Adaptive Information Retrieval Systems

Improve the performance of information retrieval systems through question generation

Raimi bin Karim (A0082893R)
Azmi bin Mohamed Ridwan (A0225575Y)
Wang Tian Ming Kenneth (A0116351R)

Overview

Information retrieval models generally require large amount of training data to perform well. Unfortunately, most companies do not have sufficient data for training as they might not have data collection pipelines in place to collect training data. To solve the lack of training data, we generate questions for the training set by using the Text-to-text Transfer Transformer (T5) model. We believe that the performance of the information retrieval (DistillBert) model will improve after being trained on the generated questions.

Proposed Method

Definitions:
Q_O: Original questions given to us.
A_O: The universe of possible paragraphs/ documents that can be returned to the user of the information retrieval system
Q_G: The questions generated by T5
Q_{O+G}: The final set of questions used to fine tune the information retrieval model

To finetune a T5 model that is capable of generating Q_G, the T5 model is first fine tuned against the SquAD dataset. During the fine tuning process, the aim of the T5 model is to generate questions based on a given span. The fine tuned T5 model is then used to generate Q_G from A_O. Finally, Q_{O+G} and A_O are used to finetune the DistillBert (information retrieval) model.

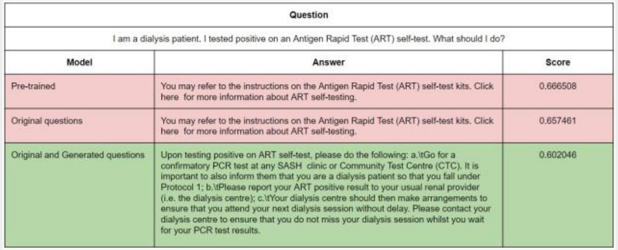
Dataset

We used a dataset from the Ministry of Health's frequently-asked questions on **Covid-19 Vaccination and Booster**[1] which informs Singapore citizens how to manage Covid-19. This dataset consists of 188 pairs of questions and answers.

This dataset will be used to (1) fine-tune the information retrieval model to fit our domain and (2) generate new questions based on the given answers.

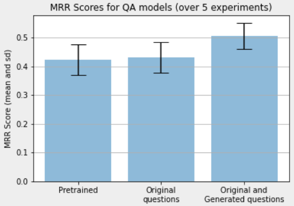
[1] https://ask.gov.sg/agency/moh?topics=COVID-19%20Vaccination%20and%20Booster

Question Generation in Action

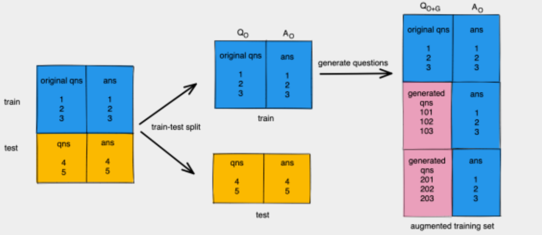


Question		
I am a dialysis patient. I tested positive on an Antigen Rapid Test (ART) self-test. What should I do?		
Model	**Answer**	**Score**
Pre-trained	You may refer to the instructions on the Antigen Rapid Test (ART) self-test kits. Click here for more information about ART self-testing.	0.666508
Original questions	You may refer to the instructions on the Antigen Rapid Test (ART) self-test kits. Click here for more information about ART self-testing.	0.657461
Original and Generated questions	Upon testing positive on ART self-test, please do the following: a.\tGo for a confirmatory PCR test at any SASH clinic or Community Test Centre (CTC). It is important to also inform them that you are a dialysis patient so that you fall under Protocol 1; b.\tPlease report your ART positive result to your usual renal provider (i.e. the dialysis centre); c.\tYour dialysis centre should then make arrangements to ensure that you attend your next dialysis session without delay. Please contact your dialysis centre to ensure that you do not miss your dialysis session whilst you wait for your PCR test results.	0.602046

Performance



Pipeline



The training set is augmented with more question-answer pairs (red), where the questions are generated by from the existing answer set in the training set. In our implementation, we generated 10 sets of questions (shown above are 2). This augmented training set, together with the test test, are used to fine tune the model.

Evaluation Metric

Mean Reciprocal Rank (MRR) is generally used as the evaluation metric for information retrieval models. Given a scenario with 2 queries, the MRR score is [(1/3) + (1/1)]/2 = 2/3

Question	Proposed answer	Correct answer	Reciprocal rank
Q1	A2, A5, A3	A3	1/3
Q2	A1, A4, A5	A1	1/1

Future Improvements

Future improvements that can be done include:

- Generating more than 10 sets of questions for every answer
- Use other data augmentation techniques like synonym replacement and random deletions to the questions
- Using multiple question generators (eg. GPT2) to generate the questions

Conclusion

We have shown that the performance of the information retrieval model is best when trained with questions generated from the T5 model. We believe that the process of generating new questions is similar to the act of augmenting data. Ultimately, the augmented data serves to represent different ways that the same question can be asked. By exposing the information retrieval model to such questions, we believe that the information retrieval model can perform much better in practical scenarios. If you have any questions, do contact us.

Raimi bin Karim: raimi.karim@u.nus.edu
Azmi bin Mohamed Ridwan: E0576209@u.nus.edu
Wang Tian Ming Kenneth: E0573193@u.nus.edu
Github link: https://github.com/kenneth-wang/cs5260