Noise Robustness in Aspect Extraction Task

Valentin Malykh, VK Research
Taras Khakhulin, SkolTech

Noise

- Typos, orthographical mistakes we call **noise**.
- To measure noise we take edit distance from original word to noised one.
- By original word we mean orthographically and syntactically correct word in context.
- By noised word - any word which differs from original one.

Noise Modeling

- In the real texts noise level is about 10%.
- We model noise analogously to spelling correction literature.
- There are no open corpora for languages in question with marked up spelling corrections.

Noise Modeling

B(1,p) - binomial distribution,

U{1,|A|} - uniform distribution,

|A| - alphabet length

$$p \in [0, 0.3]$$

Noise types:

- Current symbol deletion with probability **B(1,p)**
- Random symbol addition **U{1,|A|}** after the current one with probability **B(1,p)**
- Replace current symbol with random one **U{1,|A|}** with probability **B(1,p)**
- Swap two adjacent letters with probability **B(1,p)**

Aspect Extraction

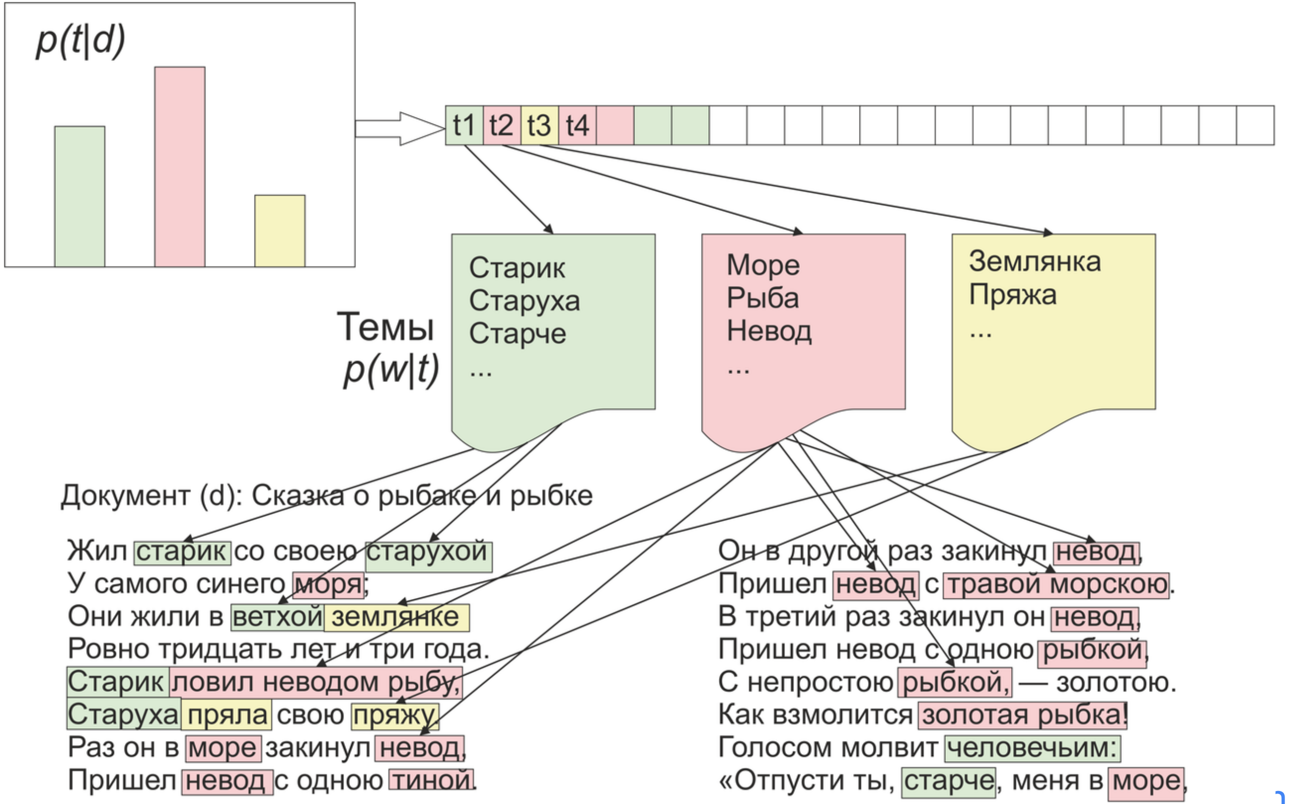
- Aspect Mining
- Aspects could be extracted as topics

- the **call quality** of **this phone** is **amazing**

Image from cs224n

Aspect Extraction

t_i - distribution parameters for topic *i*



Attention-Based Aspect Extraction

- The model is aiming to obtain vector representations of aspects for a corpus
- Each aspect is represented as some vector which is close to specific words (vector representations)
- Model trains matrix of vector representations for aspects
- Model is designed to produce text vector representation based on word vector representations and so-called reconstruction which is linear combination of aspect vector representations
- Loss function for the model is difference between two mentioned vectors

ABAE model

s - a sentence, z_S - sentece vector representation

a_i - attention weights, y_s - intermediate vector representation for a sentence

e_w - vector embedding for word w

A - attention matrix

T - aspect matrix

p_s - weights for summing aspects

r_s - reconstructed with T matrix vector representation

$$a_i = \mathrm{softmax}(e_{w_i}^{\mathrm{T}} \cdot A \cdot y_s)$$

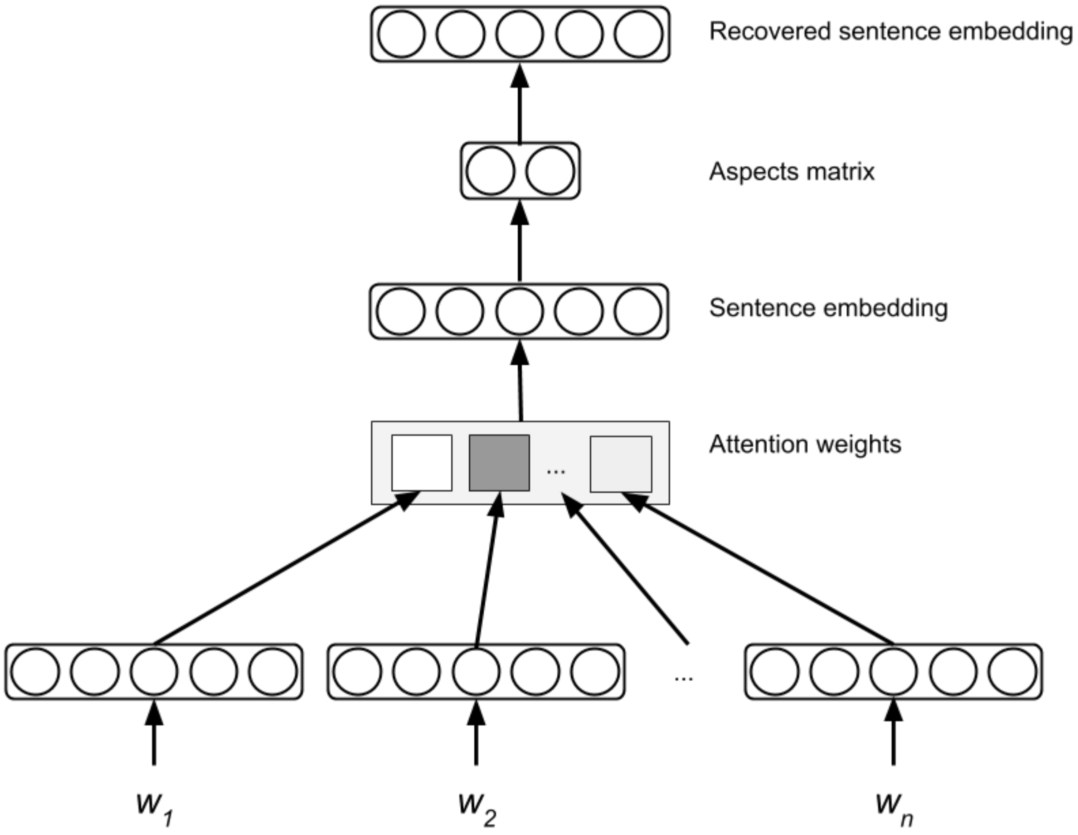
$$y_s = \sum_{i=1}^{n} e_{w_i}$$

$$z_s = \sum_{i=1}^{n} a_i e_{w_i}$$

$$p_s = \mathrm{softmax}(W \cdot z_s + b)$$

$$r_s = T^{\mathrm{T}} \cdot p_s$$

ABAE model



Recovered sentence embedding
Aspects matrix
Sentence embedding
Attention weights
...
...
w_1
w_2
w_n

Proposed Extensions

- Char embeddings which enrich existing word embeddings
- fastText word embeddings model
- RoVe word embeddings model

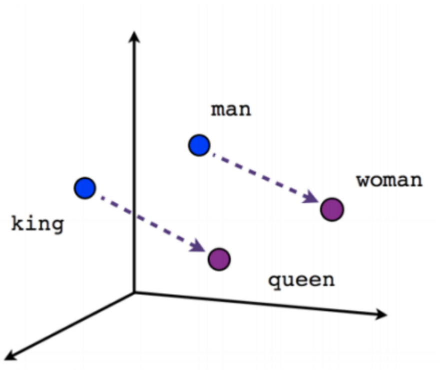
Word Vector Representations

- Words cannot be read by a computer like humans do, we need some numbers
- Simple representations basing on vocabulary are not enough.

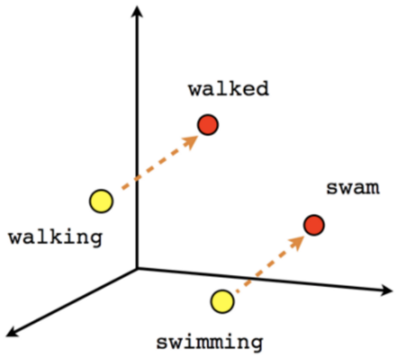
Image from cs224n

Word Vector Representations

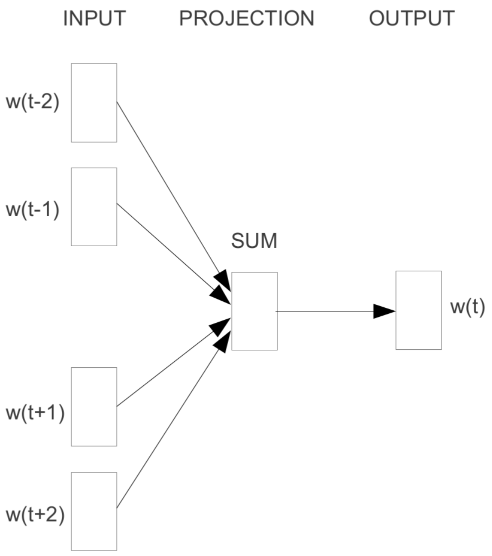
- word2vec - statistical co-occurrence model
- fastText - extension of word2vec with character n-grams



Male-Female



Verb tense



Figures belongs to T.Mikolov

Robust to Noise Vector Reps

- || - concatenation
- $c_1..c_k$ one-hot vectors for symbols of word
- n_b - prefix length, n_e suffix length
- enc - a function, left and right contexts C_{left} & C_{right}

$$B(w) = c_1 \| .. \| c_{n_b}$$

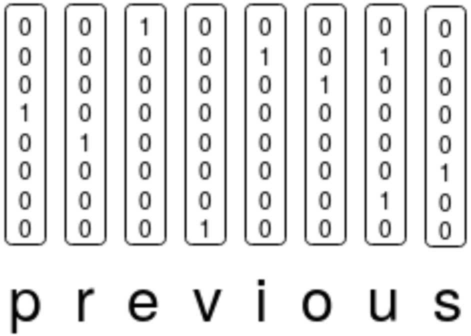
$$E(w) = c_{k-n_e} \| .. \| c_k$$

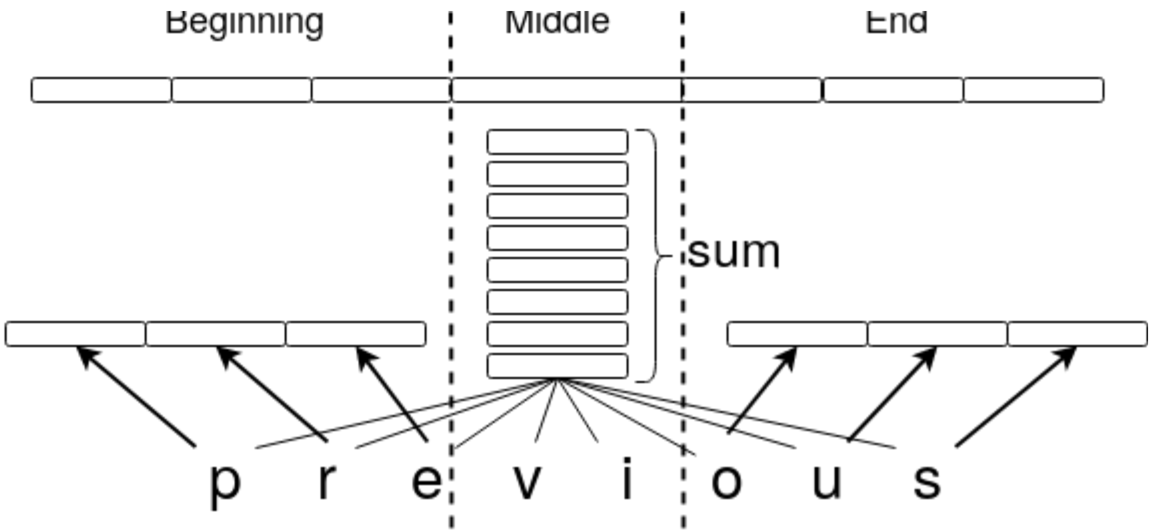
$$M(w) = \sum_{1}^{k} c_i$$

$$BME(w) = B(w) \| M(w) \| E(w)$$

$$RoVe(w) = enc(BME(w); C_{left}, C_{right})$$

Robust to Noise Vector Reps

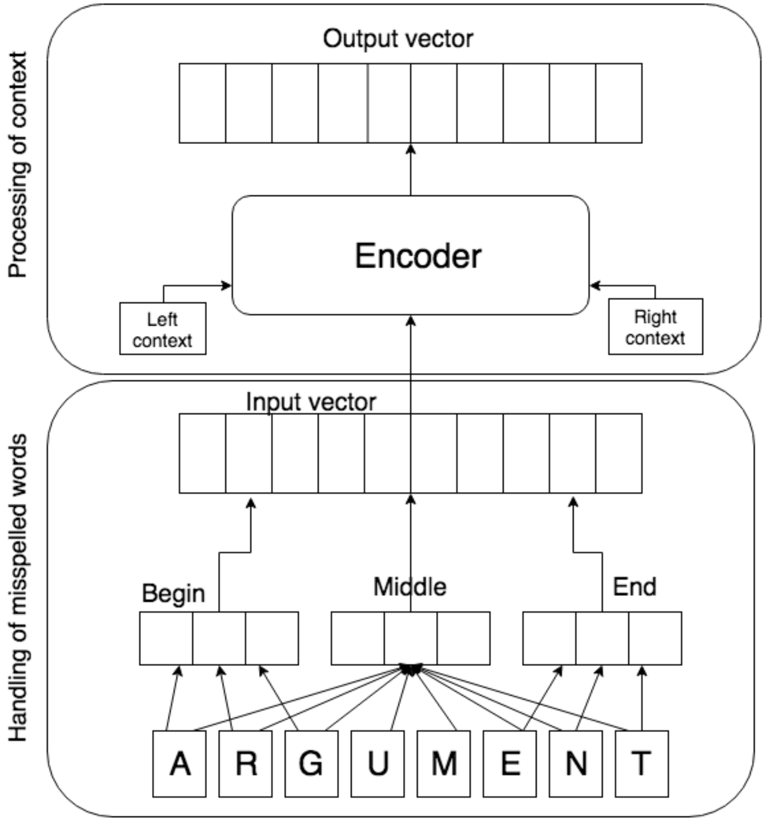




Robust to Noise Vector Reps

- Vector Rep for word «abbreviation»

- Left and right contexts are prev states of enc



Model Training

$$L(x) = log(\sum_{i \in C} e^{-s(x,w_i)}) + log(\sum_{j \notin C} e^{s(x,w_j)})$$

- Negative sampling loss

Corpus

Citysearch contains 50000 review of New-York restaurants

These reviews has been marked up with such categories:

- Food
- Price
- Service
- Ambience
- Anecdotes
- Miscellaneous

Image from cs224n

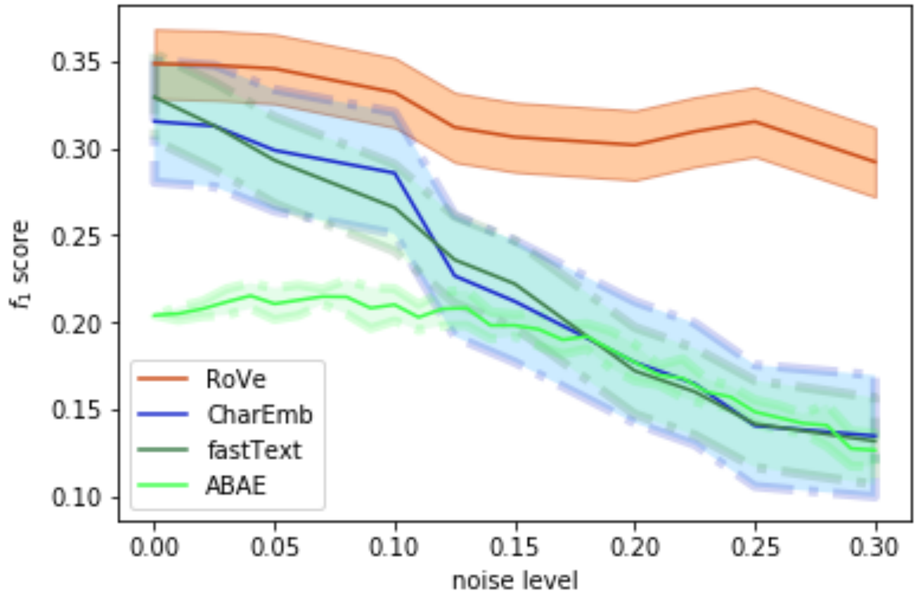
Experiement

We take a subset of Citysearch corpus, with reviews containing only only one category from the list.

- The model extracts aspects from the corpus, these aspects then marked up by categories.
- The model extracts aspects from a text and top-aspect is taken into account.
- A category of this aspect then compared to existing one by the means of F1

Results

- The metric for the experiments is F1
- RoVe model shows the best robustness



Conclusion

- The original ABAE model is not robust to noise
- We presented several model extensions which are robust to noise
- For the future work we see the direction of testing on other languages and other state of the art models for aspect extraction

References

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Valentin Malykh

valentin.malykh@vk.com

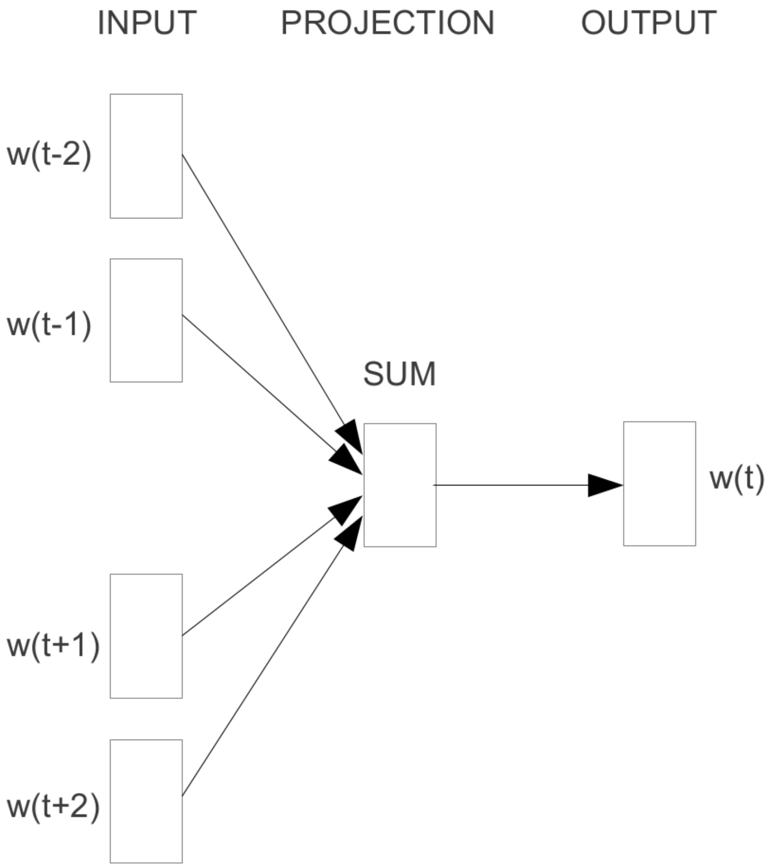
Thank You for Your Attention!

Word2Vec

$$L = \frac{1}{N}\sum_{i}^{N} ln(p(w_i|C(w_i))) \to \max$$

$$p(w_i|C(w_i)) = \underset{w_i \in W}{softmax}\left(\sum_{w_k \in C(w_i)} v_{w_k}^{\top} u_{w_i}\right)$$

w_i - in context C; v, u - word vectors

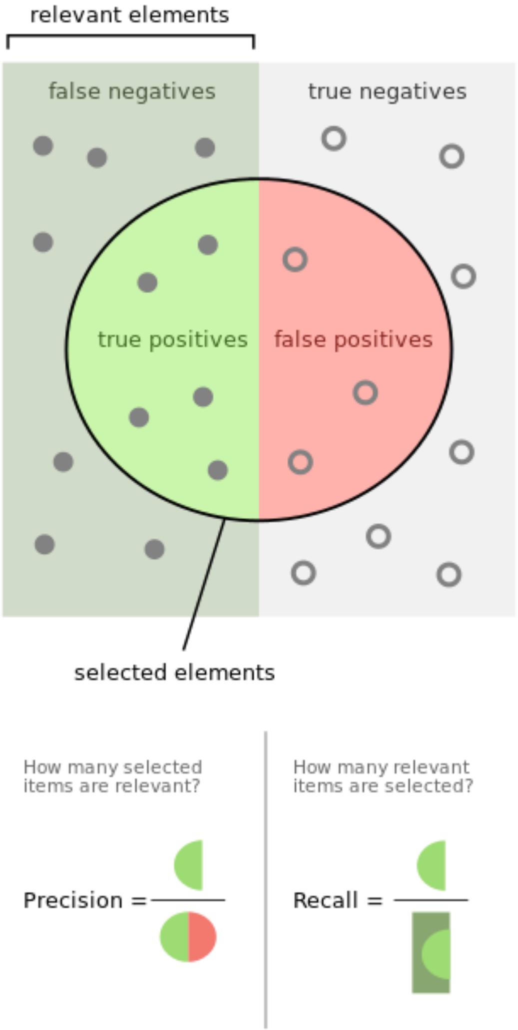


CBOW

Metric F_1

Metric F_1 - is a harmonic mean of precision and recall of a classifier

$$F_1 = \frac{2}{\frac{1}{\mathrm{recall}} + \frac{1}{\mathrm{precision}}} = 2 \cdot \frac{\mathrm{precision} \cdot \mathrm{recall}}{\mathrm{precision} + \mathrm{recall}}$$



Original ABAE model results