RE-Net: A Character-Based Model Replicating R-Net

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Introduction

Contextual question answering is a problem that has garnered a lot of attention in the past few years. The SQuAD Challenge is a question answering task that incentivizes the development of a model that can extract salient answers to a question from a large block of context text, which would be valuable in streamlined information extraction. We propose an improvement on a baseline BiDAF model by replicating R-Net, a model that adds character-level embeddings, self-matching attention and gated attention network. Our contributions to this paper will be the validation of R-Net's performance on the SQuAD2.0 dataset.

Dataset

SQuAD2.0

The first recorded travels by Europeans to China and back date from this time. The most famous traveler of the period was the Venetian Marco Polo, whose account of his trip to "Cambaluc," the capital of the Great Khan, and of life there astounded the people of Europe. The account of his travels, Il milione (or, The Million, known in English as the Travels of Marco Polo), appeared about the year 1299. Some argue over the accuracy of Marco Polo's accounts due to the lack of mentioning the Great Wall of China, tea houses, which would have been a prominent sight since Europeans had yet to adopt a tea culture, as well the practice of foot binding by the women in capital of the Great Khan. Some suggest that Marco Polo acquired much of his knowledge through contact with Persian traders since many of the places he named were in Persian.

How did some suspect that Polo learned about China instead of by actually visiting it?

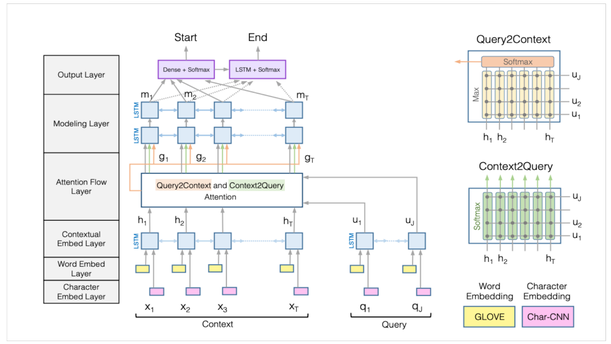
Answer: through contact with Persian traders

Source: Pranav Rajpurkar, https://rajpurkar.github.io/mlx/qa-and-squad/ [1]

- Question-answering dataset
- Difference from SQuAD1.1: Indicates if no answer is available in context paragraph

Models

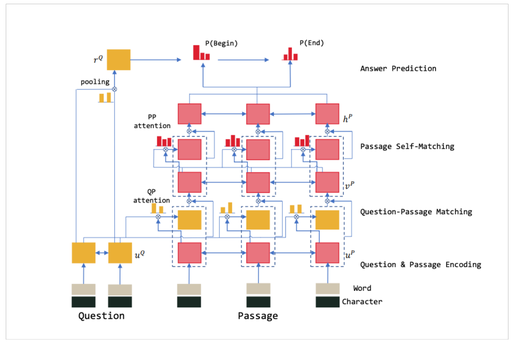
Character Embedding Model



Source: Bidirectional Attention Flow for Machine Comprehension [2]

- Convolutional neural network to generate character embeddings of words
- Combination of character embeddings and word embeddings is passed into highway network
- Contains BiDAF Attention Layer

R-Net



Source: R-NET: MACHINE READING COMPREHENSION WITH SELF-MATCHING NETWORKS [3]

- Question-Context Matching using gated attention-based RNN to create question-based passage representation
- Self-matching attention creates more context in passage representation
- Pointer network output layer

Experimental Details

- **Learning rate of 1**
- **Batch size of 16** (for memory purposes)
- Trained on **20 epochs**

Moreover, the size of the **hidden layer used was 50** and we used the **300-dimensional GLoVE vectors**, as used by the baseline model.

Results

	Dev	Test	R-Net	Baseline
EM	57.873	58.445	71.1	55.991
F1	61.504	61.635	79.5	59.291

- Improvement over baseline model
- Similar scores between RE-Net and Char-Embedding BiDAF Model
- Significantly lower than R-Net score
- Margin between EM and F1 score closer in RE-Net than R-Net

Discussion

Improvements from Baseline

- Higher EM/F1 score
- Use of character embeddings provides more information per word than use of only word embeddings

Example Inaccuracy

Model's Answer: in the possession of already-wealthy individuals or entities
Correct Answer: those who already hold wealth

- Model performs poorly on this example.
- Contains irrelevant text like "in the possession"
- Phrasing of the question suggests an answer that is the object of some action.
- The model uses this assumption and outputs the answer starting with "in the possession..."

Shortcomings

- Used hidden size of 50 rather than 75
- Ran for 20 epochs rather than 30 for time purposes.
- Learning rate of 1 rather than 0.5 reduced accuracy.
- General hyperparameter tuning to improve runtime efficiency reduced accuracy.

References

[1] Rajpurkar, Pranav. The Stanford Question Answering Dataset. https://rajpurkar.github.io/mlx/qa-and-squad/. (2017)
[2] Seo, Minjoon, Aniruddha Kembhavi, Ali Farhadi, and Hannaneh Hajishirzi. Bidirectional attention flow for machine comprehension. arXiv preprint arXiv:1611.01603, 2016.
[3] Natural Language Computing Group, Microsoft Research Asia. R-NET: Machine Reading Comprehension With Self-Matching Networks.