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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, out 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 new model not only possesses the long-term dependencies requirements, but improve the short-term dependency defects in Transformer-based models. Therefore, the new model can provide more accurate sentiment analysis for reference of disease tracking and prevention as well as for judgement of various remarks.

INDEX TERMS

Computational linguistics, Natural language processing, Natural languages, 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 form 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.

II. RNNs, LSTM

Recurrent neural networks (RNNs), long short-term Memory (LSTM), and Transformer have been ~~resolutely~~ firmly established as state of the art approaches in ~~sequence modeling~~ language modeling and language understanding. 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 ~~different~~ distinct 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~~, and gradient explosion~~. 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~~ proposed 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 would 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, Single Headed Attention RNN (SHA-RNN) was popular when it was proposed. In this research, we proposed to rebuild the encoder architecture introduced in Transformer, to improve the defect of capturing short-term memory in Transformer-based models.

III. RELATED WORKS

A. Transformer

Transformer is a Sequence to Sequence (Seq2Seq) model based on self-attention mechanism. To promote the evaluation on machine translation and optimize the model training, it performs well in specific tasks. Transformer 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.

(1)

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (*T* might refer to temperature, but T is the unit tesla). Refer to "(1)," not "Eq. (1)" or "equation (1)," except at the beginning of a sentence: "Equation (1) is ... ."

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^2 (100 Gb/in^2)." 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^2."

V. SOME COMMON MISTAKES

The word "data" is plural, not singular. The subscript for the permeability of vacuum μ_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 $Ni_{0.5}Mn_{0.5}$ whereas "Ni–Mn" indicates an alloy of some composition Ni_xMn_{1-x}.

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"

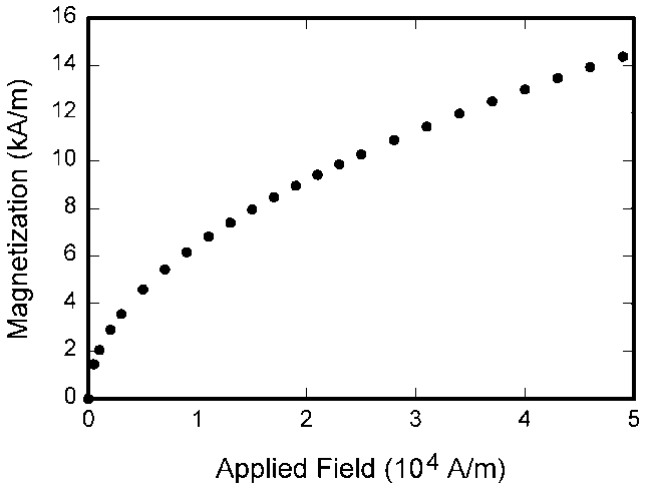

FIGURE 1. Magnetization as a function of applied field. Note that "Fig." is abbreviated. There is a period after the figure number, followed by two spaces. It is good practice to explain the significance of the figure in the caption.

(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).

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VI. GUIDELINES FOR GRAPHICS PREPARATION AND SUBMISSION

A. TYPES OF GRAPHICS

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 [a]
Φ	magnetic flux	1 Mx $\rightarrow 10^{-8}$ Wb = 10^{-8} V·s
B	magnetic flux density, magnetic induction	1 G $\rightarrow 10^{-4}$ T = 10^{-4} Wb/m^2
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·m^2 = 10^{-3} J/T
M	magnetization	1 erg/(G·cm^3) = 1 emu/cm^3 $\rightarrow 10^3$ A/m
$4\pi M$	magnetization	1 G $\rightarrow 10^3/(4\pi)$ A/m
σ	specific magnetization	1 erg/(G·g) = 1 emu/g $\rightarrow$ 1 A·m^2/kg
j	magnetic dipole moment	1 erg/G = 1 emu $\rightarrow 4\pi \times 10^{-10}$ Wb·m
J	magnetic polarization	1 erg/(G·cm^3) = 1 emu/cm^3 $\rightarrow 4\pi \times 10^{-4}$ T
χ, κ	susceptibility	1 $\rightarrow 4\pi$
χ_ρ	mass susceptibility	1 cm^3/g $\rightarrow 4\pi \times 10^{-3}$ m^3/kg
μ	permeability	1 $\rightarrow 4\pi \times 10^{-7}$ H/m = $4\pi \times 10^{-7}$ Wb/(A·m)
μ_r	relative permeability	$\mu \rightarrow \mu_r$
w, W	energy density	1 erg/cm^3 $\rightarrow 10^{-1}$ J/m^3
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.

[a]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.

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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).

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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.

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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."

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APPENDIX

Appendixes, if needed, appear before the acknowledgment.

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REFERENCES

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Examples:

[1] G. O. Young, "Synthetic structure of industrial plastics," in *Plastics*, 2nd ed., vol. 3, J. Peters, Ed. New York, NY, USA: McGraw-Hill, 1964, pp. 15–64.

[2] W.-K. Chen, *Linear Networks and Systems.* Belmont, CA, USA: Wadsworth, 1993, pp. 123–135.

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[3] J. U. Duncombe, "Infrared navigation—Part I: An assessment of feasibility," *IEEE Trans. Electron Devices*, vol. ED-11, no. 1, pp. 34–39, Jan. 1959, 10.1109/TED.2016.2628402.

[4] E. P. Wigner, "Theory of traveling-wave optical laser," Phys. Rev., vol. 134, pp. A635–A646, Dec. 1965.

[5] E. H. Miller, "A note on reflector arrays," *IEEE Trans. Antennas Propagat*., to be published.

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[6] E. E. Reber, R. L. Michell, and C. J. Carter, "Oxygen absorption in the earth's atmosphere," Aerospace Corp., Los Angeles, CA, USA, Tech. Rep. TR-0200 (4230-46)-3, Nov. 1988.

[7] J. H. Davis and J. R. Cogdell, "Calibration program for the 16-foot antenna," Elect. Eng. Res. Lab., Univ. Texas, Austin, TX, USA, Tech. Memo. NGL-006-69-3, Nov. 15, 1987.

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Examples:

[8] *Transmission Systems for Communications*, 3rd ed., Western Electric Co., Winston-Salem, NC, USA, 1985, pp. 44–60.

[9] *Motorola Semiconductor Data Manual*, Motorola Semiconductor Products Inc., Phoenix, AZ, USA, 1989.

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Examples:

[10] G. O. Young, "Synthetic structure of industrial plastics," in Plastics, vol. 3, Polymers of Hexadromicon, J. Peters, Ed., 2nd ed. New York, NY, USA: McGraw-Hill, 1964, pp. 15-64. [Online]. Available: http://www.bookref.com.

[11] *The Founders' Constitution*, Philip B. Kurland and Ralph Lerner, eds., Chicago, IL, USA: Univ. Chicago Press, 1987. [Online]. Available: http://press-pubs.uchicago.edu/founders/

[12] The Terahertz Wave eBook. ZOmega Terahertz Corp., 2014. [Online]. Available: http://dl.z-thz.com/eBook/zomega_ebook_pdf_1206_sr.pdf. Accessed on: May 19, 2014.

[13] Philip B. Kurland and Ralph Lerner, eds., *The Founders' Constitution.* Chicago, IL, USA: Univ. of Chicago Press, 1987, Accessed on: Feb. 28, 2010,

[14] [Online] Available: http://press-pubs.uchicago.edu/founders/

Basic format for journals (when available online):

J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, pp. *xxx-xxx*, Abbrev. Month, year. Accessed on: Month, Day, year, DOI: 10.1109.*XXX*.123456, [Online].

Examples:

[15] J. S. Turner, "New directions in communications," *IEEE J. Sel. Areas Commun.*, vol. 13, no. 1, pp. 11-23, Jan. 1995.

[16] W. P. Risk, G. S. Kino, and H. J. Shaw, "Fiber-optic frequency shifter using a surface acoustic wave incident at an oblique angle," *Opt. Lett.*, vol. 11, no. 2, pp. 115–117, Feb. 1986.

[17] P. Kopyt *et al.,* "Electric properties of graphene-based conductive layers from DC up to terahertz range," *IEEE THz Sci. Technol.*, to be published. DOI: 10.1109/TTHZ.2016.2544142.

Basic format for papers presented at conferences (when available online):

J.K. Author. (year, month). Title. presented at abbrev. conference title. [Type of Medium]. Available: site/path/file

Example:

[18] PROCESS Corporation, Boston, MA, USA. Intranets: Internet technologies deployed behind the firewall for corporate productivity. Presented at INET96 Annual Meeting. [Online]. Available: http://home.process.com/Intranets/wp2.htp

Basic format for reports and handbooks (when available online):

J. K. Author. "Title of report," Company. City, State, Country. Rep. no., (optional: vol./issue), Date. [Online] Available: site/path/file

Examples:

[19] R. J. Hijmans and J. van Etten, "Raster: Geographic analysis and modeling with raster data," R Package Version 2.0-12, Jan. 12, 2012. [Online]. Available: http://CRAN.R-project.org/package=raster

[20] Teralyzer. Lytera UG, Kirchhain, Germany [Online]. Available: http://www.lytera.de/Terahertz_THz_Spectroscopy.php?id=home, Accessed on: Jun. 5, 2014

Basic format for computer programs and electronic documents (when available online):

Legislative body. Number of Congress, Session. (year, month day). *Number of bill or resolution, Title*. [Type of medium]. Available: site/path/file

NOTE: ISO recommends that capitalization follow the accepted practice for the language or script in which the information is given.

Example:

[21] U.S. House. 102nd Congress, 1st Session. (1991, Jan. 11). *H. Con. Res. 1, Sense of the Congress on Approval of Military Action*. [Online]. Available: LEXIS Library: GENFED File: BILLS

Basic format for patents (when available online):

Name of the invention, by inventor's name. (year, month day). Patent Number [Type of medium]. Available: site/path/file

Example:

[22] Musical toothbrush with mirror, by L.M.R. Brooks. (1992, May 19). Patent D 326 189 [Online]. Available: NEXIS Library: LEXPAT File: DES

Basic format for conference proceedings (published):

J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, City of Conf., Abbrev. State (if given), Country, year, pp. *xxxxxx.*

Example:

[23] D. B. Payne and J. R. Stern, "Wavelength-switched passively coupled single-mode optical network," in *Proc. IOOC-ECOC,* Boston, MA, USA, 1985, pp. 585–590.

Example for papers presented at conferences (unpublished):

[24] D. Ebehard and E. Voges, "Digital single sideband detection for interferometric sensors," presented at the *2nd Int. Conf. Optical Fiber Sensors*, Stuttgart, Germany, Jan. 2-5, 1984.

Basic format for patents:

J. K. Author, "Title of patent," U.S. Patent *x xxx xxx*, Abbrev. Month, day, year.

Example:

[25] G. Brandli and M. Dick, "Alternating current fed power supply," U.S. Patent 4 084 217, Nov. 4, 1978.

Basic format for theses (M.S.) and dissertations (Ph.D.):

a) J. K. Author, "Title of thesis," M.S. thesis, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.
b) J. K. Author, "Title of dissertation," Ph.D. dissertation, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.

Examples:

[26] J. O. Williams, "Narrow-band analyzer," Ph.D. dissertation, Dept. Elect. Eng., Harvard Univ., Cambridge, MA, USA, 1993.

[27] N. Kawasaki, "Parametric study of thermal and chemical nonequilibrium nozzle flow," M.S. thesis, Dept. Electron. Eng., Osaka Univ., Osaka, Japan, 1993.

Basic format for the most common types of unpublished references:

a) J. K. Author, private communication, Abbrev. Month, year.
b) J. K. Author, "Title of paper," unpublished.
c) J. K. Author, "Title of paper," to be published.

Examples:

[28] A. Harrison, private communication, May 1995.

[29] B. Smith, "An approach to graphs of linear forms," unpublished.

[30] A. Brahms, "Representation error for real numbers in binary computer arithmetic," IEEE Computer Group Repository, Paper R-67-85.

Basic formats for standards:

a) *Title of Standard*, Standard number, date.
b) *Title of Standard*, Standard number, Corporate author, location, date.

Examples:

[31] IEEE Criteria for Class IE Electric Systems, IEEE Standard 308, 1969.

[32] Letter Symbols for Quantities, ANSI Standard Y10.5-1968.

Article number in reference examples:

[33] R. Fardel, M. Nagel, F. Nuesch, T. Lippert, and A. Wokaun, "Fabrication of organic light emitting diode pixels by laser-assisted forward transfer," *Appl. Phys. Lett.*, vol. 91, no. 6, Aug. 2007, Art. no. 061103.

[34] J. Zhang and N. Tansu, "Optical gain and laser characteristics of InGaN quantum wells on ternary InGaN substrates," *IEEE Photon. J.*, vol. 5, no. 2, Apr. 2013, Art. no. 2600111.

Example when using et al.:

[35] S. Azodolmolky *et al.*, Experimental demonstration of an impairment aware network planning and operation tool for transparent/translucent optical networks," *J. Lightw. Technol.*, vol. 29, no. 4, pp. 439–448, Sep. 2011.

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