Quiz-style distractor generation using generative language models

Proposer(s) / Proposatzailea(k):
Itziar Aldabe
Oier Lopez de Lacalle

Contact / Kontaktua:
itziar.aldabe@ehu.eus
oier.lopezdelacalle@ehu.eus

Description / Deskribapena

Learning processes require the activities that the student performs to be assessed. The design and implementation of good quality assessment items related to the target learning domain is a laborious task that requires major efforts to instructional developers and/or teachers. Instructional developers must first select the appropriate material to be used as input before generating the assessment questions. It is quite obvious that any help in this hard process of manually generating assessment items will alleviate the work of instructional developers.

In the area of Technology Supported Learning Systems, automatically generated questions are being used not only to assess the learning of concepts related to a domain, but also to carry out reading comprehension activities, conduct actions with language learning purposes, especially for vocabulary learning. The automatic generation of objective tests, and, in particular, the generation of MCQs, is probably the most extensively studied aspect of question generation. MCQs are composed of a stem (the part that asks the question) and a set of options that include the correct answer/s and distractors.

Neural network-based approaches have gained increasing popularity in MCQ generation. In Lelkes et al, (2021), the problem is formulated as two sequence-to-sequence tasks: question-answer generation and distractor generation. The authors apply large pre-trained Transformer encoder-decoder models, for both tasks. Similarly, in Vachev et al., (forthcoming) two fine-tuned T5 Transformers are used to first generate the question-answer pairs, given a short passage, and then to produce the distractors. In contrast, other works focus on ranking a set of distractors. In Liang et al., (2018), an adversarial training framework is proposed to this end and in Sinha et al., (2020), a semantically aware CNN-BiLSTM model is utilized. Additional research has demonstrated the appropriateness of deep learning-based distractor generation as well. Among others, a co-attention hierarchical network to create distractors is presented in (Zhou et al., 2020) and a BERT-based scheme is proposed in (Chung et al., 2020).

Goals / Helburuak

The **main objective** of the project is to analyse and implement a deep learning approach to distractor generation. The key objectives are the following:

1. Analysis of the state of the art techniques for developing distractor generation
2. Design of a deep learning architecture which provides distractors for given question-answer pairs
3. Implementation and evaluation of the model on publicly available datasets such as RACE (Lai et al., 2017)

Requirements / Betebeharrak

English. Machine learning. Good programming skills, basic math skills.

Although it is not a requirement, taking the course "**Seminar on language technologies. Deep Learning**" (see below) will allow the student to accomplish more ambitious goals. Contact us for further details.

The dissertation can be written in Basque, English or Spanish.

Framework / Esparrua

NLP applications for education

Python, pytorch/tensorflow

Tasks and plan / Atazak eta plana

Analyze MCQs datasets.

Analyze the state of the art in MCQ, distractor generation and related topics

Design and implement a distractor generation system.

Test and evaluate the implemented algorithm on public dataset.

Analyse the output of the system to 1) perform an error analysis and 2) purpose possible improvements.

Write up the report.

References

H.-L. Chung, Y.-H. Chan, and Y.-C. Fan, "A BERT-based distractor generation scheme with multi-tasking and negative answer training strategies." in Findings of the Association for Computational Linguistics: EMNLP 2020. Online: Association for Computational Linguistics, Nov. 2020, pp. 4390–4400. [Online]. Available: https://aclanthology.org/2020.findings-emnlp.393

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A. D. Lelkes, V. Q. Tran, and C. Yu, “Quiz-style question generation for news stories,” in Proceedings of the Web Conference 2021, ser. WWW ’21. New York, NY, USA: Association for Computing Machinery, 2021, p. 2501–2511. [Online]. Available: https://doi.org/10.1145/3442381.3449892

C. Liang, X. Yang, N. Dave, D. Wham, B. Pursel, and C. L. Giles, “Distractor generation for multiple choice questions using learning to rank,” in Proceedings of the Thirteenth Workshop on Innovative Use of NLP for Building Educational Applications. New Orleans, Louisiana: Association for Computational Linguistics, Jun. 2018, pp. 284–290. [Online]. Available: https://aclanthology.org/W18-0533

M. Sinha, T. Dasgupta, and J. Mandav, “Ranking multiple choice question distractors using semantically informed neural networks,” in Proceedings of the 29th ACM International Conference on Information & Knowledge Management, ser. CIKM ’20. New York, NY, USA: Association for Computing Machinery, 2020, p. 3329–3332. [Online]. Available: https://doi.org/10.1145/3340531.3417468

K. Vachev, M. Hardalov, G. Karadzhov, G. Georgiev, I. Koychev, and P. Nakov, “Leaf: Multiple-choice question generation,” Advances in Information Retrieval, forthcoming

Zhou, X., Luo, S., & Wu, Y. (2020). Co-Attention Hierarchical Network: Generating Coherent Long Distractors for Reading Comprehension. *Proceedings of the AAAI Conference on Artificial Intelligence*, *34*(05), 9725-9732. https://doi.org/10.1609/aaai.v34i05.6522

RECOMMENDED COURSE: Seminar on Language Technologies. Deep learning.

Deep Learning neural network models have been successfully applied to natural language processing. These models are able to infer a continuous representation for words and sentences, instead of using hand-engineered features as in other machine learning approaches. The seminar will introduce the main deep learning models used in natural language processing, allowing the students to gain hands-on understanding and implementation of them in Tensorflow.

Topics

- Introduction to machine learning and NLP with Tensorflow Deep learning
- Word embeddings
- Language modeling and recurrent neural networks
- Convolutional neural networks
- Attention mechanisms

Prerequisite. Basic programming experience, a university-level course in computer science and experience in Python. Basic math skills (algebra or pre-calculus) are also needed.