

Improving Texts into Powerful Communication Tools with Classic Techniques and Deep Learning

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Abstract— Investing in transforming written content into powerful communication tools involves utilizing both classical techniques and advancements in deep learning. Classical methods offer a wealth of time-tested strategies, while deep learning technologies provide modern insights for crafting messages with more significant impact. Combining these approaches can significantly enhance the effectiveness and reach of any text. The intricacies of language and communication are explored through classical methodologies, while deep learning algorithms bring predictive capabilities and adaptability. Elevating texts into compelling communication instruments requires integrating traditional knowledge with modern technology, resulting in messages that captivate, persuade, and inspire across various platforms. The synergy between classical approaches and deep learning allows texts to transcend mere words, becoming dynamic tools of connection and influence in today's communication landscape. This article concludes with a summary of key findings and suggestions for future research.

Keywords-Textual Analysis, Machine Learning, Text Summarization.

I. INTRODUCTION

With the growing volume of online information, text summarization has become an essential field for distilling the key messages of textual content. Manual summarization of large documents is challenging, making automatic text summarization increasingly important. Text summarization refers to the process of automatically condensing a document into a shorter version while preserving its core meaning and content. It has become a significant area of research in Natural Language Processing (NLP), attracting considerable attention from researchers. There is a close relationship between text mining and summarization, and summarization systems must be tailored to the type of input text. This study explores the connection between text mining and summarization, reviews summarization approaches and key parameters for extracting relevant sentences and presents the main stages and criteria for summarization. Lastly, it highlights fundamental evaluation methods for assessing summarization quality [7].

Text summarization is summarizing text documents while preserving their context and overall content. A good summary

should highlight the fundamental concepts of any textual document. Text summarization is a fundamental area of Natural Language Processing (NLP), which uses various tools to extract relevant information from the given text [5].

Automatic text summarization is essential to Natural Language Processing (NLP), a subpart of the Artificial Intelligence domain. The widespread usage of text summarization is due to the massive use of the Internet in every aspect of life. In this research article, we perform a statistical text summarization technique.

Uniting classic methodologies with the revolutionary advances of deep learning opens the doors to communication with significant impact. The mix of traditional strategies and cutting-edge algorithms can be used to give each word power and meaning [2]. This holistic approach, which fuses the wisdom of the past with cutting-edge technology, is the foundation for creating messages that captivate, persuade, and inspire.

The rest of the paper is structured as follows. Section 2 compares two of the largest deep neural networks, the Gemini and ChatGPT 3.5 and 4.0. Section 3 discusses classical techniques and those based on deep neural networks. Section 4 contains concepts and fundamentals of summarization with deep learning and examples of applying the tools in two texts. Finally, Section 5 closes the work with a conclusion and addresses future work.

II. GEMINI AND CHATGPT 3.5 AND 4.0

Textual analysis has been a central focus of machine learning studies, as noted in [2]. It can be exemplified by platforms like Bard's Gemini Pro and ChatGPT's free version, which primarily differ in the data sources used during their training [3]. Gemini can process multiple data formats simultaneously, including text, code, audio, static images, and videos, allowing for a more comprehensive manipulation of diverse information types before generating feedback. Additionally, the accessible version of Gemini offers real-time Internet access.

In contrast, GPT-3.5, the public version of ChatGPT, is trained on a static dataset that has not been updated since 2021. A detailed comparison between Gemini and its competitors remains challenging, as Google has not yet fully

released Gemini's capabilities for public testing. Given that Gemini is still in development, its features are subject to change. However, according to tests published by Google, the Ultra version of Gemini surpassed OpenAI's ChatGPT-4 in various tasks, achieving a 90% success rate in a test involving 57 subjects, compared to 86.4% for ChatGPT-4. ChatGPT and Gemini are Large Language Models (LLMs) with remarkable capabilities, yet they differ significantly in focus, training data, and functionality.

The ability of these tools to emulate summarization highlights the potential of deep learning in handling large volumes of data and extracting relevant information efficiently. Gemini and ChatGPT utilize deep neural networks to identify patterns and relationships across different data sources, enabling them to generate concise and coherent summaries. These deep learning networks are trained to understand the meaning of words and the context in which they appear, making them powerful tools for performing summarizations with a high degree of accuracy and adaptability.

In short, deep learning offers significant advantages in summarization tasks due to its ability to capture context and nuances in language, making it more adaptable to diverse data formats and large volumes of information. Unlike classical techniques, which often rely on predefined rules and require manual feature engineering, deep learning models can automatically learn relevant features, streamlining the process. However, deep learning comes with its challenges. It demands substantial computational resources and training data, and its models are often less interpretable, functioning as "black boxes." Additionally, there is a risk of overfitting, where models may perform well on training data but need help with new inputs.

On the other hand, classical summarization techniques are generally more efficient, faster to implement, and easier to understand due to their more uncomplicated, rule-based nature. They also require fewer computational resources. However, these methods must be revised to handle complex linguistic contexts and be more scalable, particularly for large or diverse datasets. Ultimately, the choice between deep learning and classical techniques depends on the task's specific needs, balancing accuracy, efficiency, and resource availability. In the next section, more details will be provided.

Other Differences:

While typical sequence-to-sequence models with attention mechanisms have shown promising results in abstractive text summarization, they often need help with several things that could be improved. These include Out-Of-Vocabulary (OOV) issues, occasional repetition, and a tendency towards lower overall quality [6].

By applying these techniques, researchers and analysts can extract valuable information and insights from large volumes of text. Automatic text summarization is a rapidly expanding area in Artificial Intelligence, driven by the transformative power of Deep Learning. This innovative technique allows the generation of accurate and concise summaries of extensive

texts, capturing their key points and essential information autonomously.

A. What is Text Summarization with Deep Learning?

Text summarization using deep learning surpasses traditional rule-based and heuristic approaches, which typically yield shallow, context-insensitive summaries. By leveraging machine learning, deep learning architectures such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) are trained on extensive textual datasets, enabling them to capture complex relationships between words, sentences, and paragraphs. This advanced linguistic comprehension allows these models to generate summaries that are not only more informative and coherent, but also more faithful to the original meaning of the text.

B. How Summarization Works with Deep Learning?

The summarization process using deep learning consists of several essential and structured steps that ensure the generation of accurate and coherent summaries. First, in preprocessing, the input text is cleaned to remove noise such as punctuation, special characters, and unnecessary formatting, followed by tokenization into individual words or sub-words for subsequent analysis. In the encoding phase, these tokenized words are transformed into numerical representations using techniques like word embeddings (for example, Word2Vec, GloVe) or contextual embeddings (for example, BERT, GPT), enabling the model to process the text computationally. Next, during modeling, the deep learning model—trained on large corpora of text and their corresponding summaries—processes the encoded sequence, identifying the most relevant sentences, phrases, or paragraphs by learning patterns and relationships within the data. Finally, in the decoding phase, the selected numerical representations are converted back into text, forming the final summary. Depending on the approach, this step can involve extractive summarization, where key sentences are retained verbatim, or abstractive summarization, where the model generates new sentences that capture the meaning of the original content.

C. Advantages of Summarization with Deep Learning

Accuracy: Deep learning models produce highly precise and informative summaries, capturing the essential elements of the source text with exceptional fidelity.

Relevance: These models can select the most contextually pertinent information, aligning with the specific goals and purpose of the summarization task.

Cohesion: Summaries generated by deep learning exhibit a high degree of linguistic cohesion and grammatical correctness, ensuring fluidity and readability.

Flexibility: The adaptability of deep learning allows for the generation of summaries in various lengths and styles, tailored to the specific needs of users or applications.

Efficiency: The automation of the summarization process via deep learning models significantly reduces manual effort and time, enhancing overall operational efficiency.

D. Core Concepts and Applications of Summarization with Deep Learning

Text summarization powered by deep learning has broad applicability across numerous fields:

News and Media: Enables the rapid generation of concise and informative summaries of news articles, reports, and media content.

Academic Research: Assists in synthesizing literature reviews by identifying key articles and producing comprehensive research summaries.

Legal Documents: Facilitates the creation of accurate and concise summaries of complex legal texts, such as contracts, regulations, and case laws.

Customer Service: Automates the summarization of support tickets, FAQs, and other service-related documents to enhance customer interaction efficiency.

Education: Supports the development of personalized learning materials, including book summaries, study guides, and educational articles, promoting more efficient knowledge dissemination.

III. RESULTS

Two texts will be used to instantiate the application of a classical and machine learning technique.

A. Text 1 - Robotics is the Science

“Robotics is the science that studies the technologies associated with the design and construction of robots. Robots are automatic mechanisms that use integrated circuits to perform simple or complex human activities and movements. Robotics has wide application in several areas, from industrial production, medicine to domestic activities. The concept of robotics emerged at the beginning of the 20th century, in the work “The Liar” by science fiction author Isaac Asimov. It was the author who created the word ‘robotics’ and it was also he who presented, in the field of science fiction, the Laws of Robotics.”

Text summarization by frequency, order, and context of words in the text will be performed.

Textual Analysis

Robotics: 4 mentions (title, 1st sentence, 2nd sentence, last sentence) - Keyword that defines the main theme of the text.

Science: 1 mention (1st sentence) - Describes the nature of robotics as a field of study.

Technologies: 1 mention (1st sentence) - Covers the tools and knowledge used in robotics.

Conception: 1 mention (1st sentence) - Refers to the robot creation and planning stage.

Construction: 1 mention (1st sentence) - Indicates the manufacturing and assembly phase of the robots. **Robots:** 3 mentions (1st sentence, 2nd sentence, last sentence) - Central term of the text, defines the autonomous machines in question.

Mechanisms: 1 mention (2nd sentence) - Emphasizes the physical and functional nature of robots. **Automatics:** 1 mention (2nd sentence) - Highlights the ability of robots to operate without constant manual intervention.

Integrated circuits: 1 mention (2nd sentence) - Mentions the electronic components that allow the control of robots.

Activities: 1 mention (2nd sentence) - Covers the tasks that robots can perform.

Movements: 1 mention (2nd sentence) - Refers to the physical actions performed by the robots.

Humans: 1 mention (2nd sentence) - Establishes a comparison between the capabilities of robots and humans

Application: 1 mention (3rd sentence) - Indicates the practical use of robotics in various sectors.

Areas: 1 mention (3rd sentence) - Expands the scope of application of robotics, from industry to the home.

Industrial production: 1 mention (3rd sentence) - Exemplifies the application of robotics in manufacturing.

Medicine: 1 mention (3rd sentence) - Highlights the use of robotics in medical procedures.

Domestic activity: 1 mention (3rd sentence) - Indicates the presence of robotics in the residential environment.

Concept: 1 mention (4th sentence) - Refers to the idea of robotics as a field of study. **Early 20th century:** 1 mention (4th sentence) - Places the origin of the concept in time.

Work: 1 mention (4th sentence) - Indicates a specific work that addressed the topic.

"The Liar": 1 mention (4th sentence) - Title of the work that explored the concept of robotics. **Isaac Asimov:** 1 mention (4th sentence) - Name of the author who contributed to the development of the concept.

Author: 1 mention (5th sentence) - Returns to the figure of Isaac Asimov as responsible for something. **Word:** 1 mention (5th sentence) - Indicates the term "robotics" as Asimov's creation.

Laws of Robotics: 1 mention (5th sentence) - Highlights a set of principles related to robotics, devised by Asimov.

With this classic technique, the text would look like:

"Robotics, the science of technologies for designing and building robots, has wide applications in industrial, medical, and domestic activities. The concept emerged in the 20th century in the work "The Liar" by Isaac Asimov, author of science fiction, who also introduced the Laws of Robotics."

Resume by deep learning 1 Microsoft (ChatGPT 3.5 free):

"Robotics studies technologies to create robots, automatic mechanisms that perform human tasks. It has applications in production, medicine, and domestic activities. The concept emerged at the beginning of the 20th century in work "The Liar" by Isaac Asimov, the author who also created the word "robotics" and the Laws of Robotics in science fiction".

Resume by deep learning 2 (Gemini free - Google):

“Uncovering the World of Robotics: Robotics presents itself as a fascinating science that explores the creation and development of autonomous machines capable of performing everything from simple tasks to complex movements that imitate humans. These mechanisms come to life through integrated circuits and become valuable tools in several areas”.

Resume by deep learning 3 Microsoft (ChatGPT4):

“Robotics is the study of technologies for designing and building robots, automatic mechanisms that employ integrated circuits to perform everything from simple tasks to complex movements without direct human intervention. With extensive applications in sectors such as industrial production, medicine, and domestic tasks, robotics is a discipline that emerged at the beginning of the 20th century, as highlighted by the work "The Liar" by Isaac Asimov, a pioneer of science fiction.”

B. Text 2: The Myth of the Cave “Inspirational text” (Plato)

The myth tells about prisoners (since birth) who live trapped in chains in a cave and who spend all their time looking at the back wall, which is illuminated by the light generated by a fire. Shadows of statues representing people, animals, plants, and objects are projected onto this wall, showing everyday scenes and situations. The prisoners keep giving names to the images (shadows), analysing and judging the situations. Let us imagine that one of the prisoners was forced to escape his chains to explore the cave and the outside world [4]. He would get in touch with reality and realize that he spent his entire life analysing and judging only images projected by statues. When leaving the cave and meeting the real world, he would be enchanted by real beings, nature, animals, etc. He would return to the cave to pass on all the knowledge acquired outside the cave to his colleagues who were still trapped. However, he would be ridiculed when he told everything he saw and felt, as his colleagues can only believe in the reality they see on the illuminated wall of the cave. The prisoners will call him crazy, threatening him with death if he does not stop talking about those ideas considered absurd.

Prisoners in the cave since birth, chained and limited to the perception of shadows on the wall (symbolizes ignorance and limitation of sensory knowledge). Awakening and Search for Truth: A freed prisoner explores the cave and the outside world, discovering actual reality (represents the search for knowledge and philosophy). The prisoner returns to the cave to share his knowledge but is ridiculed and misunderstood by the other prisoners (evidence resistance to change and attachment to preconceived beliefs). The myth serves as a metaphor for the human condition, trapped in one's own

beliefs and perceptions limited, with the search for truth being an arduous and often lonely challenge.

*Textual Analysis**Frequent Words:*

Cave (4x): Place where prisoners are imprisoned.
 Prisoners (3x): People who live chained in the cave.
 Shadows (3x): Images projected on the cave wall.
 Reality (2x): True world outside the cave. Truth (2x): Real knowledge of the world.
 Ignorance (2x): Lack of knowledge of the truth.
 Light (2x): Source of lighting for the cave and the outside world.
 World (2x): Refers to both the cave and the outside.
 Belief (2x): Conviction based on limited perceptions.
 Freedom (1x): Possibility of escaping the cave and knowing the truth.
 Knowledge (1x): Acquisition of information and understanding of reality. Plato proposes that most people live like prisoners, trapped in their limited beliefs and perceptions, without access to the truth.

With this classic technique, the text would look like:

“The myth of the cave is a metaphor for the human condition. Plato proposes that most people live like prisoners, trapped in their limited beliefs and perceptions, without access to the truth. The search for knowledge and freedom from ignorance requires effort and overcoming internal and external resistance.”

Resume with deep learning 2 (Google):

“Prisoners in the cave since birth, chained and limited to the perception of shadows on the wall (symbolizes ignorance and limitation of sensory knowledge). A freed prisoner explores the cave and the outside world, discovering actual reality (represents the search for knowledge and philosophy). The prisoner returns to the cave to share his knowledge but is ridiculed and misunderstood by the other prisoners (evidence resistance to change and attachment to preconceived beliefs). The myth serves as a metaphor for the human condition, trapped in our limited beliefs and perceptions, with the search for truth being an arduous and often lonely challenge”.

Resume by deep learning 3 (ChatGPT4):

“Plato's myth of the cave describes prisoners chained from birth in a cave, where they see only shadows cast on the wall lit by a fire. When a prisoner is forced out of the cave and discovers the actual reality outside it, he returns to share his knowledge but is ridiculed by the other prisoners who only believe in the shadow reality. This myth metaphorizes the human condition of being trapped in limited perceptions and

established beliefs, highlighting the search for truth as a lonely and often misunderstood challenge.”

IV. POSSIBLE METRICS FOR QUALITY ANALYSIS TEXT SUMMARIZATION

Several potential metrics can be used to evaluate the quality of text summarization [7], particularly in deep learning contexts [8]:

- ROUGE (Recall-Oriented Understudy for Gisting Evaluation): ROUGE measures the overlap between the generated summary and reference summaries regarding n-grams, word sequences, or word pairs. ROUGE-N, ROUGE-L, and ROUGE-S are commonly used to assess recall, precision, and F1-score, making it a standard metric for summarization accuracy.

- BLEU (Bilingual Evaluation Understudy): While initially developed for machine translation, BLEU is sometimes used to evaluate summarization by comparing n-gram overlap between the generated summary and reference text. It focuses on precision, making it useful for measuring how much of the generated summary covers the reference text.

- METEOR (Metric for Evaluation of Translation with Explicit Ordering): METEOR extends BLEU by incorporating stemming and synonym matching, improving its ability to capture semantic equivalence. It helps evaluate the semantic accuracy of summaries.

- Content Overlap: This metric assesses how well the summary captures the essential content of the original text. It can involve manual or automated comparison of critical ideas, entities, or facts mentioned in the original and the summary.

- Compression Ratio: This evaluates the efficiency of summarization by measuring the summary length relative to the original text. A good compression ratio balances brevity with informativeness, ensuring key points are retained without unnecessary verbosity.

- Coherence and Fluency: These subjective metrics assess how logically connected the sentences in the summary are and how natural the language sounds. Human evaluators often rate summaries based on linguistic cohesion and overall readability.

- Semantic Similarity: Using vector-based methods such as cosine similarity, this metric evaluates how semantically similar the generated summary is to the original text, ensuring that the key meaning is preserved even if the wording differs.

- Human Evaluation: Human judgment remains an important metric, particularly for assessing aspects like relevance, coherence, and informativeness that automated metrics may miss. It provides insights into the subjective quality of the summary from an end-user perspective.

Combining all the above metrics can comprehensively evaluate summarization quality, balancing quantitative measures with subjective assessments.

V. CONCLUSION

Text interpretation is subjective, and summarization adds complexity. Studies comparing traditional textual analysis to

machine learning demonstrate potential, especially when integrating advanced visual techniques with conventional methods. According to metrics, and despite challenges like large datasets and model complexity, the future of deep learning-based text summarization is promising, driven by innovations such as Google's Gemini, which shows improvements in accuracy in its free version. However, when comparing paid versions, ChatGPT has demonstrated superior performance. Continued advancements in algorithms will enhance the adaptability and efficiency of these systems, impacting sectors like education, healthcare, finance, and media. Future research should focus on hybrid models that combine the strengths of various techniques and on incorporating real-time processing and deeper contextual understanding. Additionally, developing quantitative metrics will improve the precision, reliability, and reproducibility of evaluations, fostering better comparisons across studies and revealing patterns overlooked by interpretive analysis alone. This approach will contribute to a more comprehensive understanding of the field.

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