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AI Based Question Answering System

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Abstract – *Academic assessments are the only available metrics of evaluating student knowledge today. But the current procedure of manually setting questions and evaluating student answers tend to be hectic, expensive and time-consuming. Human intervention in the entire process consumes instructors' valuable time and can end up being biased intentionally or unintentionally. The goal of this project is to build an automated software module to provide an inexpensive and a more effective alternative to the existing examination system. The software will assess students' knowledge in the particular courses by generating potential questions and evaluating the student's understanding of the course. Natural language Processing Toolkit is used to understand and interpret the user answers along side some open-source machine learning modules which ensure the software performance is accurate and reliable.*

***Key Words*: Subjective Question-Answer Generation, Objective Question-Answer Generation, Subjective Answer Evaluation, Keywords Extraction**

1. INTRODUCTION

Examination systems were introduced into the education system to understand and evaluate learner's understanding of the course but over the course of time, examination system have become competitive in nature and no longer tends to serve the purpose of evaluating the learner's understanding and provisioning him to improve. Newer technologies and inventive approaches for teaching courses have arrived but there haven't been any measures taken to ensure proper testing of knowledge, without it being biased or unfair.

A good assessment should test the knowledge of the learner thoroughly in the course and should evaluate learner's understanding by fair means. It must also ensure that the conduction of the assessment is undergone in a malpractice free environment, thus ensuring the assessment is fair.

With the help of Natural Language Processing Toolkit the learner responses and subject material is processed by the machine learning models, that extract key words like important headings and phrases from the subject material to frame questions around the same.

For objective questions, a pre-trained machine learning module is used to generate distractor options which are close to the correct answer, to increase the difficulty of the question and challenge the learner.

The learner understanding is evaluated by checking for the similarity between the correct answer and learner response using mathematical vector notations.

2. LITERATURE SURVEY

2.1 TEXT SUMMARISATION USING PRE-TRAINED TRANSFORMER

Urvashi Kandelwal, Kevin Clark, Dan Jurafsky, and Lukasz Kaiser's review paper "Sample Efficient Text Summarisation with a Single Pre-Trained Transformer" centres around the summarisation of a huge document of text into a smaller meaning that conveys the context and abstract of the document.

2.2 COSINE SIMILARITY TO CALCULATE TEXT RELEVANCE BETWEEN TWO DOCUMENTS

D Gunawan, C A Sembiring, and M A Budiman's review paper "The application of Cosine Similarity to Calculate Text Relevance between Two Documents" examines the relevance of two documents using text similarity measures such as cosine similarity. To determine the similarity of online pages, this study employs a classification technique known as Naïve Bayes.

2.3 EXTRACTIVE TEXT SUMMARISATION USING DEEP NATURAL LANGUAGE FUZZY PROCESSING

"Extractive Text Summarisation Using Deep Natural Language Fuzzy Processing" is a review paper. The work of Neelima G, Veeramanickam M.R.M, Sergey Gorbachev, and Sandip A. Kale focuses on distilling a document's meaning into a manageable number of sentences. It employs fuzzy logic, with the Naïve-Bayes technique being used to identify the most essential sentences in a given document.

2.4 UNSUPERVISED KEYPHRASE EXTRACTION USING MASKED DOCUMENT EMBEDDING

Linhan Zhang, Qian Chen, Wen Wang, Chong Deng, Shiliang Zhang, Bing Li, Wei Wang, and Xin Cao's review paper "A Masked Document Embedding Rank Approach for Unsupervised Key-Extraction" focuses on extracting keywords from a huge document of text. The keywords are generated using a BERT-based model. It extracts essential phrases by selectively masking terms in the manuscript depending on their importance and use.

3. PROPOSED WORK

The proposed solution is a two interfaced platform, for the two user groups, tutor and learner. The question generation is initiated with a tutor uploading the subject material. Two types of assessments are generated for the uploaded subject material, objective and subjective questions. The questions are generated using the software and once the questions are generated, the answer pairs for all the above questions are produced. Additionally, for MCQ type questions, distractor options that are similar to the actual answers are created to challenge the learner. After generation of the question-answer pair, the user responses are collected and evaluated with the ideal answers generated for respective questions. Based on how similar the response and the ideal answers are, a score is generated for the student to assess their performance in the assessment.

3.1 SYSTEM ARCHITECTURE

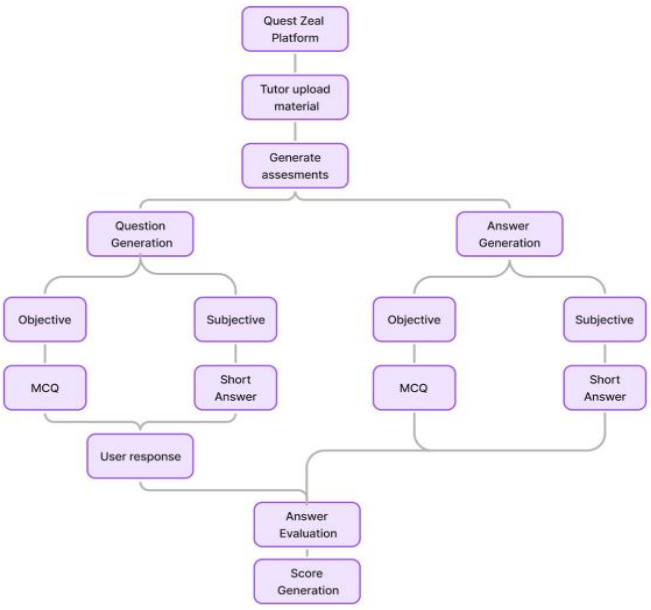

Figure 1 - Flow Chart

A. Question Generation – The subject material uploaded by the tutor is processed using Natural Language Processing techniques and questions are generated from the subject material based on their relevance with the subject.

B. Answer Generation – The answers to the formed questions are identified from the corpus and generated, which will be later utilized to compare with the learner's responses.

C. Answer Evaluation – The answers evaluation is performed by measuring the similarity distance between the ideal answers generated and learner responses.

3.2 ML MODELS AND PARAMETERS

The question-answer generation is performed using open-source Google BERT Model also known as the hugging face model. It performs keyword extraction on the obtained text corpus. Alongside this open-source model, other open-source pre trained models like race-distractors model, multitask qg-ag model and sv2 model are used for the processing of the natural language and to predict the question and answers from the text corpus.

3.3 METHODOLOGY

3.3.1 SUBJECTIVE QUESTION ANSWER GENERATION

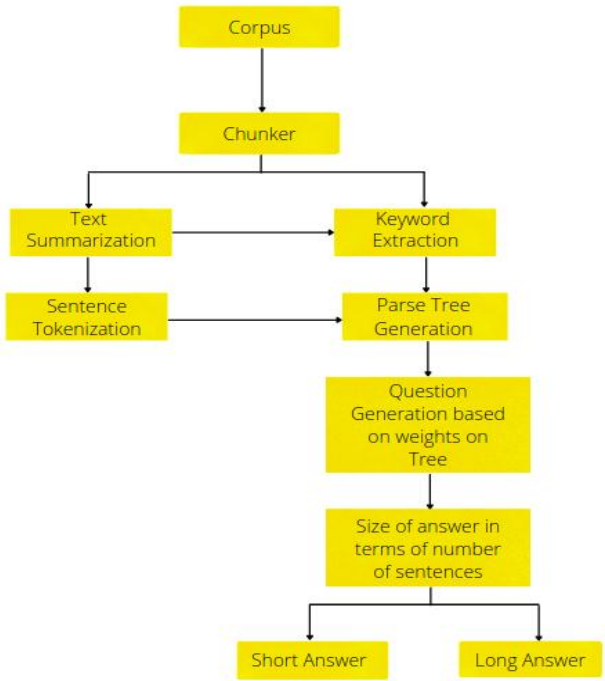

Figure 2 - Subjective Question Answer Generation

The corpus is first divided into chunks and then text summarization is performed. The summarized text is later tokenized as sentences, which form the parse tree. Simultaneously the model also generates keywords using BERT model and sv2 model which are used as weights on the parse tree and based on the keywords and weights on sub tree, subjective questions are generated by appending the keyword to one of the existing 7 question frames that suit the keyword and context better. The ideal answer is then generated from the parse tree.

3.3.2 OBJECTIVE QUESTION ANSWER GENERATION

The corpus first undergoes text summarization using BERT model and then the summarized text undergoes keyword extraction to find potential answers to generate objective questions. Once relevant keywords are extracted suing sv2 model, questions are generated by omitting the keywords in the sentences. Multiple options are created to that question using race-distractors which created key words from the given corpus that have high relevance and similarity to the answer.

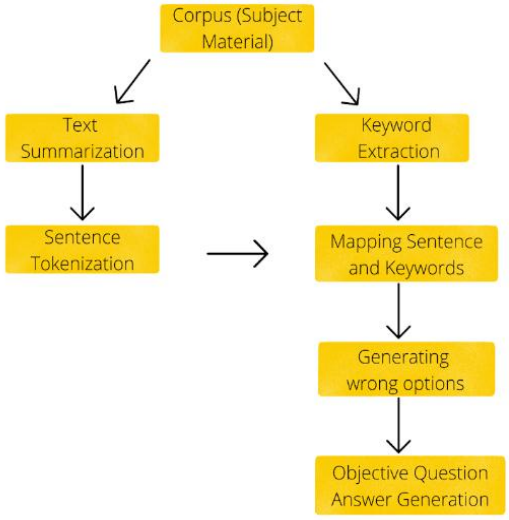

Figure 3 - Objective Question Answer Generation

3.3.3 SUBJECTIVE ANSWER EVALUATION

Subjective score is generated using 3 similarity measures to ensure that the score generated is absolutely credible and doesn't deviate much from the human score. The 3 similarity measures used are Synset similarity to check the similarity of words with their synonyms, Cosine similarity to vectorize the words and check for text angle difference, Jaccard similarity to ensure the main keywords aren't missing from the user response.

4. RESULTS

The proposed model was implemented over 100 sample subject material with varying noise and subject content. The questions generated for the following subject material dbmst.txt are:

1. Explain in detail isolation.
2. Write a short note on Application Software.
3. Write a short note on wait loop.
4. Explain in detail a school database.
5. Explain in detail Data redundancy.

Figure 4 - Subjective Questions generated on following sample corpus dbms.txt

What is a collection of related data?
- Data
- Database
- Information
- DBMS

What is a computer-software application that interacts with end-users, other applications and the database itself to capture and analyze data?
- A database management system
- A computersoftware application

What is allowed to continue while reads on the snapshot are happening?
- Data is stored in a database
- Data is stored
- Database writes

Figure 5 – Objective Questions generated on same corpus

The model accuracy in evaluating the learner knowledge to the posed questions is compared and contrasted below.

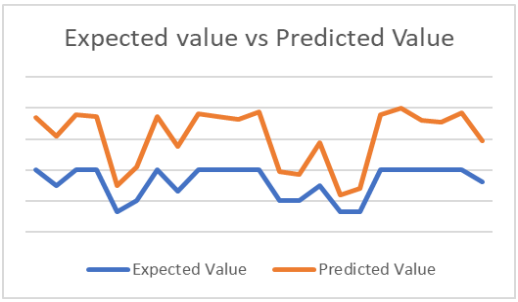

Figure 6 – Line graph of actual score vs Model score on the following sample corpus link

5. CONCLUSIONS

The proposed AI Based Question answering system aims to reduce the bias in the assessment system and create fair assessment that help learner understand the course better. But the proposed system is limited to subjects that don't involve diagrams or mathematical formulation and derivations. Also, evaluation of literature could pose challenges to the system as such evaluations are based on perspectives and can vary from person to person.

The model can be improved by using new age technologies like Image-Alt to frame questions on diagrams by understanding the meaning of images in the corpus. Also, Neural Network Models can be utilized to identify patterns in learner assessment approach and give a personalized training recommendation for the learner where analysis is performed on learner's weak concepts and more support can be provided to the learner to understand those concepts better.

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