Walter Daelemans

Abstract: We present a dictionary-based approach to racism detection in Dutch social media comments, which were retrieved from two public Belgian social media sites likely to attract racist reactions. These comments were labeled as racist or non-racist by multiple annotators. For our approach, three discourse dictionaries were created: first, we created a dictionary by retrieving possibly racist and more neutral terms from the training data, and then augmenting these with more general **words** to remove some **bias**. A second dictionary was created through automatic expansion using a \texttt{word2vec} model trained on a large corpus of general Dutch text. Finally, a third dictionary was created by manually filtering out incorrect expansions. We trained multiple Support **Vector** Machines, using the distribution of **words** over the different categories in the dictionaries as features. The best-performing model used the manually cleaned dictionary and obtained an F-score of 0.46 for the racist class on a test set consisting of unseen Dutch comments, retrieved from the same sites used for the training set. The automated expansion of the dictionary only slightly boosted the model's performance, and this increase in performance was not statistically significant. The fact that the coverage of the expanded dictionaries did increase indicates that the **words** that were automatically added did occur in the corpus, but were not able to meaningfully impact performance. The dictionaries, code, and the procedure for requesting the corpus are available at: https://github.com/clips/hades △ Less

Submitted 31 August, 2016; **originally announced** August 2016.

Comments: 7 pages, presented at the first workshop on Text Analytics for Cybersecurity and Online Safety (TA-COS), collocated with LREC 2016

15. arXiv:1607.06520 [pdf, other] cs.CL cs.AI cs.LG stat.ML

Man is to Computer Programmer as Woman is to Homemaker? Debiasing Word Embeddings

Authors: Tolga Bolukbasi, Kai-Wei Chang, James Zou, Venkatesh Saligrama, Adam Kalai

Abstract: The blind application of machine learning runs the risk of amplifying biases present in data. Such a danger is facing us with **word** embedding, a popular framework to represent text data as **vectors** which has been used in many machine learning and natural language processing tasks. We show that even **word** embeddings trained on Google News articles exhibit female/male gender stereotypes to a disturbing extent. This raises concerns because their widespread use, as we describe, often tends to amplify these biases. Geometrically, gender **bias** is first shown to be captured by a direction in the **word** embedding. Second, gender neutral **words** are shown to be linearly separable from gender definition **words** in the **word** embedding. Using these properties, we provide a methodology for modifying an embedding to remove gender stereotypes, such as the association between between the **words** receptionist and female, while maintaining desired associations such as between the **words** queen and female. We define metrics to quantify both direct and indirect gender biases in embeddings, and develop algorithms to "debias" the embedding. Using crowd-worker evaluation as well as standard benchmarks, we empirically demonstrate that our algorithms significantly reduce gender **bias** in embeddings while preserving the its useful properties such as the ability to cluster related concepts and to solve analogy tasks. The resulting embeddings can be used in applications without amplifying gender **bias**. △ Less

Submitted 21 July, 2016; **originally announced** July 2016.

16. arXiv:1606.08340 [pdf, other] cs.CL

Topic Aware Neural Response Generation

Authors: Chen Xing, Wei Wu, Yu Wu, Jie Liu, Yalou Huang, Ming Zhou, Wei-Ying Ma

Abstract: We consider incorporating topic information into the sequence-to-sequence framework to generate informative and interesting responses for chatbots. To this end, we propose a topic aware sequence-to-sequence (TA-Seq2Seq) model. The model utilizes topics to simulate prior knowledge of human that guides them to form informative and interesting responses in conversation, and leverages the topic information in generation by a joint attention mechanism and a biased generation probability. The joint attention mechanism summarizes the hidden **vectors** of an input message as context **vectors** by message attention, synthesizes topic **vectors** by topic attention from the topic **words** of the message obtained from a pre-trained LDA model, and let these **vectors** jointly affect the generation of **words** in decoding. To increase the possibility of topic **words** appearing in responses, the model modifies the generation probability of topic **words** by adding an extra probability item to **bias** the overall distribution. Empirical study on both automatic evaluation metrics and human annotations shows that TA-Seq2Seq can generate more informative and interesting responses, and significantly outperform the-state-of-the-art response generation models. △ Less

Submitted 18 September, 2016; **v1** submitted 21 June, 2016; **originally announced** June 2016.

17. arXiv:1606.02006 [pdf, ps, other] cs.CL

Incorporating Discrete Translation Lexicons into Neural Machine Translation

Authors: Philip Arthur, Graham Neubig, Satoshi Nakamura

Abstract: Neural machine translation (NMT) often makes mistakes in translating low-frequency content **words** that are essential to understanding the meaning of the sentence. We propose a method to alleviate this problem by augmenting NMT systems with discrete translation lexicons that efficiently encode translations of these low-frequency **words**. We describe a method to calculate the lexicon probability of the next **word** in the translation candidate by using the attention **vector** of the NMT model to select which source **word** lexical probabilities the model should focus on. We test two methods to combine this probability with the standard NMT probability: (1) using it as a **bias**, and (2) linear interpolation. Experiments on two corpora show an improvement of 2.0-2.3 BLEU and 0.13-0.44 NIST score, and faster convergence time. △ Less

Submitted 4 October, 2016; **v1** submitted 6 June, 2016; **originally announced** June 2016.

Comments: Accepted at EMNLP 2016

18. arXiv:1603.08702 [pdf] cs.CL

Nine Features in a Random Forest to Learn Taxonomical Semantic Relations

Authors: Enrico Santus, Alessandro Lenci, Tin-Shing Chiu, Qin Lu, Chu-Ren Huang

Abstract: ROOT9 is a supervised system for the classification of hypernyms, co-hyponyms and random **words** that is derived from the already introduced ROOT13 (Santus et al., 2016). It relies on a Random Forest algorithm and nine unsupervised corpus-based features. We evaluate it with a 10-fold cross validation on 9,600 pairs, equally distributed among the three classes and involving several Parts-Of-Speech (i.e. adjectives, nouns and verbs). When all the classes are present, ROOT9 achieves an F1 score of 90.7%, against a baseline of 57.2% (**vector** cosine). When the classification is binary, ROOT9 achieves the following results against the baseline: hypernyms-co-hyponyms 95.7% vs. 69.8%, hypernyms-random 91.8% vs. 64.1% and co-hyponyms-random 97.8% vs. 79.4%. In order to compare the performance with the state-of-the-art, we have also evaluated ROOT9 in subsets of the Weeds et al. (2014) datasets, proving that it is in fact competitive. Finally, we investigated whether the system learns the semantic relation or it simply learns the prototypical hypernyms, as claimed by Levy et al. (2015). The second possibility seems to be the most likely, even though ROOT9 can be trained on negative examples (i.e., switched hypernyms) to drastically reduce this **bias**. △ Less

Submitted 29 March, 2016; **originally announced** March 2016.

Comments: in LREC 2016

19. arXiv:1511.08407 [pdf, other] cs.CL cs.LG doi 10.1007/s10994-017-5634-8

The Mechanism of Additive Composition

Authors: Ran Tian, Naoaki Okazaki, Kentaro Inui

Abstract: Additive composition (Foltz et al, 1998; Landauer and Dumais, 1997; Mitchell and Lapata, 2010) is a widely used method for computing meanings of phrases, which takes the average of **vector** representations of the constituent **words**. In this article, we prove an upper bound for the **bias** of additive composition, which is the first theoretical analysis on compositional frameworks from a machine learning point of view. The bound is written in terms of collocation strength; we prove that the more exclusively two successive **words** tend to occur together, the more accurate one can guarantee their additive composition as an approximation to the natural phrase **vector**. Our proof relies on properties of natural language data that are empirically verified, and can be theoretically derived from an assumption that the data is generated from a Hierarchical Pitman-Yor Process. The theory endorses additive composition as a reasonable operation for calculating meanings of phrases, and suggests ways to improve additive compositionality, including: transforming entries of distributional **word vectors** by a function that meets a specific condition, constructing a novel type of **vector** representations to make additive composition sensitive to **word** order, and utilizing singular value decomposition to train **word vectors**. △ Less

Submitted 6 March, 2017; **v1** submitted 26 November, 2015; **originally announced** November 2015.

Comments: More explanations on theory and additional experiments added. Accepted by Machine Learning Journal

20. arXiv:1511.04586 [pdf, other] cs.CL

Character-based Neural Machine Translation

Authors: Wang Ling, Isabel Trancoso, Chris Dyer, Alan W Black

Abstract: We introduce a neural machine translation model that views the input and output sentences as sequences of characters rather than **words**. Since **word**-level information provides a crucial source of **bias**, our input model composes representations of character sequences into representations of **words** (as determined by whitespace boundaries), and then these are translated using a joint attention/translation model. In the target language, the translation is modeled as a sequence of **word vectors**, but each **word** is generated one character at a time, conditional on the previous character generations in each **word**. As the representation and generation of **words** is performed at the character level, our model is capable of interpreting and generating unseen **word** forms. A secondary benefit of this approach is that it alleviates much of the challenges associated with preprocessing/tokenization of the source and target languages. We show that our model can achieve translation results that are on par with conventional **word**-based models. △ Less

Submitted 14 November, 2015; **originally announced** November 2015.

21. arXiv:1505.07931 [pdf, ps, other] cs.CL

Supervised Fine Tuning for Word Embedding with Integrated Knowledge

Authors: Xuefeng Yang, Kezhi Mao

Abstract: Learning **vector** representation for **words** is an important research field which may benefit many natural language processing tasks. Two limitations exist in nearly all available models, which are the **bias** caused by the context definition and the lack of knowledge utilization. They are difficult to tackle because these algorithms are essentially unsupervised learning approaches. Inspired by deep learning, the authors propose a supervised framework for learning **vector** representation of **words** to provide additional supervised fine

tuning after unsupervised learning. The framework is knowledge rich approacher and compatible with any numerical **vectors word** representation. The authors perform both intrinsic evaluation like attributional and relational similarity prediction and extrinsic evaluations like the sentence completion and sentiment analysis. Experiments results on 6 embeddings and 4 tasks with 10 datasets show that the proposed fine tuning framework may significantly improve the quality of the **vector** representation of **words**. △ Less

Submitted 29 May, 2015; **originally announced** May 2015.