

SUPPORTING CONTENT EVALUATION OF STUDENT SUMMARIES BY IDEA UNIT EMBEDDING

Marcello Gecchele
University of Trento
Trento, Italy
marcello.gecchele@pm.me

Hiroaki Yamada
School of Computing
Tokyo Institute of Technology
Tokyo, Japan
yamada.h.ax@m.titech.ac.jp

Takenobu Tokunaga
School of Education
Waseda University
Tokyo, Japan
take@c.titech.ac.jp

Yasuyo Sawaki
School of Education
Waseda University
Tokyo, Japan
ysawaki@waseda.jp

1. Background

Summary writing in educational scenes

Summary writing is a useful tool to develop a student's linguistic proficiency in areas like text comprehension and composition.

Problems in content-based summary evaluation

A teacher has to assess if the summary conveys correctly the important ideas of the source text.

However, finding correlated information between the summary and source text is difficult for a human. **Rephrasing** is encouraged as it is useful to avoid plagiarism, but it obfuscates the bonds between the contents of the source and summary texts.

A solution for faster summary evaluation

We propose a support tool for evaluating student summaries in terms of their contents by suggesting the links between the ideas of a source text and its summary.

We analyze texts divided into **Idea Units (IUs)** in order to deal with complex sentences that convey multiple ideas, and we make correspondence between IUs instead of sentences across the source text and its summary.

2. Idea Unit (IU)

The IU is defined as a minimal fragment of a text that conveys an "idea" or "thought" coherently. We extended the definition of IU based on Kroll (1977).

- a subject and verb counted as one idea unit together with (when present) a (a) direct object, (b) prepositional phrase, (c) adverbial element, (d) mark of subordination, or (e) a combination of the above
- full relative clauses counted as one idea unit when the relative pronoun was present
 - phrases that are set off by a complementizer are counted as an Idea Unit
 - subordinate conjunctions and relative pronouns are always attached to the subordinate clause
- phrases which occurred in sentence initial position followed by a comma or which were set off from the sentence with commas were counted as separate idea units
 - adverbial conjunctions (e.g.: "However,") are not to be split into separate Idea Units
 - citations are counted as separated idea units only when they are set off from the sentence in their entirety
- verbs whose structure requires or allows a verbal element as object were counted with both verbal elements as one idea unit
- reduced clauses in which a subordinator was followed by a non-finite verb element were counted as one idea unit
- post-nominal -ing phrases used as modifiers counted as one idea unit
- other types of elements counted as idea units were (a) absolutes, (b) appositives, and (c) verbals
- An idea unit can be discontinuous

Figure 1: Extended definition of IU (extended part in blue)

In Applied Linguistics, IUs have been employed for in-depth analyses of the content of student summaries in the second language learning and assessment literature (Johns and Mayes, 1990).

→Adopting the IU enables us to interpret our study results in reference to such previous investigations of summary content.

References

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- [3] Jeffrey Pennington, Richard Socher, and Christopher D. Manning. 2014. Glove: Global vectors for word representation. In Empirical Methods in Natural Language Processing (EMNLP), pages 1532–1543.
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3. Task overview

Input: a pair of a source document and its summary

Output: For each source IU a ranking list of the most probable correlated summary IUs in descending order

Sub tasks:

- IU segmentation:**
Segment sentences into IUs. We leave the automatization of this stage for a future work. This part was done manually.
- IU pair matching:**
Calculate the similarity between IUs of the source document and that of the summary and rank the possible pairs.

4. Evaluation

Data set

- Source text:**
IELTS English proficiency test
- Summary:**
composed by 10 PhD students from UK

	Source 1	Summary	Source 2	Summary
Words	996	185.5	807	204.5
IUs	111	20.6	89	24.6
Links	—	18.0	—	21.3

Table 1: Statistics of the data set

Ranking methods for IU pair matching

Given a Summary IU, its similarity to every Source IU is calculated to create a ranking list of Source IUs that are arranged in descending order of similarity.

- Similarity metrics:**
 - ROUGE based baselines; ROUGE-1, ROUGE-2 and ROUGE-L (Lin, 2004)
 - Cosine similarity based on averaged GloVe (Pennington et al., 2014) word vectors per IU

Evaluation metrics

$$Precision^{(n)}(s) = \frac{|PR^{(n)}(s) \cap GL(s)|}{|PR^{(n)}(s)|}$$

$$Recall^{(n)}(s) = \frac{|PR^{(n)}(s) \cap GL(s)|}{|GL^{(n)}(s)|}$$

s is a summary, $PR^{(n)}(s)$ is the Prediction Ranking sliced at the top n links for summary s and $GL(s)$ is the set of Gold links for summary s . We further averaged recall and precision values over all summaries.

Results

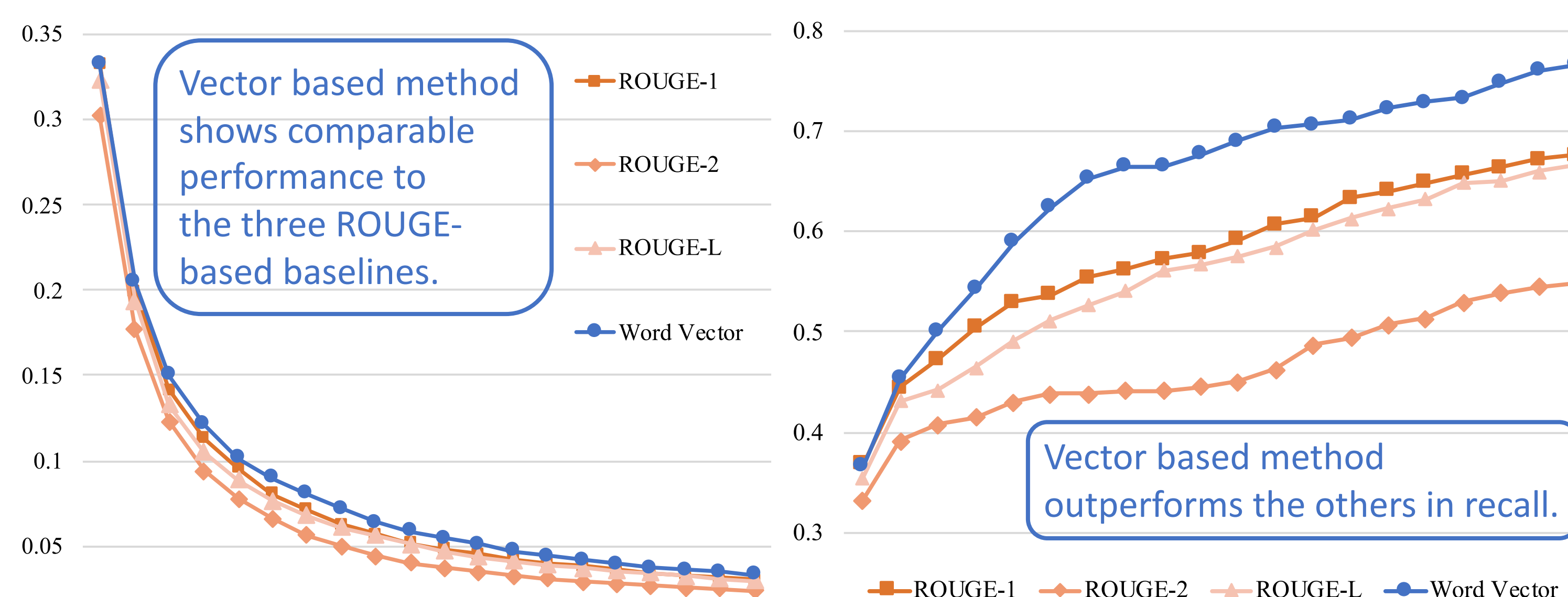


Figure 2: Averaged precision at rank threshold n

Figure 3: Averaged recall at rank threshold n

5. Conclusion

- We proposed a segment alignment method based on word-vector embeddings that is comparable to the baseline in precision and better in recall.
- We adopted this alignment method in our GUI tool **Segment Matcher (Demo available!)** to help teachers find matching information between student summaries and their source texts.