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RESEARCH TOOL USING TRANSFORMERS IN NATURAL LANGUAGE PROCESSING

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ABSTRACT

In the recent past, with the appearances of the transformer models, the sphere of NLP has certain advantages. Transformers have emerged as the new milestones in NLP tasks as they have shown the state-of-the-art performance in many tasks involving text classification, machine translation, for sentiment analysis and question answering. To be precise, main models like BERT (Bidirectional Encoder Representations from Transformers), GPT (Generative Pre-trained Transformer), and few more have shown a lot of results. In this study a comprehensive discussion is made on transformers and how they can be applied in natural language processing. Therefore, let's begin with the most simplified idea of the nature of the NLP transformers. Letting these types of models to read and generate text very good by considering the importance aspect such as spatial encoding and self-attention mechanisms. In the next tutorial, we will be going to talk about the new transformer models and the internal architecture and training method of the current models like BERT and GPT-3 along with the traditional Transformer model itself. This has 88% of aaccuracy in researching related data from my research tool.

Keywords: Natural Language Processing(NLP), Transformers, Tokenization, Text Classification, Web Scraping(WS).

1. INTRODUCTION

Natural Language Processing (NLP) is a branch of artificial intelligence (AI) which has been experiencing a high growth rate over the recent past, and deals with how computer programs can understand natural language. Recent progress in NLP field has been made over the last few decades so that the machines are capable to understand, analyze and produce human language. Such developments have been realized through a number of approaches in the field of machine learning, ranging from conventional approaches such as statistical models and neural networks to innovative state-of-the-art approaches.[1]In the next sections we will look at components that define transformers in more details including the architectural improvements and approaches to training. We then present more details on the development of the research tool after which we provide a detailed example of how the research tool performs on different NLP tasks. Some main issues and difficulties with transformer models and some future work and possible research areas for improvement are also discussed in the paper's conclusion .

Fig 1.1 Webscraping tool using Python-Flask, BeautifulSoup

1.1 NLP is importance in variety of applications

Hence, the importance of NLP is focused on how the cooperation between humans and machines takes place. The modern machines, as it is hard to believe[2], are capable of understanding and producing human language, which had been considered purely hypothetical not very long time ago.

The Following are some of the successful implementation of NLP in various fields and application:

From helping customer support through the use of chat bots to helping medical through the use of chat bots , From helping customer support through the use of chat bots to helping medical through the use of chat bots, As is clear from the above discussion language analysis has been found useful in the process of diagnosing, Understanding text and making it ready for analysis while also providing a new way of data analysis.

1.2 The key challenges in NLP development

However, even today this sphere faces numerous challenges: Some of the most important problems in natural language processing are listed below.

1. It has been realized that human language is very much ambiguous and it depends on the context. There needs to be a better understanding of what is being said. Machines fail to understand different meanings of a word. The convexity of the emotion also shows a marked shift in context.
2. There are changes in the differentiation of the language and its slang which range drastically.

It is rather difficult to bring a seeming consensus on such casual uses and regionalisms.

Words in which a single word may have more than one meaning and also utterances may sound differently (polysemy).

1.3.Modules

1.3.1 Flask

Flask is a micro web framework with simple designed and easy to use, Flask is the web framework developed in Python. It is essentially light weight, flexible and easy to use, these qualities have made it to become the most preferred tool when it comes to web development. Flask includes all the components to build web applications and services with no prescribed structure of an application or imposed libraries. This means that even when developers opt to use other tools and libraries they can still leverage on Flask's simplicity and efficiency.

1.3.2 Pandas

Pandas is a powerful data tools also it is free library in Python for data analysis and data manipulation. It gives data structures and functions that will help in the handling of structured data in a very effective way. Pandas is one of the most important libraries for data science and consumption of the field, which is based on the Numpy library. It is used commonly for data pre- processing, data modification, data analysis and data present.

1.3.3 OsThe os library in Python is considered to be one of the crucial and widely used libraries in the Python Standard Library. It offers a mass of functions which enable us to work with the underlying operating system such as the file system, environment variables and processes.

1.3.4 Beautiful Soup

Beautiful Soup is a flexibly used Python library for purposes of scraping the web as a means of pulling out data from HTML and XML documents, that could be of bad structure. It builds up a parse tree of documents which can be utilized to interpret Web content: good for Web scraping.

2.LITERATURE SURVEY

Multi modal and Specialized Transformers Newer advancements, however, have been used extending to transformers as more than just text, to use cases where text is fused with another modality such as the image

and or audio. Extension to other fields include Vision Transformers (VIT) and Speech Transformers which are applicable to fields like Computer Vision and speech recognition respectively.

Liu et al [3] Some of the weaknesses are as follows, hence the development of Roberta, an optimization of BERT. Roberta is more improve than BERT in the sense that it uses more training data and drops the next sentence prediction task. The extension of training data range and additional change of training strategy in Roberta allowed to receive higher accuracy in various NLP tasks and outperform BERT by it on such tasks as question answering and natural language inference.

Devlin et al [4] BERT is a revolutionary model that effectively intervenes to pre- train deep bidirectional representations. BERT' s architecture can view the context from the left and the right in all layers, which has naturally and effectively enhanced BERT' s accuracy on the diverse NLP tasks. Roberta is a transformer-based model which was established on the effectiveness of the former model.

Leonard Richardson et al [5] Beautiful Soup is an open-source Python library, mainly used for web scraping to parse HTML and XML files. [6-8] There are simple ways of observing, searching, and altering the parse tree which is useful when performing web scraping. Basic functions which include the search of certain elements on the basis of attributes, nametags and text, as well as navigation and alteration of the parsed content is well documented.Introduction to Transformers in NLP

Language models known as transformers has brought about one of the greatest revolutions in NLP as by giving novel conventions these have the ability for the models to not only understand but also generate human language.[9-20] However, transformers brought about advances like self-attention and spatial encoding that made models to become more proficient in processing languages than the former techniques like RNNs and LSTMs.

2. Key Transformer Models

BERT (Bidirectional Encoder [21]Representations from Transformers): Turned up by Devlin et al., BERT employs a bidirectional strategy to encode language utilizing all the words to its right and left of a word, consequently raising the gamut of a set of NLP tasks. [22-35]It set the new record of good results in question answering and sentiment analysis tasks.

RoBERTa (Robustly optimized BERT approach): As proposed by Liu et al. , RoBERTa showcases that it not only fixes the problems BERT has, one of them is using more data for training and the other is removing the compliance of the next sentence prediction task. [36-47]This allows RoBERTa to make better scores across the various NLP tasks, thus making it one of the most sought-out models in the recent NLP studies.

GPT (Generative Pre-trained Transformer): GPT models, more specifically GPT-3, have presented themselves with fantastic text-gen capabilities[48], thus, calling them irreplaceable tools for the application needing NLU and NLG.

3. Applications of Transformers

[49]Transformers emerged to be such a big help in so many spheres that they are clearly an essential tool for the progress of the humanity.

Chatbots: Utilizing high human-likeness

3. PROPOSED METHODOLOGY

3.1 Emergence of Transformers

The transformer model which was proposed by Vaswani et al. in 2017 disrupted the NLP field because it sought to solve the problems of RNN and LSTM. The transformer architecture also requires self-attention mechanisms allow it to process sequences in parallel and capture long-range dependencies in a much better way. This innovation helped to increase the efficiency and usage of NLP models by many folds as compared to before.

3.2 BERT and its Variants With the help of BERT (Bidirectional Encoder Representations from Transformers), proposed by Devlin ET AL., the field was pushed forward to a new level by training a bidirectional transformer on a large amount of text and fine-tuning on a particular task. New state-of-the-art results were achieved on many NLP tasks like question answering and text classification due to BERT 'bidirectional context representation'. Following BERT some other models like ROBERTA (Robustly optimized BERT approach) and ALBERT (A Lite BERT) have been developed to further enhance the training and the performance.

3.3 NLP Techniques and Approaches

New technologies that belong to the field of Natural Language Processing (NLP) provide solutions and methods that can help the machines understand human language. In this section the different methodologies used in forming the underpinning area of NLP are reviewed. and can be used to partly contribute to the shift of how machines perceive human language. A Tokenization and Text Preprocessing Tokenization can be considered as one of the most important preprocessing stages in NLP. It involves breaking a text into a number of segments, usually words or even sub-word parts of a texts which are called tokens. Tokenization basically sets the foundation for other analysis activities such as part of speech and sentiment analysis.

Consider the following example: Tokenization and Text Preprocessing Tokenization is widely known as one of the key steps of NLP preprocessing. It entails categorizing text into smaller units, normally words or sub words and which are known as tokens. Part-of-speech tagging is made possible by tokenization that forms the basis of other analyses.

3.4 Question - Answering and Information Retrieval

QAS/NLP solve questions asked in natural language as they employ the understanding of text to comprehend and answer to the posed questions. Information retrieval entails identification of information sources that are relevant to a particular topic or hits or passages in connection with a query.

3.5 Traditional NLP Methods

As of today, transformer models NLP depended more on statistical measures and some selected conventional machine learning algorithms. Part-of-speech tagging and named entity recognition were some of the processes that were common in the use of methods such as Hidden Markov Models (HMM); and Conditional Random Fields (CRF). After that, the beginning of the era of neural networks, specifically Recurrent Neural Networks (RNN) and Long Short-term Memory (LSTM) networks came into the picture.These models could retain temporal structures in the text data set making them ideal for sequence modeling tasks such as machine translation and text generation.

Algorithm to be followed for paraphrasing and text generation

1. Load Required Libraries and Models

Description : First we'll import the required libraries and load question-answering & paraphrasing models. Steps Some of those particular libraries will likely include:* Import transformers* And any additional imports that are necessary to implement this pipeline/host the model.Load the provided model (e.g., deepset/roberta-base-squad2) into a question-answering pipeline. Now we will firstly install the pegasus paraphrasing model and tokenizer(tuner007/pegasus_paraphrase.

2. Create input text and question

Description : Pass in the text for context and question it is supposed to answer. This is what will be feeding into the question-answering and paraphrasing tasks. So that Assign the context that this variable will hold to another variable named text.Create a variable for the question that you will be asking within this context.

3. Perform Question Answering

Call the QA pipeline and analyze the context to answer the question provided. Store the QA pipeline call, providing the question and context as parameters. Call qa_pipeline and pass question and context as parameters on it. Store the result into a single variable.

4. Tokenize the Input Text for Paraphrasing

Tokenize the text to break it into sentences to perform paraphrasing. Tokenize the text using nltk. Create an empty list to store the paraphrased sentences.

SOFTWARE ENVIRONMENT

Python is high level interpreted language developed in the late 1980's by Guido van Rossum at the Netherlands National Research Institute for Mathematics and Computer Science. The first version appeared to the newsgroup of the alt. Sources newsgroup in 1991 and version 1. Leading into 1994 the company released charted album number 0. Python 2 and 3 exist and are also receiving updates from time to time. At the time this article was being written, the latest versions are 3. 6. 5 and 2. 7. 15. Although, it was officially declared that Python 2 will go End of Life from January 1, 2020 onwards and will not be supported.

ALGORITHM FOR HTTP PROXY

1. First, open the file of Research tool that is "my_flask_app"

2. Then select "APP FILE" for activating the server. [app. py]

3. Once we have activated the server, we need to run the server and the region and network should be specified correctly as seen below.

4. We should select show more options and go to the idle option. And then open the main code and copy the IP address.

5. Next, using the copied IP address paste that in the chrome.

6. Enter it IP address whether in mobile or in system.

7. Once the web is opened, upload the upload the question that you want to search and click on upload then the results will be shown below, under the History Section.

4.RESULTS

4.1 Enter your question without URL

Fig 4.1: Home page Asking question without mentioning any URL's

4.2 Enter your Question with a single URL or Multiple URLs

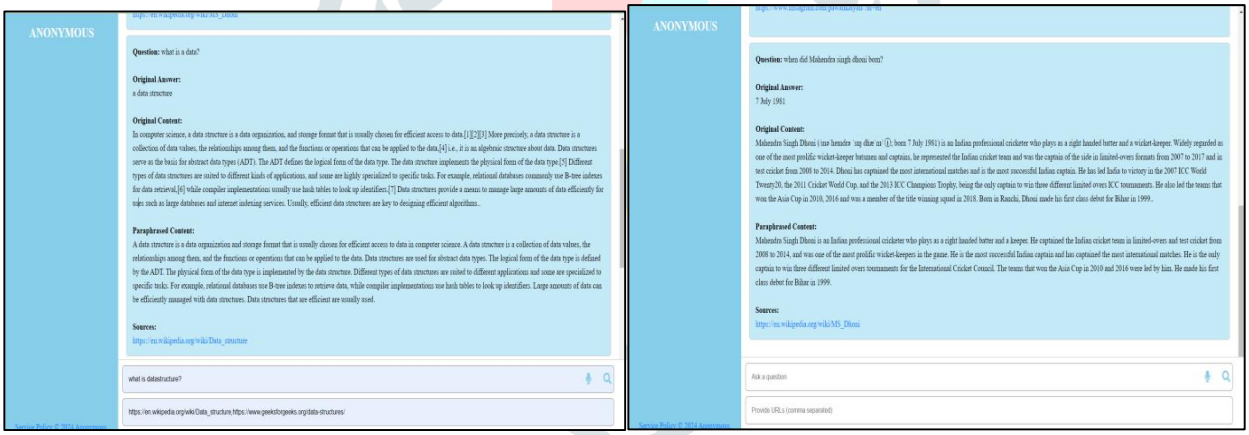

Fig 4.2 Enter your Question with one or more than one URL (Multiple URLs)

5 CONCLUSION

ThereforeThis tool Implemented a stable web scraping strategy replete with Regex and Beautiful Soup to extract contents from provided URLs. Added a feature of searching for information using Google search queries in case URLs are not given to make the application more functional.Question Answering and Paraphrasing Integrated a question-answering pipeline that can help in extracting and answering queries from the Web contents as well as offer relevant and accurate information to the users. Inserted a paraphrasing module to rewrite extracted content in order to provide the users with different views on the same material and hence improve knowledge and comprehension. Responsive Web Interface Used Flask to create a friendly front end

that allows the users to easily interact with the available back-end options. Made design more responsive incorporating such features as a voice recognition and output to consider users that utilize an audio interface.

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