

# EDM-RoBERTa (Enhancing the Dependency Mechanism of RoBERTa)

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**ABSTRACT** A Sentiment Analysis plays a very important role in the prediction and response of social issues, especially for an outburst of disease and racism. In order to analyze public sentiment on certain issue, Single-headed Recurrent Neural Network (SHA-RNN), and Transformer are considered. Given that short-term dependencies and long-term dependencies of text can provide different benefits, our model is implemented through Transformer with Bidirectional Encoder Representation from Transformers (BERT) as its encoder, and with Boom Layer from SHA-RNN as its modified feed forward neural networks. Compared with the original Transformer and SHA-RNN, our proposed model possesses the long-term dependencies requirements, and improve the short-term dependency defects found in traditional Transformer-based models. Therefore, our model can provide more accurate sentiment analysis estimation for reference of disease tracking and prevention as well as for judgement of various remarks.

## INDEX TERMS

Natural language processing, Natural languages, Computational linguistics, Sentiment Analysis

## I. INTRODUCTION

This Natural language processing is the main objective of combining deep neural networks and linguistics, focusing on the communication between natural language and computers. Natural language processing is divided into natural language understanding (NLU), and natural language generation (NLG). Both NLU and NLG are introduced in understanding inputs, which are made in forms of sentences in text and speech formats. It's important to realize that language is far more than human languages. Languages have many forms of encoding, and each word is a signifier that maps into a signified meaning. In this paper, we introduced a pre-trained model which can be easily integrated into existing models based on A Robustly Optimized Pretraining Approach (RoBERTa). And also improving the state of the art in every considered case across the range of challenging short-term dependency problems. However, a language model (LM) should model both (1) well-trained embedding for each word, and (2) meet the short-term dependency on sequences instead of only on longer sequences.

Our representations differ from traditional word embedding models, we replace the last two hidden layers with the Boom

Layer, which assists the model to focus more on short-term dependency. For this reason, we call them EDM-RoBERTa (Enhancing the Dependency Mechanism on RoBERTa).

## II. RNNs, LSTM, Seq2Seq

Recurrent neural networks (RNNs), long short-term Memory (LSTM), and Transformer have been firmly established as state of the art NLP architectures. Numerous efforts have since continued to push the limits of language models quality estimation. In RNNs based models, words in the sequences are read in order and each is assigned with certain weights and vectors. As the distance between words and depths of networks become further and deeper, the weights input earlier would be diluted, which easily occurred due to gradient vanishing. As an example, [1] shows that language models using LSTM process the effective context size of about 200 tokens on average but are only capable of sharply distinguishing 50 tokens nearby, indicating that LSTM is hard to manage long-term dependencies. With the attention mechanism introduced in Transformer, researchers create the techniques on paying attention to specific word in sequences. For RNNs, instead of only encoding the whole sentence in a hidden state, each word has a corresponding hidden state  $h_{t-1}$

passed along with the encoding of whole sequence to the current decoding stage. Compared with RNNs and Transformer, Transformer introduced attention mechanism to improve time series problem which is a major defect in RNNs based models. For an input token, its input representation is constructed by summing the corresponding tokens, segments, and position embeddings. As the input representations pass through multi-headed attention, the feed-forward neural networks, and layer normalization are applied. An output representation from encoder (also known as inputs of decoder) would then pass through masked multi-head attention and feed-forward neural networks which are connected with residual connection. What if the feature extraction techniques of Transformer never existed, what would happen to the development in language understanding? Perhaps RNNs still take the lead as main analytic models. Thus, the Single Headed Attention RNN (SHA-RNN) was popular when proposed earlier. In this research, we rebuild the encoder architecture introduced in Transformer, to improve the defect of capturing short-term memory in Transformer-based models.

### III. RELATED WORKS

#### A. Word Embeddings

#### B. Embeddings from Language Models (ELMo)

#### C. Sequence to Sequence (Seq2Seq)

Sequence to Sequence (Seq2Seq) model is composed of an encoder and a decoder, which also known as encoder-decoder architecture. In general, Deep Neural Networks (DNNs) are great models that perform well on learning language representations. However, they cannot be applied mapping sequence to sequence in machine translation tasks. Seq2Seq is proposed to implement on end-to-end approaches applied to sequence learning. In Seq2Seq model, multi-layered LSTM is used to map input sequence into input representations, and the other LSTM is aimed to decode the input representations into another language. The other defect found in Seq2Seq is that during the encoding stage, input representations are fixed dimensionality. This deficiency indicates the model cannot process with sequences with longer length.

#### D. Transformer

Transformer is a Sequence to Sequence (Seq2Seq) model embedded with attention mechanism. On the aspect of the evaluating on machine translation and model training, it performs well in specific tasks. The architecture is composed of an encoder, and a decoder. The inputs from sequences are passed through encoder with position encoding to ensure the tokens are read in order and remain the dependencies in

phrases. The decoder is composed of multi-headed attention, feed forward neural networks, and residual connection between layers. \*Self Attention

#### E. Pre-training of Deep Bidirectional Transformers for Language Understanding (BERT)

#### F. A Robustly Optimized BERT Pretraining Approach

#### G. Singled Headed Attention RNN: Stop Thinking With Your Head (SHA-RNN)

### IV. UNITS

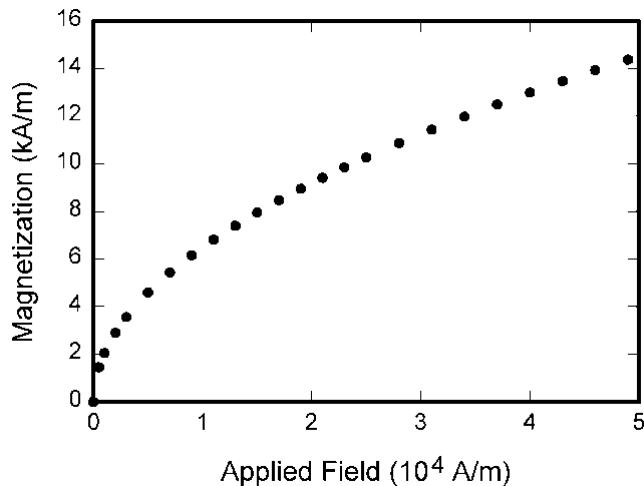
Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). This applies to papers in data storage. For example, write “15 Gb/cm<sup>2</sup> (100 Gb/in<sup>2</sup>).” An exception is when English units are used as identifiers in trade, such as “3½-in disk drive.” Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength  $H$  is A/m. However, if you wish to use units of T, either refer to magnetic flux density  $B$  or magnetic field strength symbolized as  $\mu_0 H$ . Use the center dot to separate compound units, e.g., “A·m<sup>2</sup>.”

### V. SOME COMMON MISTAKES

The word “data” is plural, not singular. The subscript for the permeability of vacuum  $\mu_0$  is zero, not a lowercase letter “o.” The term for residual magnetization is “remanence”; the adjective is “remanent”; do not write “remnance” or “remnant.” Use the word “micrometer” instead of “micron.” A graph within a graph is an “inset,” not an “insert.” The word “alternatively” is preferred to the word “alternately” (unless you really mean something that alternates). Use the word “whereas” instead of “while” (unless you are referring to simultaneous events). Do not use the word “essentially” to mean “approximately” or “effectively.” Do not use the word “issue” as a euphemism for “problem.” When compositions are not specified, separate chemical symbols by en-dashes; for example, “NiMn” indicates the intermetallic compound Ni<sub>0.5</sub>Mn<sub>0.5</sub> whereas “Ni–Mn” indicates an alloy of some composition Ni<sub>x</sub>Mn<sub>1-x</sub>.

Be aware of the different meanings of the homophones “affect” (usually a verb) and “effect” (usually a noun), “complement” and “compliment,” “discreet” and “discrete,” “principal” (e.g., “principal investigator”) and “principle”



**FIGURE 1.** Magnetization as a function of applied field. Note that “Fig.” is abbreviated. There is a period after the figure number, followed by two spaces. It is good practice to explain the significance of the figure in the caption.

(e.g., “principle of measurement”). Do not confuse “imply” and “infer.”

Prefixes such as “non,” “sub,” “micro,” “multi,” and “ultra” are not independent words; they should be joined to the words they modify, usually without a hyphen. There is no period after the “et” in the Latin abbreviation “*et al.*” (it is also italicized). The abbreviation “i.e.,” means “that is,” and the abbreviation “e.g.,” means “for example” (these abbreviations are not italicized).

A general IEEE styleguide is available at [www.ieee.org/authortools](http://www.ieee.org/authortools).

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The following list outlines the different types of graphics published in IEEE journals. They are categorized based on their construction, and use of color / shades of gray:

#### 1) COLOR/GRAYSCALE FIGURES

Figures that are meant to appear in color, or shades of black/gray. Such figures may include photographs, illustrations, multicolor graphs, and flowcharts.

#### 2) LINE ART FIGURES

Figures that are composed of only black lines and shapes. These figures should have no shades or half-tones of gray, only black and white.

#### 3) AUTHOR PHOTOS

Head and shoulders shots of authors that appear at the end of our papers.

#### 4) TABLES

Data charts which are typically black and white, but sometimes include color.

TABLE I  
UNITS FOR MAGNETIC PROPERTIES

Symbol	Quantity	Conversion from Gaussian and CGS EMU to SI <sup>a</sup>
$\Phi$	magnetic flux	1 Mx $\rightarrow$ $10^{-8}$ Wb = $10^{-8}$ V $\cdot$ s
$B$	magnetic flux density, magnetic induction	1 G $\rightarrow$ $10^{-4}$ T = $10^{-4}$ Wb/m <sup>2</sup>
$H$	magnetic field strength	1 Oe $\rightarrow$ $10^3/(4\pi)$ A/m
$m$	magnetic moment	1 erg/G = 1 emu $\rightarrow$ $10^{-3}$ A $\cdot$ m <sup>2</sup> = $10^{-3}$ J/T
$M$	magnetization	1 erg/(G $\cdot$ cm <sup>3</sup> ) = 1 emu/cm <sup>3</sup> $\rightarrow$ $10^3$ A/m
$4\pi M$	magnetization	1 G $\rightarrow$ $10^3/(4\pi)$ A/m
$\sigma$	specific magnetization	1 erg/(G $\cdot$ g) = 1 emu/g $\rightarrow$ 1 A $\cdot$ m <sup>2</sup> /kg
$j$	magnetic dipole moment	1 erg/G = 1 emu $\rightarrow$ $4\pi \times 10^{-10}$ Wb $\cdot$ m
$J$	magnetic polarization	1 erg/(G $\cdot$ cm <sup>3</sup> ) = 1 emu/cm <sup>3</sup> $\rightarrow$ $4\pi \times 10^{-4}$ T
$\chi, \kappa$	susceptibility	1 $\rightarrow$ $4\pi$
$\chi_\rho$	mass susceptibility	1 cm <sup>3</sup> /g $\rightarrow$ $4\pi \times 10^{-3}$ m <sup>3</sup> /kg
$\mu$	permeability	1 $\rightarrow$ $4\pi \times 10^{-7}$ H/m = $4\pi \times 10^{-7}$ Wb/(A $\cdot$ m)
$\mu_r$	relative permeability	$\mu \rightarrow \mu_r$
$w, W$	energy density	1 erg/cm <sup>3</sup> $\rightarrow$ $10^{-1}$ J/m <sup>3</sup>
$N, D$	demagnetizing factor	1 $\rightarrow$ 1/(4 $\pi$ )

Vertical lines are optional in tables. Statements that serve as captions for the entire table do not need footnote letters.

<sup>a</sup>Gaussian units are the same as cg emu for magnetostatics; Mx = maxwell, G = gauss, Oe = oersted; Wb = weber, V = volt, s = second, T = tesla, m = meter, A = ampere, J = joule, kg = kilogram, H = henry.

### B. MULTIPART FIGURES

Figures compiled of more than one sub-figure presented side-by-side, or stacked. If a multipart figure is made up of multiple figure types (one part is lineart, and another is grayscale or color) the figure should meet the stricter guidelines.

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#### D. SIZING OF GRAPHICS

Most charts, graphs, and tables are one column wide (3.5 inches / 88 millimeters / 21 picas) or page wide (7.16 inches / 181 millimeters / 43 picas). The maximum depth a graphic can be is 8.5 inches (216 millimeters / 54 picas). When choosing the depth of a graphic, please allow space for a caption. Figures can be sized between column and page widths if the author chooses, however it is recommended that figures are not sized less than column width unless when necessary.

There is currently one publication with column measurements that do not coincide with those listed above. Proceedings of the IEEE has a column measurement of 3.25 inches (82.5 millimeters / 19.5 picas).

The final printed size of author photographs is exactly 1 inch wide by 1.25 inches tall (25.4 millimeters x 31.75 millimeters / 6 picas x 7.5 picas). Author photos printed in editorials measure 1.59 inches wide by 2 inches tall (40 millimeters x 50 millimeters / 9.5 picas x 12 picas).

#### E. RESOLUTION

The proper resolution of your figures will depend on the type of figure it is as defined in the "Types of Figures" section. Author photographs, color, and grayscale figures should be at least 300dpi. Line art, including tables should be a minimum of 600dpi.

#### F. VECTOR ART

In order to preserve the figures' integrity across multiple computer platforms, we accept files in the following formats: .EPS/.PDF/.PS. All fonts must be embedded or text converted to outlines in order to achieve the best-quality results.

#### G. COLOR SPACE

The term color space refers to the entire sum of colors that can be represented within the said medium. For our purposes, the three main color spaces are Grayscale, RGB (red/green/blue) and CMYK (cyan/magenta/yellow/black). RGB is generally used with on-screen graphics, whereas CMYK is used for printing purposes.

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#### H. ACCEPTED FONTS WITHIN FIGURES

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##### 1) FIGURE AXIS LABELS

Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity "Magnetization," or "Magnetization  $M$ ," not just " $M$ ." Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write "Magnetization (A/m)" or "Magnetization ( $A \cdot m^{-1}$ )," not just "A/m." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K."

Multipliers can be especially confusing. Write "Magnetization (kA/m)" or "Magnetization ( $10^3$  A/m)." Do not write "Magnetization (A/m)  $\times 1000$ " because the reader would not know whether the top axis label in Fig. 1 meant 16000 A/m or 0.016 A/m. Figure labels should be legible, approximately 8 to 10 point type.

##### 2) SUBFIGURE LABELS IN MULTIPART FIGURES AND TABLES

Multipart figures should be combined and labeled before final submission. Labels should appear centered below each subfigure in 8 point Times New Roman font in the format of (a) (b) (c).

#### J. FILE NAMING

Figures (line artwork or photographs) should be named starting with the first 5 letters of the author's last name. The next characters in the filename should be the number that represents the sequential location of this image in your article. For example, in author "Anderson's" paper, the first three figures would be named ander1.tif, ander2.tif, and ander3.ps.

Tables should contain only the body of the table (not the caption) and should be named similarly to figures, except that '.t' is inserted in-between the author's name and the table number. For example, author Anderson's first three tables would be named ander.t1.tif, ander.t2.ps, ander.t3.eps.

Author photographs should be named using the first five characters of the pictured author's last name. For example, four author photographs for a paper may be named: oppen.ps, moshc.tif, chen.eps, and duran.pdf.

If two authors or more have the same last name, their first initial(s) can be substituted for the fifth, fourth, third... letters of their surname until the degree where there is differentiation. For example, two authors Michael and Monica Oppenheimer's photos would be named oppmi.tif, and oppmo.eps.



#### K. REFERENCING A FIGURE OR TABLE WITHIN YOUR PAPER

When referencing your figures and tables within your paper, use the abbreviation “Fig.” even at the beginning of a sentence. Do not abbreviate “Table.” Tables should be numbered with Roman Numerals.

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#### VII. CONCLUSION

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the

abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

#### APPENDIX

Appendixes, if needed, appear before the acknowledgment.

#### ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ... .” Instead, write “F. A. Author thanks ... .” In most cases, sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.

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References need not be cited in text. When they are, they appear on the line, in square brackets, inside the punctuation. Multiple references are each numbered with separate brackets. When citing a section in a book, please give the relevant page numbers. In text, refer simply to the reference number. Do not use “Ref.” or “reference” except at the beginning of a sentence: “Reference [3] shows ... .” Please do not use automatic endnotes in *Word*, rather, type the reference list at the end of the paper using the “References” style.

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Number footnotes separately in superscripts (Insert|Footnote).<sup>1</sup> Place the actual footnote at the bottom of the column in which it is cited; do not put footnotes in the reference list (endnotes). Use letters for table footnotes (see Table I).

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If you want to submit your file with one column electronically, please do the following:

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--Third, click and drag the right margin bar to just over 4 inches in width.

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- 5) Papers that describe ongoing work or announce the latest technical achievement, which are suitable for presentation at a professional conference, may not be appropriate for publication.

## REFERENCES

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