Deep Learning Approaches in Contextual Search

(Track: Research)

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Contextual Search

- Contextual search is used to optimize web-based search results based on the context provided by the user.
- Among many approaches used in contextual search, in most of the recent studies, methods involving neural networks are preferred rather than traditional methods.
- There are many different types of neural networks (e.g. CNN, RNN, LSTM, …) used in contextual searching.

Research Question

- However, in the literature, there is no comprehensive research that compares these methods to find the ones, which give more relevant results in contextual search.
- In this project, the deep learning approaches used in the contextual search field is examined and the methods which give more relevant results is discussed.

Deep Learning

- Artificial intelligence is the ability of a computer or a computer-controlled robot to perform various activities similar to intelligent creatures.
- The basis of the artificial neural network is to enable the machine to learn with an approach similar to the work of neurons in the human brain.
- Deep learning is a part of machine learning methods based on artificial neural networks. A single-layer artificial neural network is made multi-layered to obtain a deep artificial neural network.

Deep Learning Methods in Contexual Search

- Although there are many different models and approaches used in the studies on contextual deep search field, LSTM, RNN and CNN are among the most preferred and studied ones.
- Some of these studies are briefly summarized in this presentation.

C-DSSM

- The model is implemented based on a convolutional neural network (CNN).
- Local contextual information is modeled using the convolution-max pooling operation. Then, important local features in a word sequence are combined to form a global feature vector.
- The high-level semantic information of the word sequence is extracted to form a global vector representation.
- It outperforms the DSSM, which is a DNN based model, according to the NDCG performance measure.

CLSM

- The model is motivated by the convolutional structure of the CNN.
- Local contextual features are extracted using the convolutional layer and global contextual features are extracted using the max-pooling layer.
- The higher layers in the architecture uses the extracted context-sensitive features for matching documents and queries in web search applications.

LSTM-RNN

- The model sequentially takes each word in a sentence, extracts its information, and embeds it into vector.
- It automatically attenuates the unimportant words and detects the important keywords in the sentence.
- Bidirectional LSTM-RNN model obtained better results than normal LSTM-RNN.
- It outperforms the proposed CNN based models, according to the NDCG performance measure.

Results

- As a result of many studies examined on the subject;
- The highest success in this area was achieved using the bidirectional LSTM model
- The basic DNN model is now inadequate compared to other models.

Results

- A summary of the most used models and their success on the same dataset is as follows:

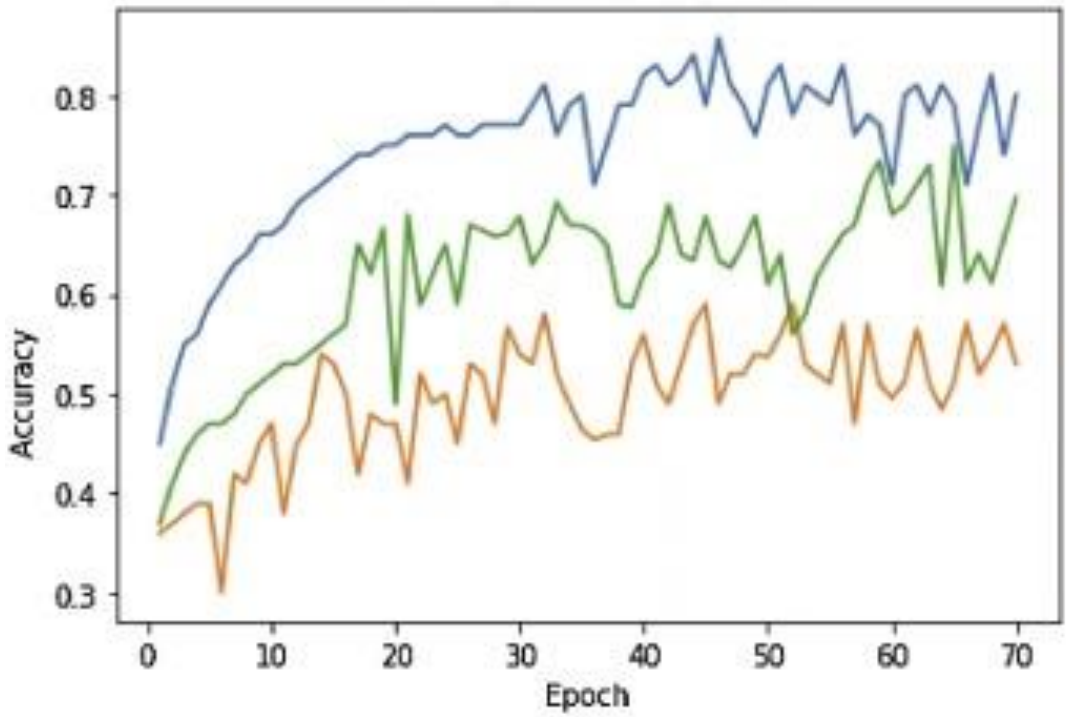
Model	NDCG@1	NDCG@3	NDCG@10
DNN	31.0%	34.4%	41.7%
RNN	31.7%	35.0%	42.3%
CNN	32.1%	35.2%	42.7%
LSTM	33.1%	36.4%	43.7%
Bidirectional LSTM-RNN	33.2%	36.6%	43.6%

Implementation

- CNN, RNN and LSTM models are implemented to get results using IMDb dataset.
- Although the accuracy values obtained are not satisfactory, the result obtained in terms of order of success, did not differ from the results, obtained through the literature review.

Implementation

- The accuracies obtained for classification according to the surrounding context is as follows:
- orange line for RNN,
- green line for CNN,
- blue line for LSTM



Project Timeline

- The project timeline that was given in the proposal:

06.04.2020 – 26.04.2020	Literature review
27.04.2020 – 15.05.2020	Implementations
16.05.2020 – 29.05.2020	Evaluation of results

- To question the reasons behind these results (e.g. why LSTM gives the best results), is the only thing that is not completed in the project, according to the proposal.
- It is planned to be completed by June 5.

Project Timeline

- So the modified timeline is:

06.04.2020 – 26.04.2020	Literature review
27.04.2020 – 15.05.2020	Implementations
16.05.2020 – 29.05.2020	Evaluation of results
30.05.2020 – 05.06.2020	Reasonings

Discussion

Difficulties encountered during the project:

- Finding an appropriate dataset
- Evaluation of methods

References

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- Hamid Palangi, et al. 2016. Deep sentence embedding using long short-term memory networks: Analysis and application to information retrieval. IEEE/ACM Transactions on Audio, Speech, and Language Processing, April 2016, 694-707.
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