PhD Themes in Neural NLP

April 20, 2015

These three themes are broadened and generalized from discussed topics.

1 Reversible Phrase and Document Embeddings

featuring: Re-Synthesis of Text from Vector Representations

See also: Natural Language Generation (the opposite of natural language understanding.)

1.1 Applications / Possible Tasks/Projects within

- Summarization of a paragraph into a sentence
  - Abstraction summarization
- Production of a Short Title, via trade-off function between length and capture of meaning
  - Again Abstractive summarization
- Translation
  - Using two stocatically reversible mappings from different language spaces into the same Meaning space
- Robustness/Flow/Re-Synthesis cross over: Finding corrupted sentences/paragraphs and inserting correct word/sentence.
- The creation of a generative, rather than a discriminative model for phrase embeddings.

1.2 Existing Work

1.2.1 Single Word Embedding

The alot of work on Word Embeddings note the existence of linear substructures in single-word embeddings for example: $v(\text{"}king\text{"}) - v(\text{"}man\text{"}) + v(\text{"}woman\text{"})$ has nearest neighbor $v(\text{"}queen\text{"})$. The paper which first established this seems to be [**?**]. Single word generation is fairly simple via nearest neighbor for word embedding.

Word Embedding spaces seem to combine syntax and semantics, when combining the words from a sentence it would be better to end up in a syntax free space.

1.2.2 Summarization

Notably this would be Abstractive Summarization, of building a model then generating text from it.

[**?**](on Extractive Multidocument Summarization) using word and phrase embedding stated that the authors were not aware of any other papers which used continuous vector space models for summarization tasks. Which is indicative that this area is not well explored, as summarization is a very natural use to put any Re-Synthesis system to.

1.2.3 Knowledge base systems

[**?**] is quiet a compicated system for performing full natural language queries with natural language output, and with memorisation.

It has several componants, notable for this section is the R (Response). In most of there examples the response is set up to just returns a single word response, but some example are shown where they used a RNN. Details are not given, but I believe they used a RNN language model similar to [**?**] (which they reference).

[**?**] does not make use of word embeedings, and is very similar to n-gram based model.

There is also [**?**], which models word relationships with tensors, in a way a much more advanced version of [**?**], though I have not seen comparasons (They were both presented at the same conference I believe).

2 Extended Meaning Flow/ Discourse Analysis

Combining the meaning of multiple sentences, for greater understanding

2.1 Applications / Possible Tasks/Projects within

- Source Separation of Transcribed Arguments.
  - Could use the Hansard (Parliament Transcriptions).
- When an Input to a system can not be reliably resolved (and such a state can be detected.), then a system could respond with "Could you repeat that in a different way?", and then combine the meaning of the multiple inputs to get more confidence.

- Document Issue detection. Eg
  - Picking out where paragraphs suddenly change in meaning.
  - Find contradictions
  - Changes in tone/POV/tense
  - Detection of Author change
- Summarization (again),
  - via picking out key sentences based on having more semantic similarity to the whole document. ie Extractive Summarization
  - One particular use of this is extracting summarize from multiple difference view points.[?]

2.2 Existing Work

In [?], a RNN Language model is enhanced by using LDA.

The LDA is uses to calculate the topic of the document seen so far, and is presented as an additional input to the RNN Language model.

In [?], text is analised using a dependancy graph based approch, to find contractictions.

3 Robustness in Understanding

Handling the problem of incorrect transcription.

3.1 Existing Work

3.2 Applications / Possible Tasks/Projects within

- Enhance Speech Recognition with Meaning Component.
  - Modern speech recognition systems (eg Kaldi), combine components that ensure that phones combine to make dictionary words, and words combine to grammatical sentences. Both these are syntactical concerns. Added language understanding, would check the semantic concerns. Sentences which don't make sense (eg "The whale ran down the street") could be weighted less likely than others that do (eg "The whale ran down the fleet"). Similarly on a paragraph level, sentences which contradict could be weighted lower.

References

[1] T. Mikolov, W.-t. Yih, and G. Zweig, "Linguistic regularities in continuous space word representations." in *HLT-NAACL*, 2013, pp. 746–751. [Online]. Available: http://www.msr-waypoint.com/en-us/um/people/gzweig/Pubs/NAACL2013Regularities.pdf

[2] M. Kågebäck, O. Mogren, N. Tahmasebi, and D. Dubhashi, "Extractive summarization using continuous vector space models," in *Proceedings of the 2nd Workshop on Continuous Vector Space Models and their Compositionality (CVSC)@ EACL*, 2014, pp. 31–39. [Online]. Available: http://www.aclweb.org/anthology/W14-1504

[3] J. Weston, S. Chopra, and A. Bordes, "Memory networks," *CoRR*, vol. abs/1410.3916, 2014. [Online]. Available: http://arxiv.org/abs/1410.3916

[4] T. Mikolov, S. Kombrink, L. Burget, J. H. Cernocky, and S. Khudanpur, "Extensions of recurrent neural network language model," in *Acoustics, Speech and Signal Processing (ICASSP), 2011 IEEE International Conference on*. IEEE, 2011, pp. 5528–5531. [Online]. Available: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=5947611

[5] R. Socher, D. Chen, C. D. Manning, and A. Y. Ng, "Reasoning with neural tensor networks for knowledge base completion," in *Advances in Neural Information Processing Systems 26*, 2013. [Online]. Available: http://nlp.stanford.edu/ socherr/SocherChenManningNg$_NIPS$2013.*pdf*

[6] N. Tahmasebi, L. Borin, G. Capannini, D. Dubhashi, P. Exner, M. Forsberg, G. Gossen, F. D. Johansson, R. Johansson, M. Kågebäck *et al.*, "Visions and open challenges for a knowledge-based culturomics," *International Journal on Digital Libraries*, vol. 15, no. 2-4, pp. 169–187, 2015. [Online]. Available: http://link.springer.com/article/10.1007/s00799-015-0139-1/fulltext.html

[7] T. Mikolov and G. Zweig, "Context dependent recurrent neural network language model." in *SLT*, 2012, pp. 234–239. [Online]. Available: http://www.msr-waypoint.com/en-us/um/people/gzweig/Pubs/SLT2012.pdf

[8] M.-C. De Marneffe, A. N. Rafferty, and C. D. Manning, "Finding contradictions in text." in *ACL*, vol. 8, 2008, pp. 1039–1047. [Online]. Available: http://nlp.stanford.edu/pubs/contradiction-acl08.pdf