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PREDICTING EFFECTIVE ARGUMENTS IN WRITINGS USING NLP

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Abstract: Automated feedback using AI is changing the way of evaluation and is continuously improving the efficiency of the writing ability of students. There exists lot of feedback tools in the market for English grammar, sentiment analysis etc. But they lack to give efficient feedback on argumentative writings. An argumentative text is a type of writing that expresses coherence through reasoning that refutes or justifies something, in order to persuade the reader. The main goal of this project is to classify argumentative elements in student writings as “effective”, “adequate”, or “ineffective”. We will create a NLP based deep learning model trained on dataset that is representative of the 6th -12th grade population in the United States which is taken from Kaggle. We hope that the model derived from this project will help pave the way for students to receive enhanced feedback on their argumentative writing. With automated guidance, students can complete more assignments and ultimately become more confident, proficient writers.

Index Terms - Argumentative, NLP, Feedback, Deep learning.

I. INTRODUCTION

Writing is crucial for success. In particular, argumentative writing fosters critical thinking and civic engagement skills, and can be strengthened by practice. In argumentative writing, you are typically asked to take a position on an issue or topic and explain and support your position with research from reliable and credible sources. However, only 13 percent of eighthgrade teachers ask their students to write persuasively each week. Additionally, resource constraints disproportionately impact Black and Hispanic students, so they are more likely to write at the “below basic” level as compared to their white peers. Argumentative writing means, an essay or research paper that makes an argument seeks to make a statement about a certain event, concept, or phenomenon. The author makes a claim and makes an argument, backing it up with substantial theoretical and empirical study and convincing evidence. In the prewriting stage and beyond, cognitive talents are crucial. Your pupils must be able to assess the proof they have obtained via research, balance the advantages and disadvantages of a topic, and persuasively argue their position. Teaching your pupils how to produce an excellent argumentative text requires developing their memory, attention spans, and problem-solving abilities. Argumentative essays are responses to other people's essays, societal problems, or global trends. Your students must thoroughly investigate the subject by reading a lot of material on it before they can write persuasively. Due to the fact that prewriting constitutes a significant portion of the reading comprehension process, you should provide your students with a variety of reading comprehension tactics. As the two are inextricably linked, feel free to employ engaging methods to teach reading to your pupils before making them work on their writing abilities.

II. LITERATURE SURVEY

1) Automated Essay Feedback Generation in the Learning of Writing: A Review of the Field

AUTHORS: Paraskevas Lagakis, and Stavros Demetriadis

Despite being investigated for over 50 years, the task of automated essay scoring continues to draw a lot of attention in the natural language processing community, in part because of its commercial and educational values, as well as due to the associated research challenges. Although the importance of automating the holistic scoring of an essay is indisputable, such systems could potentially have a wider impact if they could help students improve their essay writing skills while providing them with some sort of feedback. A mere low score could not possibly help a student understand the reason for scoring weakly neither would it show the areas where the student could improve and how. In light of this deficiency, researchers have begun anew to work on scoring specific aspects of text quality such as consistency, technical mistakes, and relevance to prompt. Automated essay scoring systems that offer didactic feedback along multiple dimensions of essay quality have also begun to arise. This paper critically reviews the recently published scientific literature on AES systems that provide automated student feedback and their impact on student learning and the teachers/students attitude towards using such systems in the learning procedure.

2) The State of the Art in Providing Automated Feedback to Open-Ended Student Work

AUTHORS: Brian Frank

This article provides a review of the state of the art of technologies in providing automated feedback to open-ended student work on complex problems. It includes a description of the nature of complex problems and elements of effective feedback in the context of engineering education. Existing technologies based on traditional machine learning methods and deep learning methods are compared considering the cognitive skills, transfer skills and student performance expected in a complex problem solving setting. Areas of interest for future research are identified.

3) Automated Essay Evaluation: The Criterion Online Writing Service

AUTHORS: Jill Burstein, Martin Chodorow, and Claudia Leacock

The Criterion Online Essay Evaluation Service, a web-based system that provides automated scoring and evaluation of student essays. Criterion has two complementary applications: (1) Critique Writing Analysis Tools, a suite of programs that detect errors in grammar, usage, and mechanics, that identify discourse elements in the essay, and that recognize potentially undesirable elements of style, and version 2.0, an automated essay scoring system. Critique and e-rater provide students with feedback that is specific to their writing in order to help them improve their writing skills and is intended to be used under the instruction of a classroom teacher. Both applications employ natural language processing and machine learning techniques. All of these capabilities outperform baseline algorithms, and some of the tools agree with human judges in their evaluations as often as two judges agree with each other.

III. EXISTING APPROACH

- There exists a lot of feedback tools based on AI/ML, but they are more concerned with English grammar, proficiency and overall sentiment etc. of the writings.
- There are no models or tools for especially for argumentative writing.
- Argumentative writings are different from normal topics, and it needs some extra care for evaluation.

IV. LIMITATIONS IN EXISTING APPROACH

- There are numerous automated writing feedback tools currently available, but they all have limitations, especially with argumentative writing. Existing tools often fail to evaluate the quality of argumentative elements, such as organization, evidence, and idea development. Most importantly, many of these writing tools are inaccessible to educators due to their cost.
- Existing feedback tools are primarily concentrating on grammar, vocabulary, spellings, and overall sentiment of the text. But there are no such tools specifically for argumentative writings.

V. PROPOSED APPROACH

- We propose here a hybrid deep learning model to handle the large data and to produce efficient results.
- Hybrid Deep Learning Model: We are going to develop a deep learning model stacking input layers with DeBERTa-v3-large model and connecting those outputs to dense output layer.
- DeBERTa-v3 is a pre-trained language model published in 2021 by Microsoft.
- In our model it acts as the backbone and generates meaningful tokens from the input, which are then learned by the last output layer during the training to predict the respective labels.
- We are going to test our model with DeBERTa, DeBERTa-large, and DeBERTav3-large as backbones and ensemble the results to achieve more accurate results.

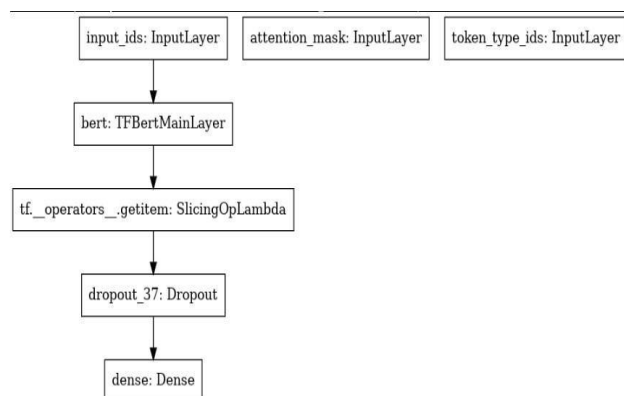
VI. IMPLEMENTATION

The implementation of this project consists of two parts:

- 1) ML model building and
- 2) Website for user interaction.

Machine Learning model that we are going to create has two major phases in it:

1) MODEL ARCHITECTURE



The model consists of three main layers input layer, DeBERTa layer, and finally Dense output layer. Input layer is divided into three parts which are responsible for taking discourse text, discourse type and input id as input. These input layers are made compatible with the DeBERTa model's input by encoding the input text accordingly. Then the output from the DeBERTa model are fed into Dense layer stack through a Dropout layer. This final Dense Layer stack consists of 3 Dense layers each containing 128, 64 and 32 nodes in the respective layers and then the output from the 32 node layer is fed into the final layer consisting of 3 nodes which represent our labels i.e Effective, Adequate or

Ineffective.

2) MODEL TRAINING

The model consisted of about 4 million parameters to be trained and is trained on around 30k discourses for 2 hour and 37 minutes using cross validation and we trained it several times tuning the hyperparameters to land at our final model using different hyperparameter tuning techniques.

VII. CONCLUSION

The trained ML Model has made around 91% accurate predictions on test data and it was generalized well for other instances too. It will be very useful for children in Mid or High schools for getting instant and accurate feedback on their argumentative writings. It can also be used by the teachers for speed and easy evaluation.

VIII. ACKNOWLEDGEMENT

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