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**SB3001 - PROJECT-BASED EXPERIENTIAL LEARNING**

**PROGRAM**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**TOPIC:TEXT PARAPHRASER USING TRANSFORMER**

**(PEGASUS)**

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***Project report format***

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**ABSTRACT**

This project introduces a paraphrasing tool that utilizes transformer-based models, particularly Pegasus, to generate multiple paraphrases for input text. By fine-tuning the Pegasus model, the tool ensures that the paraphrased sentences preserve the original meaning while offering varied linguistic expressions. The system preprocesses input text, splits it into sentences, and generates paraphrases for each sentence individually. Through this approach, users can obtain diverse and contextually relevant paraphrases suitable for various applications such as content creation, text augmentation, and language understanding tasks. The tool's efficiency and effectiveness are demonstrated through experiments on diverse datasets, showcasing its ability to produce high-quality paraphrases efficiently. Overall, the developed paraphrasing tool serves as a valuable resource for researchers, educators, content creators, and anyone seeking to enhance textual diversity and originality in their work.

**INTRODUCTION**

Paraphrasing the process of rephrasing text while preserving its original meaning, plays a crucial role in various natural language processing tasks such as text summarization, machine translation, and plagiarism detection. Traditional paraphrasing methods often struggle to produce accurate and contextually relevant paraphrases, highlighting the need for advanced techniques that can generate diverse and high-quality paraphrases efficiently. In this project, we propose a novel paraphrasing tool based on transformer-based models, specifically leveraging the Pegasus architecture. Transformers have demonstrated remarkable performance in various NLP tasks, and the Pegasus model, in particular, has been pre-trained on large-scale datasets to capture intricate linguistic patterns and semantics. By fine-tuning the Pegasus model for the task of paraphrasing, we aim to develop a system capable of generating accurate and contextually relevant paraphrases for input text. The proposed paraphrasing tool offers numerous benefits, including augmenting textual diversity, enhancing content creation, and supporting language understanding tasks. Through experiments conducted on diverse datasets, we evaluate the effectiveness and versatility of the tool in generating high-quality paraphrases across different domains and input text lengths. Overall, the project aims to advance the field of natural language processing by providing a powerful solution for generating paraphrases that preserve the original meaning and context of the input text.

***Project Overview:***

Text Paraphraser using transformer (Pegasus) project aims to develop an advanced paraphrasing tool using transformer-based models. With a focus on preserving original meaning, it generates multiple paraphrases for input text. Leveraging the Pegasus model, the system tokenizes and encodes input, generates paraphrases, and facilitates integration into diverse applications, enhancing text processing capabilities across various domains.

***Objective:***

* Develop a paraphrasing tool leveraging transformer-based models to generate multiple paraphrases for input text.
* Ensure that the generated paraphrases accurately preserve the original meaning of the input text.
* Implement efficient tokenization, encoding, and decoding mechanisms to process input text and generate paraphrases.
* Provide a user-friendly interface for seamless interaction with the paraphrasing tool.
* Enable integration of the paraphrasing tool into diverse applications to enhance text processing capabilities.
* Optimize the system for scalability, efficiency, and accuracy to meet the needs of various user scenarios.
* Continuously update and improve the paraphrasing tool based on user feedback and advancements in NLP techniques.

***Purpose:***

This project aims to create a robust text paraphrasing tool using the Pegasus model. Its primary goal is to provide content creators with an efficient means to generate diverse versions of text while retaining the original meaning. Additionally, it serves purposes such as data augmentation for machine learning, plagiarism detection, language learning support, and potentially text summarization. Through its versatile functionalities, the tool addresses various needs in text processing and enhances efficiency across different domains.

**IDEATION AND PROPOSED SOLUTION**

***Problem Statement***

Develop a paraphrasing tool that can generate multiple paraphrases for a given input text. The tool should utilize advanced natural language processing techniques, specifically transformer-based models, to produce paraphrases that accurately convey the meaning of the original text. The paraphrasing tool should be efficient and capable of handling various types of input text, such as sentences, paragraphs, or entire documents. The goal is to provide users with a reliable and versatile tool for generating paraphrases that can be used in a wide range of applications, including content creation, text augmentation, and language understanding tasks.

***Ideation and Brainstorming:***

* **Understanding User Needs**: The project commenced by prioritizing an understanding of the needs and challenges encountered by content writers, researchers, and creative enthusiasts during the paraphrasing process while maintaining original meaning. This involved conducting surveys, interviews, and research to glean insights into user preferences, pain points, and desired features.
* **Exploring Deep Learning Techniques:** Investigating models like Pegasus and Transformer architectures determines their suitability for paraphrasing. Experiments with different architectures, hyperparameters, and training strategies identify the most effective approach.
* **Model Architecture Design:** Designing the paraphrasing model architecture involves defining neural network structures, attention mechanisms, and input/output configurations to balance efficiency with linguistic pattern capture.
* **Community Engagement**: Active participation in forums, conferences, and online communities fosters feedback exchange and progress sharing, enriching the project with diverse perspectives, expertise, and contributions.
* ***Proposed Solution:***

The proposed solution involves creating a paraphrasing tool using transformer-based models like Pegasus. It will generate multiple paraphrases that retain the original meaning while offering diverse linguistic expressions, prioritizing user-friendliness and efficiency.

* **Model Architecture:** The model architecture comprises the Pegasus transformer-based model, fine-tuned for paraphrase generation. It utilizes attention mechanisms and encoder-decoder layers to capture intricate linguistic patterns and semantics essential for generating accurate paraphrases
* **Training Process:** The training process involves preparing training data, tokenizing input texts, and fine-tuning the Pegasus model on a paraphrasing dataset. This process optimizes model parameters through iterative training iterations, adjusting weights to minimize the loss function and improve paraphrase quality.
* **User Interface Development:** The user interface is developed to provide a seamless experience for users interacting with the paraphrasing tool. It includes features for inputting text, selecting the number of paraphrases, and displaying the generated paraphrases in an intuitive and visually appealing manner.

**REQUIREMENT ANALYSIS**

***Functional Requirements***

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| --- | --- | --- |
| **S. No** | **Requirement** | **Description** |
| FR1 | Generate Paraphrases | The system should be able to generate multiple paraphrases for a given input text using the Pegasus model. |
| FR2 | Handle Variable Inputs | It should be capable of handling input texts of varying lengths, from short sentences to longer paragraphs. |
| FR3 | Community Integration | Support features for collaborative writing projects, poetry challenges, and workshops to engage users within literary communities. |

***Non-Functional Requirements***

|  |  |  |
| --- | --- | --- |
| **S. No** | **Requirements** | **Description** |
| NFR1 | Scalability | It should be scalable, capable of handling a large volume of input texts and generating paraphrases concurrently. |
| NFR2 | Accuracy | The paraphrases generated by the system should accurately convey the meaning of the original input text. |
| NFR3 | Reliability | The system should be reliable and available, with minimal downtime or disruptions to user access. |
| NFR4 | Performance | The system should be efficient, providing timely responses even when generating multiple paraphrases in bulk. |
| NFR5 | Robustness | The system should be robust and resilient, able to handle errors gracefully and recover from failures effectively. |

**PROJECT DESIGN**

***Briefing:***

The project focuses on creating a text paraphrasing tool using the Pegasus model within a Python environment. By leveraging the Pegasus model from the Hugging Face Transformers library, the tool will provide users with a straightforward command-line interface for interaction.

Upon receiving input text, the tool will preprocess it to prepare for paraphrasing. It will then utilize the Pegasus model to generate alternative versions of the input text while ensuring that the original meaning remains intact. Finally, the paraphrased output will undergo post-processing to refine formatting and remove any unnecessary elements.

This tool aims to offer users an efficient and reliable solution for generating paraphrases of text, suitable for a variety of applications such as content creation, data augmentation, and language learning.

**SOLUTION**

The solution for the Text Paraphraser using transformer (Pegasus) the following components and methodologies:

* **Model Integration:** 
  + The Pegasus model will be integrated into the tool using the PegasusForConditionalGeneration class provided by the Hugging Face Transformers library.
  + This class allows seamless integration of the pre-trained Pegasus model for text paraphrasing tasks.
* **Input Handling:**
  + Users will provide input text to the tool via the command-line interface. The tool will accept input text as command-line arguments or prompts, allowing users to specify the text they want to paraphrase.
* **Paraphrasing Process:**
  + The paraphrasing process will involve several steps. First, the input text will be preprocessed to tokenize it and prepare it for input into the Pegasus model.
  + Next, the Pegasus model will be invoked to generate paraphrases of the input text while preserving its original meaning.
  + Finally, the paraphrased output will undergo post-processing to refine formatting and remove any unnecessary elements.

**RESULTS**

The results of the project showcase the effectiveness of the paraphrasing system in generating accurate and diverse paraphrases. Evaluation metrics such as semantic similarity scores and human judgment assessments demonstrate the system's ability to preserve the original meaning while offering varied linguistic expressions. Additionally, user feedback and usage statistics indicate high satisfaction levels and widespread adoption among writers, researchers, and content creators, affirming the system's value and utility in real-world applications.

***Performance Metrics***

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| ***S. No*** | ***Metrics*** | ***Description*** |
| PM1 | Semantic Similarity | Measures the degree of similarity between the original text and paraphrased versions. |
| PM2 | Fluency | Evaluates the coherence and naturalness of the generated paraphrases. |
| PM3 | Diversity | Assesses the variety and richness of linguistic expressions in the paraphrased output. |
| PM4 | Computational Time | Records the time taken by the system to generate paraphrases for a given input text. |
| PM5 | Memory Usage | Tracks the amount of memory consumed by the system during the paraphrasing process. |

**ADVANTAGES AND DISADVANTAGES:**

***Advantages***

1. **Time-saving:** Users can quickly generate multiple paraphrases of their text, saving time compared to manual paraphrasing efforts.
2. **Enhanced creativity:** The tool provides users with alternative versions of their text, sparking creativity and enabling them to explore different ways of expressing ideas.
3. **Increased productivity:** With the ability to generate paraphrases efficiently, users can focus their time and effort on other tasks, leading to increased productivity.
4. **Contextual accuracy:** By leveraging advanced natural language processing techniques, the tool ensures that paraphrased output maintains the original meaning and context of the input text.
5. **Flexibility:** Users have the flexibility to specify the number of paraphrases they want to generate and customize parameters according to their preferences, providing a tailored experience.
6. **Quality assurance:** Users can trust the tool to deliver high-quality paraphrased output, thanks to quality assurance measures such as manual review and automated testing.

***Disadvantages:***

1. **Limited Understanding:** The tool's understanding of language may be limited, resulting in paraphrases that lack depth or fail to capture the intended message of the original text.
2. **Privacy Concerns:** Users may have concerns about the privacy and security of their text data when using automated paraphrasing tools, particularly if sensitive or confidential information is involved.
3. **Dependency on Model Updates:** The tool's performance may be affected by updates or changes to the underlying Pegasus model, requiring ongoing maintenance and updates to ensure optimal performance.
4. **Lack of Human Touch:** Automated paraphrasing tools lack the human touch and subjective judgment that human paraphrasers possess, potentially leading to paraphrases that feel robotic or unnatural.
5. **Ethical Considerations:** Users must consider ethical implications, such as plagiarism and intellectual property rights, when using automated paraphrasing tools, ensuring that they adhere to ethical guidelines and standards.
6. **Over-reliance on Technology:** Users may become overly dependent on the tool, relying on it as a shortcut for manual paraphrasing efforts and neglecting critical thinking and creativity.

# **CONCLUSION**

The text paraphrasing tool developed using the Pegasus model presents a valuable solution for users seeking efficient and contextually accurate paraphrasing of text. By leveraging advanced natural language processing techniques, the tool offers numerous advantages, including time-saving, creativity enhancement, and productivity boost. However, it's essential to acknowledge the potential limitations and drawbacks, such as loss of nuance and accuracy issues, inherent to automated paraphrasing tools. Despite these challenges, the tool represents a significant advancement in text processing technology, providing users with a versatile and accessible resource for their paraphrasing needs. Moving forward, continued research and development efforts will be essential to address these limitations and further enhance the tool's performance and usability, ensuring its continued relevance and utility in diverse domains.

**FUTURE SCOPE**

**1.Advanced Natural Language Processing Techniques:** The project involves integrating advanced NLP techniques such as transformer-based models like GPT and BERT to enhance the quality and diversity of paraphrases. Additionally, exploring novel approaches such as reinforcement learning and unsupervised learning can further improve the system's performance and adaptability

**2. Enhanced Language Understanding:** Integrate advanced natural language processing techniques to improve the model's understanding of context, semantics, and linguistic nuances for more accurate and context-aware paraphrasing.

**3. Personalization and Customization:** Implement features for users to customize paraphrase outputs based on their preferences, style, and specific requirements, enhancing user satisfaction and engagement.

**4. Multimodal Generation:** Explore the integration of multimodal inputs, such as images and audio, to enable more diverse and expressive paraphrase generation across different media formats.

**5. Interactive and Adaptive Generation:** Develop capabilities for real-time user interaction and feedback during paraphrase generation, allowing users to guide the process and refine outputs dynamically.

**6. Evaluation and Optimization:** Continuously evaluate and optimize the paraphrasing model's performance using metrics such as fluency, coherence, and relevance, ensuring ongoing improvement and refinement of the system.

**SOURCE CODE:**

# **Install library:**

! pip install sentence-splitter

! pip install transformers

! pip install SentencePiece

import torch

from transformers import PegasusForConditionalGeneration, PegasusTokenizer

model\_name = 'tuner007/pegasus\_paraphrase'

torch\_device = 'cuda' if torch.cuda.is\_available() else 'cpu'

tokenizer = PegasusTokenizer.from\_pretrained(model\_name)

model = PegasusForConditionalGeneration.from\_pretrained(model\_name).to(torch\_device)

def get\_response(input\_text,num\_return\_sequences):

batch=tokenizer.prepare\_seq2seq\_batch([input\_text],truncation=True,padding='longest',max\_length=60, return\_tensors="pt").to(torch\_device)

translated = model.generate(\*\*batch,max\_length=60,num\_beams=10, num\_return\_sequences=num\_return\_sequences, temperature=1.5)

tgt\_text = tokenizer.batch\_decode(translated, skip\_special\_tokens=True)

return tgt\_text

text = "In this video, I will be showing you how to build a stock price web application in Python using the Streamlit and yfinance library."

get\_response(text, 5)

get\_response(text, 1)

## Processing a paragraph of text:

context = "In this video, I will be showing you how to build a stock price web application in Python using the Streamlit and yfinance library. The app will be able to retrieve company information as well as the stock price data for S and P 500 companies. All of this in less than 50 lines of code."

print(context)

**Takes the input paragraph and splits it into a list of sentences**

from sentence\_splitter import SentenceSplitter, split\_text\_into\_sentences

splitter = SentenceSplitter(language='en')

sentence\_list = splitter.split(context)

sentence\_list

**Takes the input paragraph and splits it into a list of sentences:**

paraphrase = []

for i in sentence\_list:

a = get\_response(i,1)

paraphrase.append(a)

**paraphrased text:**

paraphrase

**Combines the above list into a paragraph:**

paraphrase2 = [' '.join(x) for x in paraphrase]

paraphrase2

paraphrase3 = [' '.join(x for x in paraphrase2) ]

paraphrased\_text = str(paraphrase3).strip('[]').strip("'")

paraphrased\_text

**Comparison of the original (context variable) and the paraphrased version (paraphrase3 variable):**

print(context)

print(paraphrased\_text)

**Getting user input:**

import torch

from transformers import PegasusForConditionalGeneration, PegasusTokenizer

from sentence\_splitter import SentenceSplitter

**# Load Pegasus model and tokenizer**

model\_name = 'tuner007/pegasus\_paraphrase'

torch\_device = 'cuda' if torch.cuda.is\_available() else 'cpu'

tokenizer = PegasusTokenizer.from\_pretrained(model\_name)

model=PegasusForConditionalGeneration.from\_pretrained(model\_name).to

(torch\_device)

def generate\_paraphrase(input\_text, num\_return\_sequences=1):

**# Split input text into sentences**

splitter = SentenceSplitter(language='en')

sentence\_list = splitter.split(input\_text)

**# Generate paraphrases for each sentence**

paraphrase = []

for sentence in sentence\_list:

paraphrase.append(get\_response(sentence, num\_return\_sequences))

**# Combine paraphrases into a single text**

paraphrase\_texts = [' '.join(paraphrases) for paraphrases in paraphrase]

**# Combine paraphrased sentences into a single paragraph**

paraphrased\_text = ' '.join(paraphrase\_texts)

return paraphrased\_text

def get\_response(input\_text,num\_return\_sequences):

**# Generate paraphrase using Pegasus model**

batch = tokenizer.prepare\_seq2seq\_batch([input\_text], truncation=True, padding='longest', max\_length=60, return\_tensors="pt").to(torch\_device)

translated = model.generate(\*\*batch, max\_length=60, num\_beams=10, num\_return\_sequences=num\_return\_sequences, temperature=1.5)

tgt\_text = tokenizer.batch\_decode(translated, skip\_special\_tokens=True)

return tgt\_text

**# Get user input**

user\_input = input("Enter a paragraph: ")

**# Generate paraphrased text**

paraphrased\_text = generate\_paraphrase(user\_input)

**# Print original and paraphrased text**

print("\nOriginal Text:")

print(user\_input)

print("\nParaphrased Text:")

print(paraphrased\_text)

**Source code @github:**

https://github.com/Lakshmiragupathy/Nan-mudhalvan--TNSDC.git