Revisiting Automatically-Generated Adjectival Scales with Continuous Space Word Representations

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Abstract

The goal of this study is to examine, replicate, and extend the model proposed by Kim and de Marneffe (2013). Their model uses the continuous space word representations described by Mikolov et al. (2010) to vectorize adjectives and discuss their relationships, with regards to their adjectival scale and relative intensity, in the new, high-dimensional, continuous space. The goal is discover what information and connections can be gleaned from these representations.

This study reviews and critiques a number of alternative approaches to generating an adjectival scale, and evaluates the performance of the original model on an expanded dataset and on the datasets of alternative models. The conclusion is clear: continuous space word representations are meaningful, but are inconsistent in determining adjectival scales.

1 Introduction

Continuous space word representations generated by neural networks capture syntactic and semantic meaning. The continuous model creates an n-dimensional space to represent a word, as compared to an n-gram model, which more directly bounds words to their discrete contexts. This makes them ideal to examine more complex relationships between words.

This paper attempts to use that meaning to construct a scale for adjective word representations. Using precomputed word representations, I map out the relationships between adjectives, under the assumption that the relationship is linear. There are a number of distance metrics one can use, depending on what attributes one wants to highlight.

Cosine similarity is one way to measure where a particular word fits on the scale (or what word fits at a particular point on the scale). Another is simple Euclidean distance. For example, to find the comparative adjective, one can find the word closest to the middle of the superlative and base adjective. Similarly, one can determine which adjective best fits a scale, when given a number of options, by measuring their similarity to words on the scale.

Our model trains the word2vec model developed by Mikolov et al. (2013), on the Google News data set (1B words, 3M word vectors with 300 dimensions). Our test set includes adjectival scales introduced by Wilkinson and Oates (2016) and de Melo and Bansal (2013), as well as a more expansive dataset generated using the intensity scales introduced by Taboada et al. (2011).

We generate both *full* and *half* scales using the datasets and test the performance of our model on both. The difference between a *full* adjectival scale and a *half* adjectival scale is a matter of extremes. We define a *full* adjectival scale as an adjectival scale that goes from antonym to antonym, centering around a neutral or transitioning adjective. By contrast, I define a *half* adjectival scale as an adjectival scale that only has increasing intensity, centering around a comparative adjective. So, for example, *hot*, *lukewarm*, *cold* versus *tepid*, *warmer*, *hot* are full scale and half scale, respectively.

We compare our approach and results to those of Wilkinson and Oates (2016) and de Melo and Bansal (2013). Notably, I do not use the question-answer approach used by Kim and de Marneffe (2013) nor their IQAP data-set to determine accuracy, opting instead for a more explicit generation of an adjectival scale.

2 Model and previous work

The paper on which study is based (de Marneffe 2013), used the recurrent neural network language model (RNNLM) described by (Mikolov

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2011), and expanded on in (mikolov 2013) to generate continuous word representations. We use a similar model, trained on Google News data set, xxx words with dimensionality 300. (de Marneffe 2013) uses the Broadcast news dataset (320M words) with dimensionality 1,600.

The RNNLM described by

3 Data

As discussed above, I use the "gold-standard" adjectival scales (half and full) from both Wilkinson and Oates (2016) and de Melo and Bansal (2013), as well as generated adjectival scales using the intensity data provided by Taboada et al. (2011). I only include scales that have three or greater adjectives in the scale (since adjective pairs are not too useful to compare for our purposes). I run experiments on both the half scales and the full scales, but have separated the results into (Table 1) for half scales and (Table 2) for full scales.

Oates (Wilkinson and Oates (2016)) This dataset is simply 12 "gold-standard" full adjectival scales ranging in size (from four to seven adjectives) and complexity (defined loosely as a measure of how abstract the adjectives are). An example of a complex scale would be: *same, alike, similar, different*. A simple scale would be: *freezing, cold, warm, hot*. These scales were generated, cleaned, and sourced by crowd-sourcing answers via Mechanical Turk to determine which adjective was "higher" than the other.

Bansal (de Melo and Bansal (2013)) This dataset has an initial 88 "gold-standard" half adjectival scales. They begin with full scale sets, which are are extracted from clustering WordNet dumbbell structures, extended with synonyms, and then split into two antonymous halves. I partition this data into four segments: the initial 88 half scale clusters, the extended XXX half scale development set, a recreation of the original full scales, and then a recreation of the extended full scales. I recreate the full scales by comparing the poles of different half scales and cross-listing them with WordNet to determine if they are antonyms. If they are, I join the two antonymous half scales. I effectively reverse the process discussed in de Melo and Bansal (2013). This results in XX "initial" full scales and XX extended full scales.

Taboada (Taboada et al. (2011)) Unlike the other two dataset, this dataset has no "gold-standard" adjectival scale. Instead, I try to use this dataset to create my own. The model discussed in Taboada et al. (2011) is focused around analyzing sentiment from text, and grades words based upon intensity (on a scale of 0 to 5) and sentiment (negative numbers indicate a negative opinion, positive numbers indicate a positive opinion). Here Dr. Marianna Apidianaki was indispensable. She cross-listed the words in the SO-CAL dictionaries with synonym and antonym sets in WordNet. She then created "intensity pairs," which are words in SO-CAL that are matched with their synonyms or antonyms that are also in SO-CAL. The end result was pairs of related words, with their intensity data. For example: *sinful unholy -2 -3*. Here, *unholy* is considered more negative than *sinful*. I was then able to use those pairings to create both full scales and half scales, based around the intensities of the words (as ranked by SO-CAL).

4 Approach

5 Evaluation

6 Discussion and Conclusion

7 General Instructions

Manuscripts must be in two-column format. Exceptions to the two-column format include the title, authors' names and complete addresses, which must be centered at the top of the first page, and any full-width figures or tables (see the guidelines in Subsection **??**). **Type single-spaced.** Start all pages directly under the top margin. See the guidelines later regarding formatting the first page. The manuscript should be printed single-sided and its length should not exceed the maximum page limit described in Section 9. Pages are numbered for initial submission. However, **do not number the pages in the camera-ready version**.

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The author list for submissions should include all (and only) individuals who made substantial contributions to the work presented. Each author listed on a submission to NAACL-HLT 2019 will be notified of submissions, revisions and the final decision. No authors may be added to or removed from submissions to NAACL-HLT 2019 after the submission deadline.

7.1 The Ruler

The NAACL-HLT 2019 style defines a printed ruler which should be presented in the version submitted for review. The ruler is provided in order that reviewers may comment on particular lines in the paper without circumlocution. If you are preparing a document without the provided style files, please arrange for an equivalent ruler to appear on the final output pages. The presence or absence of the ruler should not change the appearance of any other content on the page. The camera ready copy should not contain a ruler. (LaTeX users may uncomment the \aclfinalcopy command in the document preamble.)

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7.2 Electronically-available resources

NAACL-HLT provides this description in LaTeX2e (`naaclhlt2019.tex`) and PDF format (`naaclhlt2019.pdf`), along with the LaTeX2e style file used to format it (`naaclhlt2019.sty`) and an ACL bibliography style (`acl_natbib.bst`) and example bibliography (`naaclhlt2019.bib`). These files are all available at http://naacl2019.org/downloads/ naaclhlt2019-latex.zip. We strongly recommend the use of these style files, which have been appropriately tailored for the NAACL-HLT 2019 proceedings.

7.3 Format of Electronic Manuscript

For the production of the electronic manuscript you must use Adobe's Portable Document Format (PDF). PDF files are usually produced from LaTeX using the *pdflatex* command. If your version of LaTeX produces Postscript files, you can convert these into PDF using *ps2pdf* or *dvipdf*. On Windows, you can also use Adobe Distiller to generate PDF.

Please make sure that your PDF file includes all the necessary fonts (especially tree diagrams, symbols, and fonts with Asian characters). When you print or create the PDF file, there is usually an option in your printer setup to include none, all or just non-standard fonts. Please make sure that you select the option of including ALL the fonts. **Before sending it, test your PDF by printing it from a computer different from the one where it was created.** Moreover, some word processors may generate very large PDF files, where each page is rendered as an image. Such images may reproduce poorly. In this case, try alternative ways to obtain the PDF. One way on some systems is to install a driver for a postscript printer, send your document to the printer specifying "Output to a file", then convert the file to PDF.

It is of utmost importance to specify the **A4 format** (21 cm x 29.7 cm) when formatting the paper. When working with `dvips`, for instance, one should specify `-t a4`. Or using the command \special{papersize=210mm,297mm} in the latex preamble (directly below the \usepackage commands). Then using dvipdf and/or pdflatex which would make it easier for some.

Print-outs of the PDF file on A4 paper should be identical to the hardcopy version. If you cannot meet the above requirements about the production of your electronic submission, please contact the publication chairs as soon as possible.

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Format manuscripts two columns to a page, in the manner these instructions are formatted. The exact dimensions for a page on A4 paper are:

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- Top margin: 2.5 cm
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Type of Text	Font Size	Style
paper title	15 pt	bold
author names	12 pt	bold
author affiliation	12 pt	
the word "Abstract"	12 pt	bold
section titles	12 pt	bold
document text	11 pt	
captions	10 pt	
abstract text	10 pt	
bibliography	10 pt	
footnotes	9 pt	

Table 1: Font guide.

- Column height: 24.7 cm

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7.5 Fonts

For reasons of uniformity, Adobe's **Times Roman** font should be used. In LaTeX2e this is accomplished by putting

```
\usepackage{times}
\usepackage{latexsym}
```

in the preamble. If Times Roman is unavailable, use **Computer Modern Roman** (LaTeX2e's default). Note that the latter is about 10% less dense than Adobe's Times Roman font.

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Headings: Type and label section and subsection headings in the style shown on the present document. Use numbered sections (Arabic numerals) in order to facilitate cross references. Number subsections with the section number and the subsection number separated by a dot, in Arabic numerals. Do not number subsubsections.

Citations: Citations within the text appear in parentheses as (Gusfield, 1997) or, if the author's name appears in the text itself, as Gusfield (1997). Using the provided LaTeX style, the former is accomplished using \cite and the latter with \shortcite or \newcite. Collapse multiple citations as in (Gusfield, 1997; Aho and Ullman, 1972); this is accomplished with the pro-

vided style using commas within the \cite command, *e.g.*, \cite{Gusfield:97,Aho:72}. Append lowercase letters to the year in cases of ambiguities. Treat double authors as in (Aho and Ullman, 1972), but write as in (Chandra et al., 1981) when more than two authors are involved. Collapse multiple citations as in (Gusfield, 1997; Aho and Ullman, 1972). Also refrain from using full citations as sentence constituents.

We suggest that instead of

"(Gusfield, 1997) showed that ..."

you use

"Gusfield (1997) showed that ..."

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As reviewing will be double-blind, the submitted version of the papers should not include the authors' names and affiliations. Furthermore, self-references that reveal the author's identity, *e.g.*,

"We previously showed (Gusfield, 1997) ..."

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output	natbib	previous ACL style files
(Gusfield, 1997)	\citep	\cite
Gusfield (1997)	\citet	\newcite
(1997)	\citeyearpar	\shortcite

Table 2: Citation commands supported by the style file. The citation style is based on the natbib package and supports all natbib citation commands. It also supports commands defined in previous ACL style files for compatibility.

should be avoided. Instead, use citations such as

"Gusfield (1997) previously showed ... "

Any preliminary non-archival versions of submitted papers should be listed in the submission form but not in the review version of the paper. NAACL-HLT 2019 reviewers are generally aware that authors may present preliminary versions of their work in other venues, but will not be provided the list of previous presentations from the submission form.

Please do not use anonymous citations and do not include when submitting your papers. Papers that do not conform to these requirements may be rejected without review.

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Provide as complete a citation as possible, using a consistent format, such as the one for *Computational Linguistics* or the one in the *Publication Manual of the American Psychological Association* (American Psychological Association, 1983). Use of full names for authors rather than initials is preferred. A list of abbreviations for common computer science journals can be found in the ACM *Computing Reviews* (for Computing Machinery, 1983).

The LATEX and BibTEX style files provided roughly fit the American Psychological Association format, allowing regular citations, short citations and multiple citations as described above.

- Example citing an arxiv paper: (Rasooli and Tetreault, 2015).

- Example article in journal citation: (Ando and Zhang, 2005).

- Example article in proceedings, with location: (Borschinger and Johnson, 2011).

- Example article in proceedings, without location: (Andrew and Gao, 2007).

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Submissions should accurately reference prior and related work, including code and data. If a piece of prior work appeared in multiple venues, the version that appeared in a refereed, archival venue should be referenced. If multiple versions of a piece of prior work exist, the one used by the authors should be referenced. Authors should not rely on automated citation indices to provide accurate references for prior and related work.

Appendices: Appendices, if any, directly follow the text and the references (but see above). Letter them in sequence and provide an informative title: **Appendix A. Title of Appendix**.

7.7 Footnotes

Footnotes: Put footnotes at the bottom of the page and use 9 point font. They may be numbered or referred to by asterisks or other symbols.[1] Footnotes should be separated from the text by a line.[2]

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Illustrations: Place figures, tables, and photographs in the paper near where they are first discussed, rather than at the end, if possible. Wide illustrations may run across both columns. Color illustrations are discouraged, unless you have verified that they will be understandable when printed in black ink.

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[1]This is how a footnote should appear.
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Table 1). Captions longer than one line are left-aligned (see Table **??**). Do not overwrite the default caption sizes. The naaclhlt2019.sty file is compatible with the caption and subcaption packages; do not add optional arguments.

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8 Translation of non-English Terms

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The NAACL-HLT 2019 main conference accepts submissions of long papers and short papers. Long papers may consist of up to eight (8) pages of content plus unlimited pages for references. Upon acceptance, final versions of long papers will be given one additional page – up to nine (9) pages of content plus unlimited pages for references – so that reviewers' comments can be taken into account. Short papers may consist of up to four (4) pages of content, plus unlimited pages for references. Upon acceptance, short papers will be given five (5) pages in the proceedings and unlimited pages for references. For both long and short papers, all illustrations and tables that are part of the main text must be accommodated within these page limits, observing the formatting instructions given in the present document. Papers that do not conform to the specified length and formatting requirements are subject to be rejected without review.

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Workshop chairs may have different rules for allowed length and whether supplemental material is welcome. As always, the respective call for papers is the authoritative source.

Acknowledgments

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