

Automatic MCQ Generator Using Natural Language Techniques.

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Abstract:

Background: Multiple choice question (MCQ) generation from a text is a popular research area. They are widely used for a learner's knowledge assessment in the education sector. Manual generation of Mcq is hard, time-consuming and expensive. We have developed a system using various applications of Natural Language Processing Techniques. In this paper, we present a set of MCQs (Multiple Choice Questions) generated for any given input text along with a set of distractors and the correct answer to the question. In addition, The BERT(Bidirectional Encoder Representations from Transformers) model is used to generate a summary of the input text. The RAKE (Random Automatic Keyword Extraction) technique is used for extracting the keyword from the generated summary. This keyword is used as a parameter to generate questions as well as distractors for the MCQs. Distractors are the options that are generated apart from the correct answer. For the generation of MCQ, the wordnet and conceptnet algorithms are used. For the question generation, a T5 Transformer Model is trained using the encoder-decoder architecture. For the generation of MCQ, the wordnet and conceptnet algorithms are used. The final result has is a combination of questions with four options and a correct answer.

Materials and Methods: In this study , The system will start with a prompt to provide an input file as a text document file .A description box will be available which will give information about the working of the software. Once the user enters the texts file , they will immediately get a list of multiple choice questions along with correct answer. The text file will be converted into a summary using the summarizer. The summary will be a single paragraph. The keywords will be extracted from the summary using RAKE . The Raw Automatic Keyword Extractor will generate mcq using the graph technique of natural language processing. Once the keyword is extracted the summary and the keyword will be provided as an input to the question Generation model . The question generation model will provide a set of questions on the basis of keywords and the summary provided. The keyword that is associated with the question will be used for distractor generation. The distractor generator will be done using conceptnet and wordnet . The final result will be a list of mcqs with correct answer under each question.

Results: The final result will be a set of Multiple choice questions with a set of distractors and a correct answer to the question.

Conclusion: The basic motivation of creating this desktop application were examinations attempted during Covid- 19 pandemic which were inefficient. This system tends to overcome many flaws that the previous application sustained. The system summarizes the text and generates MCQs with distractors and right answer with probably higher accuracy.

Key Words: Summary, Keywords, Distractor, Wordnet, Conceptnet, BERT, RAKE

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I. Introduction

Assessment is said to be very crucial in learning and question stands to be the very basic need for the assessment. Multiple choice question (MCQ) is the most well known and widespread form of a question for various levels of assessment like SATs. MCQs come handy and efficient due to their immense ease of quick evaluation, less testing time, consistent scoring, and the possibility of an electronic evaluation. Many examinations use MCQ based question papers through a computerized environment for the quick yet efficient way to assess. However, manual preparation of MCQs is time-consuming, costly and difficult in a way. Methods of assessment used MCQs are fill-in questions with multiple choices provided and one correct choice among them, which the student has to choose. The major advantage of assessment through MCQs is that it becomes simple for the test takers to assess the knowledge of a student with few simple yet tricky questions, and the method is simple and makes test takers job a bit fast. MCQs can be quite useful for self-assessment and online learning as well. In addition, the task of the teachers to check the answers and evaluate it becomes faster than

the traditional way. However, it becomes a hectic process for the test-makers to create the MCQ test along with the sensible options, i.e., distractors. The test makers also experience the burden of creating relatable distractors or the test will come out at easy or baseless. intervention once the knowledge base for MCQ generation is provided which is the input text. This system works by first taking the knowledge base and the generating MCQs with sensible distractors and one correct choice which is the answer for the question being asked. at the distraction generation process, this system uses concepts like WordNet and ConceptNet. This makes distractor generation process sensible which makes the system even more advantageous.

MCQ generation is composed of three major components:

1. Stem
2. Key
3. Distractor

II. Material And Methods

This comparative study was carried out on a database named “SQUAD”. The database consists of context, question and answers.

Study Design: Data Analytics.

Study Location: Online.

Study Duration: August 2020 to November 2021.

Sample size: 88318 records consisting of context, answer and questions in the dataset. Out of which 78,665 records were trained and 9,653 records were used for testing purpose.

Sample size calculation: 90% of the sample size was trained in order to generate the questions and remaining 10% was used for testing purpose.

Subjects & selection method: The methods for generation of multiple-choice questions include summarization, key- word extraction, question generation, distractor generation. For the question generation , a T5 transformer model was trained by providing a context and answer as input and the model provides a question as output.

For MCQ Generation Inclusion criteria :

1. Text file

Exclusion criteria:

1. A set of Multiple Choice Questions along with distractors and correct answers.

For Question Generation Inclusion criteria :

1. Context and a correct answer.

Exclusion criteria:

1. Question

Procedure methodology

The system will start with a prompt to provide an input file as a text document file .A description box will be available which will give information about the working of the software. Once the user enters the file ,they will immediately get a list of multiple choice questions along with correct answer. The questions will be in the form of fill in the blanks. The right answer will fit in the blank space. The blank can be in any part of the sentence, I.e. Start , end, centre .

The system will start working once it receives a text file . The text file will be converted into a summary using the summarizer. The summary will be a single paragraph. The keywords will be extracted from the summary using RAKE . The Raw Automatic Keyword Extractor will generate mcq using the graph technique of natural language processing. Once the keyword is extracted the summary and the keyword will be provided as an input to the question Generation model . The question generation model will provide a set of questions on the basis of keywords and the summary provided. The keyword that is associated with the question will be used for distractor generation. The distractor generator will be done using conceptnet and wordnet . The final result will be a list of mcqs with correct answer under each question.

The text file is given as an input to the BERT summarizer. BERT is an encoder transformer.

When two encoders are stacked upon each other a Bidirectional Encoder Representation From Transformed is formed. The BERT Summarizer takes the text file as an input as gives a summary as an output. This is the first step of the system. The next process is of Keyword Extraction. The keywords are extracted from the summary. The Rapid Automatic Keyword Extraction Algorithm is used for the process of keyword extraction. The Algorithm takes the summary and number of keywords expected as input and then produces keywords as output. The keywords are nouns ,proper nouns ,adjectives and verbs from the summary. It is a

language and domain independent, unsupervised method for extracting the keywords. It is based on the individual frequency of words and its co-occurrences with other words in a document. The co-occurrence graph of the words and the phrases are built to identify the frequency of association, after splitting the summary into an array of words by specified delimiters. A score is then calculated for each phrase, which is the sum of the individual word scores from the co-occurrence graph. And the words are passed on to a list depending upon score. These keywords are later used as an input to the question generation model as well as for distractor generation. For the Question Generation Model, we have generated a model using the T5 Transformer Model. The t5 transformer, is a supervised transformer, that follows the traditional architecture of transformer i.e. encoder-decoder architecture. The primary building block of the transformer is self-attention. It is trained using teacher-forcing. Teacher-forcing technique, is where the target word is passed as an input to the Decoder. For decoding, the transformer uses greedy decoding. The T5 treats every problem as text-to-text problem. Text-to-text means that we give text as an input and get another text as an input. For this model, We have provided two parameters as inputs and we get a single output. The input is the context and answer, and the output is a question for the input. For distractor generation, we have used three methods mainly wordnet, conceptnet and sense2vec models.

Distractors are the incorrect answers in a multiple choice question. Choosing your distractors poorly can make your multiple choice questions much easier or harder than you may have intended. Wordnet is a lexical database i.e. dictionary of semantic relations like(synonyms) between

words in more than 200 languages. It is present in NLTK for NLP. They consists of Sysnets. WSD stands for Word Sense Disambiguation. Example Bat.Sysnets set of words sharing same meaning or concept in a Group. Hypernyms:(more abstract terms) in a sysnet tree, hypernyms provide a way to categorize and group words based on similarity. Example: Color is hypernym for Red. Hyponyms: (More specific term) these help in creating distractors. Example: Hyponyms of color can be purple, blue, green, which can be used as distractors. Conceptnet is a free multilingual knowledge graph. Good for generating distractors that have "parts of" relationship. Example : Arizona, Seattle, and Texas.(Similar to Cohyponyms in Wordnet). Good for generating distractors that have "part of" relationship. Example California is a part of United States. It helps people to understand the meaning of words humans use.

Sense2vec is a neural network model that generates vector space representations of words from large corpora. Sense2vec creates embeddings for "senses" rather than tokens of words. Sense2vec aims to solve this problem by generating contextually-keyed word vectors.

III. Result

The Question Generation Model is trained in order to generate questions for the keyword. The 90% of the dataset is trained and remaining 10% is used for the testing purpose. The model provides questions based on the context and answers. The T5 transformer can be compressed using FastT5 Library. Once the model is compressed it reduces by 3 times in size and increases the inference speed by almost 5 times. The dataset consists of context, question and answer.

Context	Answer	Question
Neetu likes to eat ice-cream.	Ice-cream	What does Neetu like to eat?
Rahul lives in Rajkot.	Rajkot	Where does Rahul live?
I went on a trek to Vasota fort.	Vasota fort	Where did I go on a trek?
I like to read books.	Books	What do I like to read?
Narendra Modi is the prime minister of India.	Narendra Modi	Who is the prime minister of India?

Table 1 : Shows the inputs (context, Answer) and the output (Question) received.

The latency of the original model before the compression is as follows:

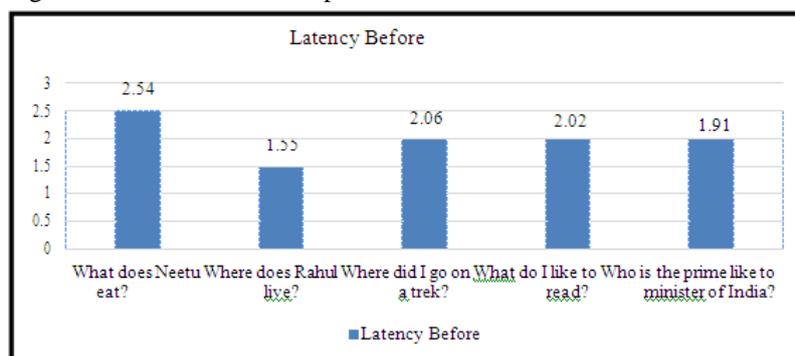


Figure 1: Latency calculated by the original model.

The model is compressed in order to make it compatible to be used in all the softwares. The ONNX technique is used for the purpose. ONNX stands for Open Neural Network Exchange.

The latency of the model after compression is as follows:

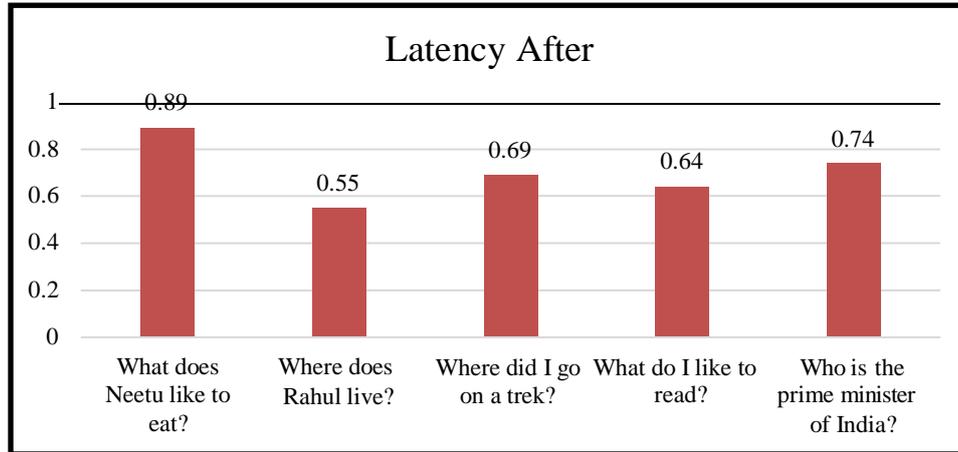


Figure 2: Latency calculated by the compressed model.

The difference in the latencies is almost equal to 3 times decrease. Hence the compressed model is used in the system as it acquires less space, gives same accuracy, takes less time to generate output.

The decrease in the latency is shown below:

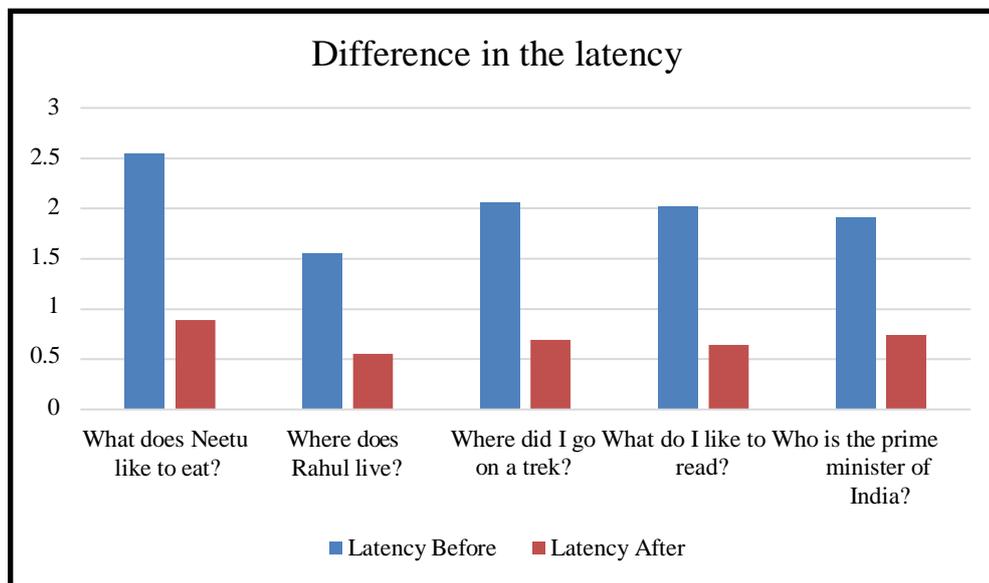


Figure 3 : Difference in both the latencies.

Once the model is trained and tested, it can be used for the further process of MCQ generation. The basic approach for the system is as follows:

1. Get a text file which contains paragraphs ranging from 1 to many.
2. Create a summary of the text in the text file using Summarizer ().
3. Initialize the number of keywords to be extracted from the summary. extract keyword using the rake algorithm
4. Generate the Questions from the transformer.
5. Generate distractors using wordnet, conceptnet, etc.
6. Result: Print List of questions with 4 options and one right answer

The final output is a set of multiple choice questions which can be used by the user.

IV. Discussion

Multiple Choice Questions play an important role in the educational field. But MCQ generation is tedious, tiring and hectic process. Manual MCQ generation can be done as well but it may have the risk of human errors like spelling mistakes, same distractors or same keys (right answer) in the distractors provided. We had experienced MCQs assessment prior to the making of this system as well and had experienced similar problems. World was facing a pandemic crisis and assessments were conducted digital and online. Theoretical Assessments were conducted in the form of MCQs. We as students, had faced many issues while answering them as most of the questions had similar distractors or the right answer repeated twice as the distractor. The MCQs which were provided for assessment also had spelling mistakes and missing texts that construct a meaningful sentence, making the understanding of the questions difficult. Considering this, the idea of this system had pondered. Assessments are important and beneficial for all the courses as it gives the idea of one's capability of fulfilling the requirement of need for the opted course. MCQs have stood as the best possible way of assessing a student as it not only checks the ability of answering but also checks of how assured the student is with the answer as it chooses from the set of wrong choices. Developing automatic methods will alleviate the burden of both paper-and-pencil and technology aided assessments. Abstractly speaking, this system would only take the basic data like knowledge base as input and produce reasonable number of questions with their distractor and right answer as output which adheres to given specifications. To construct a balanced test, a test maker has to go through a lot of difficulties like predicting how certain number of students will react on the particular questions of the test. This process makes it time consuming and even pressurizing for test makers. So, rather than thinking about why the system provided us those MCQs during our assessments, we tried to make our own MCQ Generation system which tends to overcome those issues. This system is beneficial as it almost covers the human errors and makes the teachers task of evaluation faster yet efficient .

V. Conclusion

The basic motivation of creating this system was examinations attempted during the pandemic which were inefficient. This system tends to overcome many flaws that the previous application sustained. The system summarizes the text and generates MCQs with distractors and right answer with probably higher accuracy. The whole agenda is fulfilled.

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