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Semantic Analysis for Document Validation

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Abstract
Every year many competitive, institutional and non-institutional examinations are conducted. Most of the institutional exams demand descriptive type answers. However, only objective answers are being evaluated by the machines effectively. Evaluation of descriptive answers has always been a hurdle in the development of Electronic learning. The existing systems consider just the keywords or frequency of the terms but not the meaning of the answers while evaluating. The proposed system is expected to solve the above problem by using dependency parsing. Here we make use of the relationship between the terms in a text to extract its meaning. The system is expected to enhance the evaluation process by reducing the time and manpower thereby improving the quality.

Keywords: *Automated evaluation, Descriptive answers, Dependency parsing, Semantic similarity*

1. Introduction

Automation has increased the reliability and efficiency in many fields. Often, correcting examination papers become a repetitive task that can be automated. During the last decade, there is a substantial increase in the use of computers for evaluation. The aim of automating evaluation is to reduce the workload of the human evaluators and to minimize the time taken for the assessment.

In 2013, 4.2 lakh students of Anna University[1] applied for revaluation of their answer scripts. Post revaluation, 19% of the students who had failed, passed. An official said that they had to lower the standards of teachers' experience from five years' to three to increase the count of teachers. The official also stated that about fifteen percent of teachers are unfit for evaluation as they do not even have three years' experience in the subjects that they are evaluating.

The semester end examination was conducted by the Jawaharlal Nehru Technological University[2] for the final year engineering students in November 2016 and the corresponding results were announced on February 2017. Automating the evaluation process will reduce the time taken to a greater extent.

At present, there are a lot of tools available that support objective type questions or one-line answers.

But the need for evaluation of descriptive answers has arisen which will not only decrease the manpower and time taken but also helps in judging the students more accurately. There are some problems with the existing systems which include unreliable results and misunderstanding of the answers. Therefore, a proper assessment mechanism is needed to solve the above-mentioned problems.

2. Related Work

Previously, Alla Defallah Alrehily et al. have presented a paper [3] that deals with a similar problem statement. The system proposed by them makes use of keyword matching and cosine similarity for evaluation. The disadvantage is that the system does not consider the meaning of the text. Instead, it considers the keywords and the frequency of keywords.

Piyush Patil et al. have presented a paper [4] which addresses an evaluation system that only considers the keywords, question specific things and grammar of the text and not the meaning of the text.

Nilima Sandip Gite have presented a paper [5] which uses Indus-Marker Algorithm for evaluation. Here the evaluation is solely based on keyword matching.

Prince Sinha et al. have presented a paper [6] where they have proposed a system which only considers the minimum length of the answers, number of keywords

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matched and maximum marks that can be given to an answer.

Aditi Tulaskar et al. have presented a paper [7] where only the spellings, grammar and length of the answers are considered while evaluating the answers.

Dharma Reddy Tetali et al. have presented a paper [8] which proposes two methods namely fully automated and semi-automated methods. Keyword matching and phrase matching have been used for evaluation. In their research, they have found that semi-automated method is more efficient where the answer needs to be evaluated by both the machine and the human evaluator.

3. Methodology

The system comprises of four modules namely pre-processing, finding relationships, relationship comparison & grading, feedback. The architecture of the proposed system is shown in Figure 1

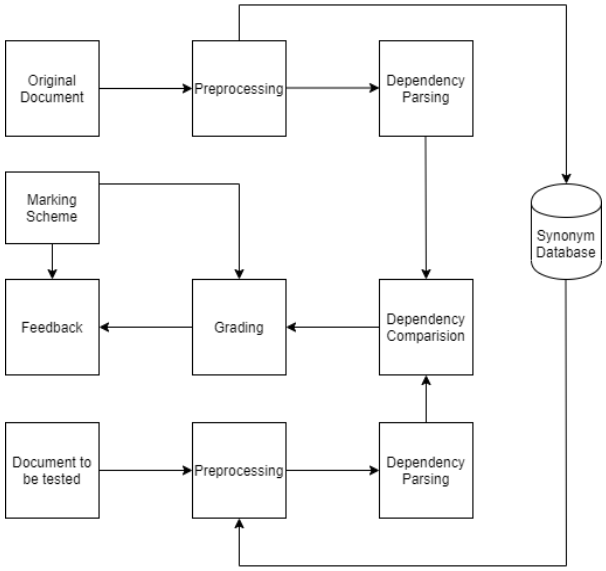

Figure 1: Architecture of proposed system

A. Preprocessing

1. Find (Noun, Pronoun) Pair *(for both original answer & student's answer)*

Firstly, we have to find and replace the pronouns with their respective nouns. It will help the machine to understand the context of the text better. This is achieved using neuralcoref module from Spacy.

Sample Input: Raj is a boy. He is good.
Sample Output: Raj is a boy. Raj is good.

2. Remove articles *(for both original answer & student's answer)*

We have to remove the articles as they do not give much meaning to the text.

Sample Input: Raj is a boy. Raj is good.
Sample Output: Raj is boy. Raj is good.

3. Sentence Tokenization *(for both original answer & student's answer)*

We must tokenize the text into individual sentences and put them into a list which makes it easier for the machine to compare the sentences for similarity. This is performed using the nltk.tokenize package.

Sample Input: Raj is boy. Raj is good.
Sample Output: ['Raj is boy.', 'Raj is good.']

4. Remove Punctuations *(for both original answer & student's answer)*

Now that we have tokenized the text into individual sentences, we will not need the punctuations any more. We can remove the punctuations listed in the string.punctuation package from the text.

Sample Input: ['Raj is boy.', 'Raj is good.']
Sample Output:['Raj is boy', 'Raj is good']

5. Find Synonyms *(for original answer)*

Since all the students might not use the same word to represent
something, we should also consider the synonyms of the words
of the original answer. We parse through each word in every
sentence of the text, find synonyms and store it in a dict of list.
This is achieved using WordNet package.

Sample Input: ['Raj is boy', 'Raj is good']
Sample Output: {Raj: ['raj'],
is: ['is'],
boy: ['male_child', 'boy', 'son']
good: ['well', 'goodness', 'skilful',
'unspoiled'] }

6. Replace Synonyms *(for student's answer)*

Each word in the student's answer is checked if it exists in the Right-hand side (value) of the synonym database that we have formed in the previous step. If exists, it is replaced by the corresponding Left-hand side (key).

Sample Input: ['Raj is boy', 'Raj is well']
Sample Output: ['Raj is boy', 'Raj is good']

B. Finding Relationships: (for both original answer & student's answer)

After pre-processing, we move on to finding the relationship between the terms in a sentence as shown in

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Figure 2. This process is known as Dependency Parsing. This is achieved using Spacy package.

Sample Input: [‘Raj is boy’, ‘Raj is good’]
Sample Output: [[['Raj', 'NNP', 'is', 'nsubj']
['is', 'VBZ', 'is', 'ROOT']
['boy', 'NN', 'is', 'attr']],

[['Raj', 'NNP', 'is', 'nsubj']
['is', 'VBZ', 'is', 'ROOT']
['good', 'JJ', 'is', 'acomp']]]

Diagrammatic Representation of the Output

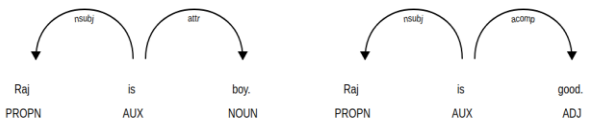

Figure 2: Dependency parsing

C. Relationship Comparison & Grading

After finding the relationship between the terms in both original answer and the student’s answer, we have to compare both the relationships to grade the student’s answer.

The machine will also be fed with the marking scheme with a list of keywords that must be present in an answer. In a sentence, if a word that is wrong or missing is one of the keywords in the list provided, then marks are detected in accordance to the marking scheme.

Original Answer: Photosynthesis is the process by which plants prepare their own food with the help of sunlight, chlorophyll and water.

Marking Scheme:
Total : 3 marks
plants prepare food : 1.5 marks
sunlight, chlorophyll, water : 1.5 marks (0.5 m each)

Student’s Answer: The process by which food is prepared using sunlight and chlorophyll by plants is called photosynthesis.

D. Feedback

In this module, the students are provided with the reason for their score. For the input in the previous step, the feedback would be,

Missing keyword: water – 0.5 marks detected
Marks scored by the student: 2.5

4. Results and Conclusion

From this work we can conclude that using this process we are giving preference to the semantics of document than checking syntactically. So the key generated by the professor can be used to evaluate or a complete document can be considered. 95% of the times it will generate results as per the manual correction. Sometimes humans may ignore some mistakes which will not be ignored by the systems which will lead to different results. The time variation with respect to the number of words is shown in Figure 3

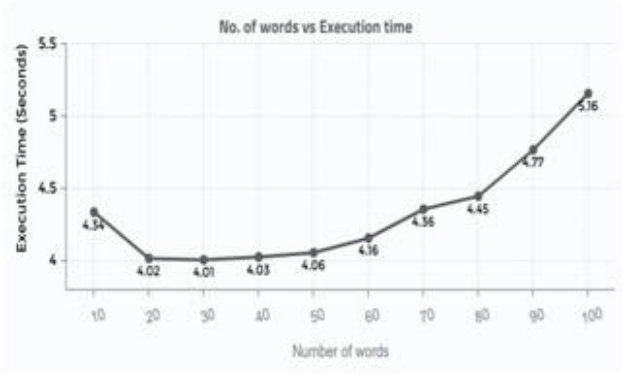

Figure 3: No.of words vs execution time

5. Acknowledgment

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