Interactive ChatBot for PDF Content Conversation Using an LLM Language Model

LLM-Based PDF ChatBot

Ting Tin Tin[1*], Seow Yu Xuan[2], Wong Man Ee[3], Lee Kuok Tiung[4]*, Ali Aitizaz[5]
Faculty of Data Science and Information Technology, INTI International University, Negeri Sembilan, Malaysia[1]
Faculty of Computing and Information Technology, Tunku Abdul Rahman University of Management and Technology, Kuala Lumpur, Malaysia[2, 3]
Faculty of Social Science and Humanities, Universiti Malaysia Sabah, Sabah, Malaysia[4]
School of Technology, Asia Pacific University, Kuala Lumpur, Malaysia[5]

***Abstract*—Natural Language Processing (NLP) leverages Artificial Intelligence (AI) to enable computer programs to understand and generate human language. ChatGPT has recently become popular in assignment accomplishment. This project aims to develop and improve an interactive PDF chat application using OpenAI's language model (LLM), specifically GPT-3.5, integrated with Streamlit and LangChain frameworks to assist in learning process. The application enhances user interaction with documents by providing real-time text extraction, summarization, translation, and user-defined question-answering to increase learning opportunities. Key features include obtaining document summaries, multilingual support for improved accessibility, and a document preview section with features such as zoom, rotation, and download. Although it currently faces limitations in handling image-rich PDFs, future enhancements include better image rendering, conversation history, and query download features. Overall, this interactive chatbot model aims to streamline document interaction, making information retrieval efficient and user-friendly.**

***Keywords*—Natural language processing; learning opportunities; ChatGPT; PDF**

I. Introduction

Natural language processing (NLP) is a study that implements artificial intelligence (AI) technology to enable computer programs to understand human language. NLP consists of two categories: natural language understanding (NLU), which refers to the process of reading and interpreting natural language, and natural language generation (NLG), which refers to the process of writing and generating natural language. With these two categories, NLP integrates deep learning models, machine learning, and computational linguistics to process human language. Before processing natural language, texts are preprocessed to clean and prepare data for classification. As texts are found to contain noise and uninformative pieces, text preprocessing plays an essential role before NLP to prevent interference in text analysis. Common text-preprocessing techniques are tokenization, normalization with stemming, lemmatization, and stop-word removal, and noise removal.

As technology advances, NLP has gained widespread adoption in many applications, including speech recognition (speech-to-text), which is the conversion of speech into text data, and sentiment analysis, which refers to the act of computationally recognizing and classifying viewpoints stated in a text, particularly to ascertain the writer's stance (positive, negative, or neutral) about a certain subject. ChatGPT is widely used especially among students with efficiency in completing assignments yet challenging in plagiarism and integrity [1], [2]. ChatGPT also provides assistants to educators in preparing course materials and exercises [3] Besides education, ChatGPT also provides various opportunities such as research, entertainment, code generation, explanation, and comments, test cases, regular expression, documentation generation, code correction, merging, conversion, and styling, metaverse learning environment [2], [4], [5].

In this project, the OpenAI language model (LLM) is used in creating an interactive chat application for conversations with documents analysis. The application consists of functionalities to extract text, answer user-defined questions, provide translation, and preview documents. We wish to achieve real-time clarification and explanation from the interactive document bot. It will act as a real-time support system where users can ask for instant clarifications or explanations for any issue they come across inside the text. This function speeds up learning or understanding by providing prompt answers to users' questions and removing the need for them to look for additional sources of information. Instant answers customized for each user's questions allow them to continue interacting with the material and ensure full comprehension of the uploaded document.

The proposed project is to develop an interactive PDF chat program with the following features: text extraction, text translation, user-defined prompt question answering, and document viewing. Users will be able to upload document files, start a discussion, ask questions regarding the document, and get answers in real-time through the program. When the file is uploaded and read, a preview of it will be displayed for the user's reference. The material can be summarized, extracted, and translated. A feature that distinguishes our application from the existing market is that it facilitates multilingual response, ensuring that it can deliver information in a different language from the one in which it was asked. This feature improves

*Corresponding Author.

The article is sponsored by INTI International University publication fund.

accessibility and comprehension by allowing users to receive replies in the language of their choice. The project will be constructed using Python, Streamlit, and OpenAI API, allowing users to access numerous document-related features and engage in conversational interactions with documents. By offering a fluid and engaging chat-based interface for document exploration and information retrieval, the program seeks to improve the user's experience when dealing with documents.

This study is constructed in the following sections. Section II presents and compares existing algorithms in NLP and LLM. This is followed by methodology design including system design in Section III. The system implementation with screenshots is presented in Section IV. Section V discusses the system features. Lastly, Section VI concludes the study with limitation and future works.

II. Literature Review

A. Background of NLP and LLM

Rapid improvement of technology, notably in natural language processing (NLP) and the development of sophisticated language models (LLMs), has created opportunities to revolutionize how people interact with textual content. Traditional document approaches, such as direct download of the PDF and reading it solely, often involve static reading, which requires external references for clarity or understanding. Furthermore, this study discusses the need for a more dynamic and user-centric approach by developing an interactive chat application that takes advantage of the capabilities of a language model, notably OpenAI's LLM.

The language model (LLM) that is implemented in our system is OpenAI. Based on research on OpenAI's LLMs, such as GPT-3 and ChatGPT, this LLM highly demonstrates its powerful abilities in natural language understanding (NLU), question answering, text summarization, and natural language generation (NLG). This empowers them to provide explanations and clear clarifications based on user-specific questions about their questions [6], [7].

Our application is to have a chatbot with an LLM basis that can help users inquire about PDF documents more conveniently. Research projects such as Chatbot as Language Learning Medium: An inquiry and an overview of Chatbot Technology show that interactive chat interfaces for exploring information within PDFs are achievable. These kinds of studies emphasize the importance of getting input on what the user wants to gain, the strategy of information retrieval from the user, and LLM response generation techniques for more effective conversational interaction.

Without the existence of artificial intelligence, understanding and extracting meaningful information from portable document format (PDF) files can be challenging due to its differences in layout, text-embedding formats, and the option of having scanned documents. Therefore, there are several studies published recently that aim to explore techniques for text pre-processing, optical character recognition (OCR), and information retrieval algorithms from multiple PDF formats. These studies are paving the way for a more accurate and precise information extraction for LLM interaction.

B. Comparison of LLM

According to the Table I comparison, the GPT 3.5 and Claude LLM models are the LLMs that are more suitable for chat with PDFs [8], [9]. As for GPT 3.5, it is highly adaptable and may be used for almost any task. It is reasonably priced. In addition, application in personal and professional tasks has already begun and is rapidly expanding. Alternatively, this Claude LLM model can be used when the user's prompts are in high volume, and the user wants to deliver the chat messages or prompts without utilizing workarounds. The prompt size offered is 100k tokens, which can fully accommodate roughly 75k words in a single prompt.

TABLE I. Comparison of Different Language Models Based on the Specifications, Pros and Cons

Model	GPT-3.5	Google PaLM [10]	Claude v1 [11]	Microsoft T5 [12]
Parameters	175 Billion	540 Billion	Unknown	11 Billion
API Availability	Yes	Yes	Yes	Pending
MMLU	70	-	75.6	47.7
MT-Bench Score	7.94	6.4	7.9	3.04
Tasks It Excels	Summarization Question Answering Text Generation	Summarization Question-Answering Text Generation Code Generation	Language-specific tasks	Custom Fine Tunes Translation Text Classification
Pros	Performs fairly well for a wide range of tasks. Custom fine-tunings are easy to create commercial use permitted	Performs very well for a wide range of tasks Code Generation Capabilities Easy API Integration Commercial use permitted	Largest token window support in one message (100k tokens, 75k words, approximately) Performs fairly well for wide range of tasks	Allows both supervised and unsupervised fine-tuning. Multiple models available based on use case
Cons	Biases in Output Generation moderately expensive	Risk of biased or inappropriate outputs	Fails to generate very human-like responses	Commercial use not permitted. Getting access is cumbersome

*Massive Multitask Language Understanding (MMLU) helps to evaluate the distortion between original and synthesized signal where it helps to qualify the performance and quality of synthesis systems.

*MT-bench score refers to the performance measure that reflects a model's ability to generate accurate and high-quality translations.

*In order to test out the LLMs above, https://poe.com/ (Poe) is able to provide a similar interface to the ChatGPT and in this website we are able to chat with different LLMs.

Based on the comparison of different LLMs above, we decided to integrate a GPT 3.5 (OpenAI) API as the language model in our PDF Chat model. This is due to the fact that GPT-3.5 can perform excellent data extraction from documents. It is good for text summarization, question answering, and text generation. Therefore, it is the perfect language model to use for a chatbot that is mainly a function for PDF summarisation. To further elaborate, when a user creates a query, the response given is perfectly structured information that has extracted the required text that the user queries from the PDF document. In addition, another advantage of GPT 3.5 is that it has a high level of customization, and therefore, the execution of complex workflows is available in our model. In summary, we decided to use GPT 3.5 to develop our interactive chatbot model that improves the user experience within PDFs. This study aims to increase the comprehension, accessibility and information for a wide range of users by combining real-time clarification, context-aware explanations, and NLP features such as translation and information extraction.

III. Methodology

A. *Application of Algorithms / Libraries*

1) Streamlit: Streamlit is an open-source Python library that allows for the creation of graphic user interfaces for data science and machine learning projects. Given that little code is required, it is best for those who lack the front-end skills necessary to integrate their code into a web application. Although no front-end knowledge such as HTML, CSS and JavaScript is needed, Streamlit enables the integration to allow design flexibility of the application. However, there are not many choices available in Streamlit to customize the look and feel of the application. If a great level of application customization is required, it is recommended to use more versatile web frameworks [13], [14].

2) LangChain: LangChain is an open-source framework dedicated to developing applications with language models (LLM). These models are deep learning architectures trained on large datasets, equipped to answer user inquiries and create graphics in response to text-based prompts. A collection of tools and abstractions offered by LangChain are available to enhance the adaptability, accuracy, and relevance of the data produced by these models. The core component of LangChain is the LLM interface, which gives developers access to APIs in which they can connect to and query LLMs from their code [15].

3) OpenAI API: An application programming interface (API) is a mechanism that provides a set of specifications and protocols by which two software components can interact with one another. This agreement outlines the requests and replies used in communication between the client and the server. With the OpenAI API key, users can access a range of powerful AI models and resources offered by OpenAI. The functions include natural language processing (NLP), text generation, and language translation.

B. *System Flow Chart*

Fig. 1 shows the flow of the PDF chatbot operation design. The figure illustrates the process of how our ChatApp interacts with PDF documents to provide responses. This system begins with the user uploading any number of documents that are then read and split into chunks of text. Each chunk of text is converted into embeddings, which are vector representations that capture the semantic meaning of the text. The knowledge base consists of these embeddings, which are kept in a vector store. In addition, a user's question is transformed into an embedding and compared via a semantic search with the stored embeddings. A large language model (LLM) ranks and processes the pertinent fragments that the search pulls from the knowledge base to produce the final response, which is then sent back to the user.

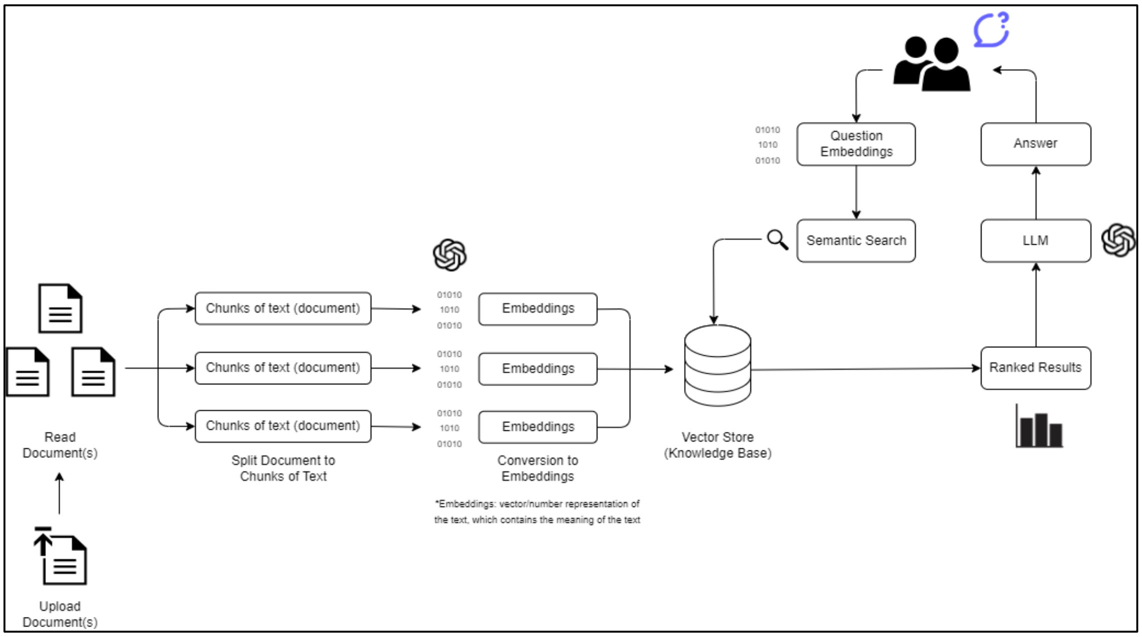

01010
1010
01010
Question Embeddings
Answer
Semantic Search
LLM
Chunks of text (document)
Chunks of text (document)
Chunks of text (document)
01010
1010
01010
Embeddings
Embeddings
Embeddings
Ranked Results
Read Document(s)
Split Document to Chunks of Text
Conversion to Embeddings
Vector Store (Knowledge Base)
*Embeddings: vector/number representation of the text, which contains the meaning of the text
Upload Document(s)

Fig. 1. PDF chatbot operation design.

IV. Results and Discussion

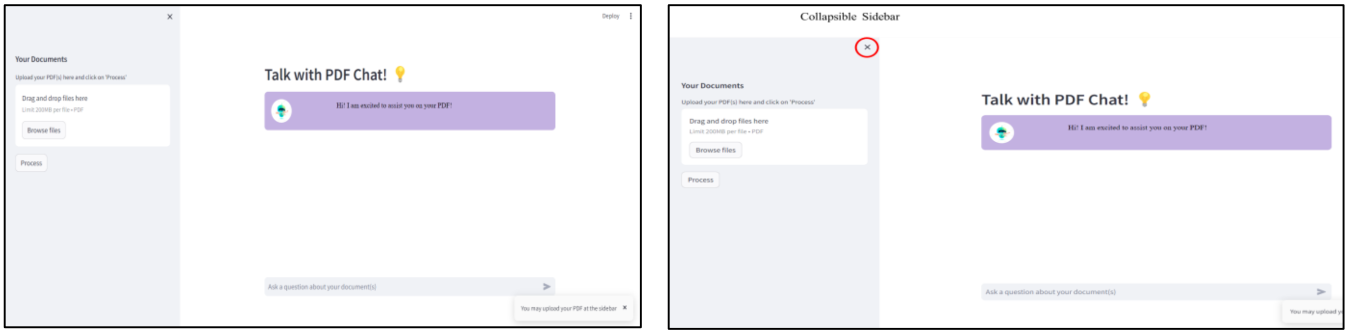
Fig. 2 illustrates the graphic user interface (GUI) when the application is first launched. On the left of the page is the file browser, where files can be uploaded and previewed; the right, the conversation with the PDF chatbot happens. A collapsible sidebar is equipped for file upload. When the cross (x) in the upper right corner is clicked, the section will collapse. When clicking the arrow (>) on the upper left corner of the page, the sidebar expands.

In Fig. 3, a file browser is provided in the sidebar for the user to upload PDF documents. The “Browse File” button turns red when it is clicked and a file window will pop up for the user to select the desired file(s). Once the document is uploaded, a throbber will appear with the text “Processing” after the “Process” button is selected. Lastly, a “PDF Upload Completed” message will appear upon successful upload. Fig. 4 illustrates the document preview section. There are additional features regarding the document, including the page count, zoom-in and zoom out, rotation of the page, downloading, and printing of the document, along with the document settings.

Fig. 5 shows a series of conversations initiated. The details are as follows:

1) A greeting to the bot
2) A general question about the document
3) A question that is not related to the document
4) A detailed question about the document

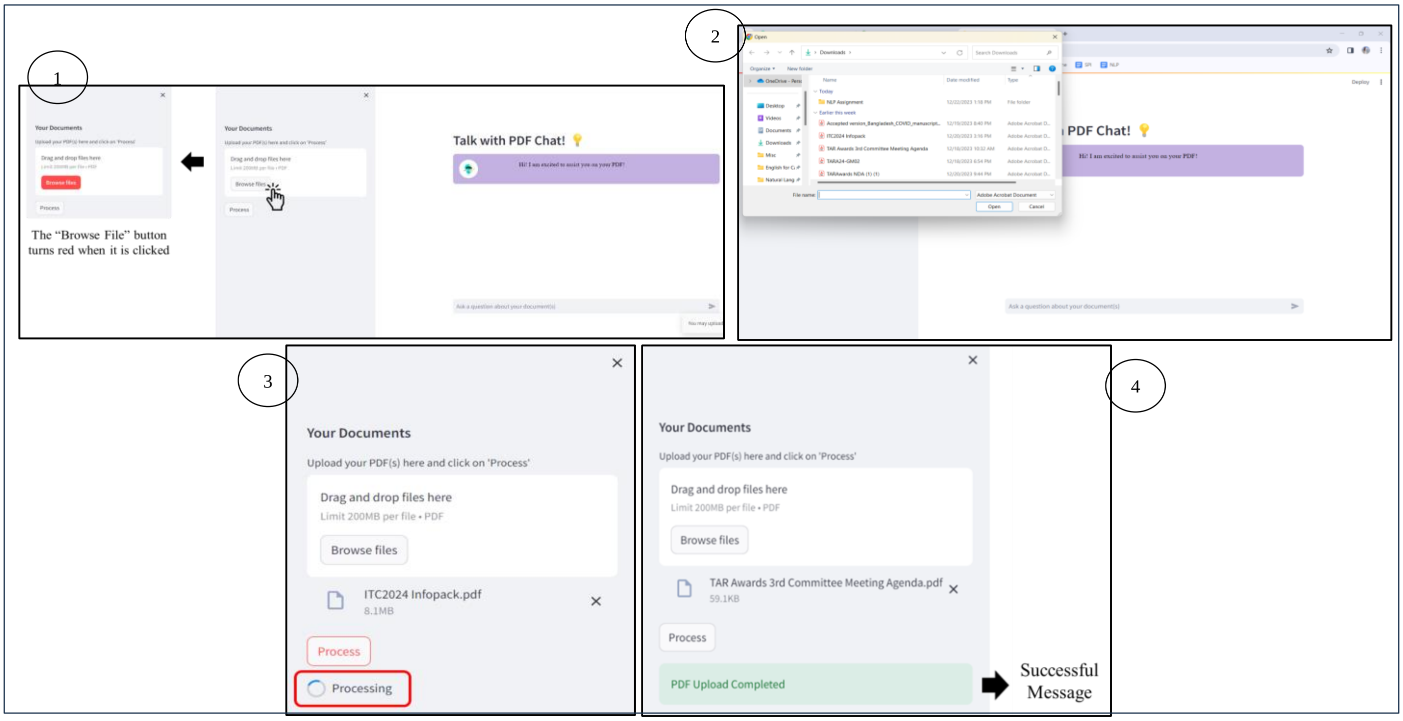
Fig. 6 shows the PDF Chatbot function that receives and responds to questions in different languages. The screenshot includes languages of English, Chinese, and Malay. Fig. 7 shows the extraction of text, in which the questions prompted are about a particular chapter of the document. In addition, the question requested the answer in a particular language (Chinese and Korean in the example), which the PDF Chatbot provided accurate answers. In addition to that, PDF Chatbot allows the upload and preview of more than one document. Fig. 8 shows the PDF chatbot function of answering questions about two documents.


Collapsible Sidebar
Your Documents
Upload your PDF(s) here and click on 'Process'
Drag and drop files here
Limit 200MB per file • PDF
Browse files
Process
Deploy
Talk with PDF Chat! 💡
Ask a question about your document(s)

Hi! I am excited to assist you on your PDF!

You may upload your PDF at the sidebar

Fig. 2. Graphic user interface of the PDF chatbot with collapsible sidebar.



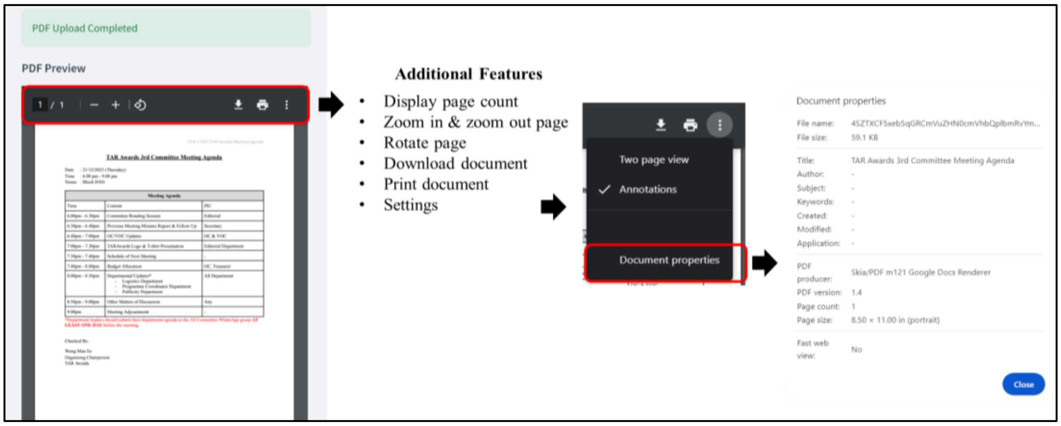
Hi! I am excited to assist you on your PDF!

PDF Upload Completed

The “Browse File” button turns red when it is clicked

Successful Message

Fig. 3. PDF document processing.



TAR UMT/TAR Awards/Meeting Agenda

TAR Awards 3rd Committee Meeting Agenda

Date : 21/12/2023 (Thursday)
Time : 6.00 pm - 9.00 pm
Venue : Block H301

Meeting Agenda		
Time	Content	PIC
6.00pm - 6.30pm	Committee Bonding Session	Editorial
6.30pm - 6.40pm	Previous Meeting Minutes Report & Follow Up	Secretary
6.40pm - 7.00pm	OC/VOC Updates	OC & VOC
7.00pm - 7.30pm	TARAwards Logo & T-shirt Presentation	Editorial Department
7.30pm - 7.40pm	Schedule of Next Meeting	-
7.40pm - 8.00pm	Budget Allocation	OC, Treasurer
8.00pm - 8.30pm	Departmental Updates* - Logistics Department - Programme Coordinator Department - Publicity Department	All Department
8.30pm - 9.00pm	Other Matters of Discussion	Any
9.00pm	Meeting Adjournment	-

*Department leaders should submit their department agenda to the All Committee WhatsApp group AT LEAST ONE DAY before the meeting.

Checked By:

Wong Man Ee
Organising Chairperson
TAR Awards

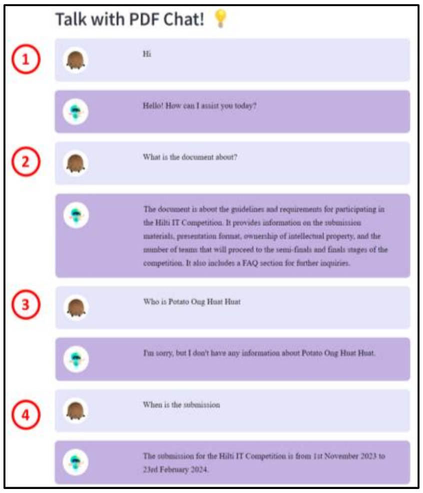
Additional Features

- Display page count
- Zoom in & zoom out page
- Rotate page
- Download document
- Print document
- Settings

Document properties

File name:	4SZTXCF5xeb5qGRCmVuZHN0cmVhbQplbmRvYm...
File size:	59.1 KB
Title:	TAR Awards 3rd Committee Meeting Agenda
Author:	-
Subject:	-
Keywords:	-
Created:	-
Modified:	-
Application:	-
PDF producer:	Skia/PDF m121 Google Docs Renderer
PDF version:	1.4
Page count:	1
Page size:	8.50 × 11.00 in (portrait)
Fast web view:	No

Fig. 4. PDF document review.



Hi

Hello! How can I assist you today?

What is the document about?

The document is about the guidelines and requirements for participating in the Hilti IT Competition. It provides information on the submission materials, presentation format, ownership of intellectual property, and the number of teams that will proceed to the semi-finals and finals stages of the competition. It also includes a FAQ section for further inquiries.

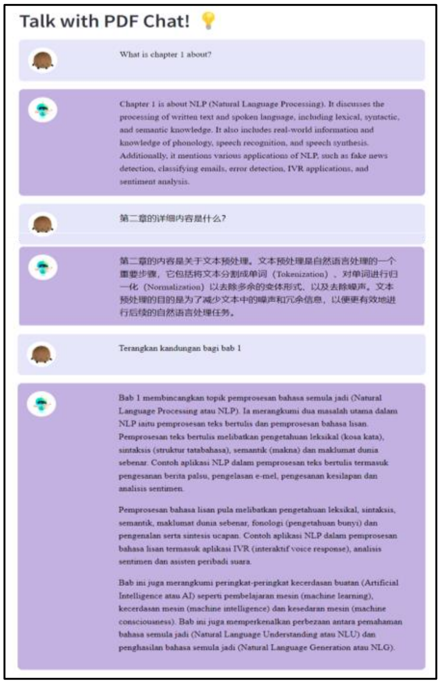
Who is Potato Oug Huat Huat

I'm sorry, but I don't have any information about Potato Oug Huat Huat.

When is the submission

The submission for the Hilti IT Competition is from 1st November 2023 to 23rd February 2024.

Fig. 5. Conversation with PDF chatbot.



What is chapter 1 about?

Chapter 1 is about NLP (Natural Language Processing). It discusses the processing of written text and spoken language, including lexical, syntactic, and semantic knowledge. It also includes real-world information and knowledge of phonology, speech recognition, and speech synthesis. Additionally, it mentions various applications of NLP, such as fake news detection, classifying emails, error detection, IVR applications, and sentiment analysis.

第二章的详细内容是什么?

第二章的内容是关于文本预处理。文本预处理是自然语言处理的一个重要步骤，它包括将文本分割成单词（Tokenization）、对单词进行归一化（Normalization）以去除多余的变体形式、以及去除噪声。文本预处理的目的是为了减少文本中的噪声和冗余信息，以便更有效地进行后续的自然语言处理任务。

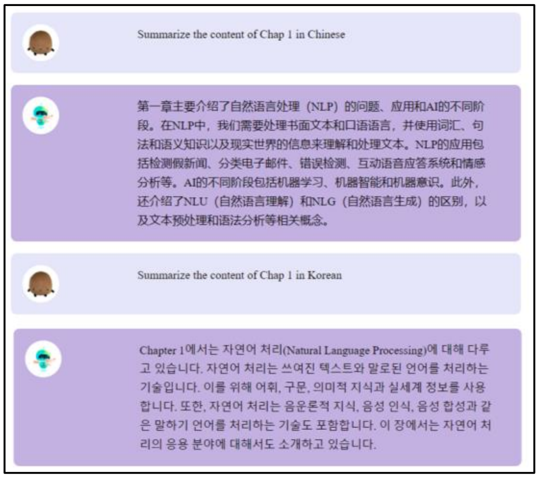
Terangkan kandungan bagi bab 1

Bab 1 membincangkan topik pemprosesan bahasa semula jadi (Natural Language Processing atau NLP). Ia merangkumi dua masalah utama dalam NLP iaitu pemprosesan teks bertulis dan pemprosesan bahasa lisan. Pemprosesan teks bertulis melibatkan pengetahuan leksikal (kosa kata), sintaksis (struktur tatabahasa), semantik (makna) dan maklumat dunia sebenar. Contoh aplikasi NLP dalam pemprosesan teks bertulis termasuk pengesanan berita palsu, pengelasan e-mel, pengesanan kesilapan dan analisis sentimen.

Pemprosesan bahasa lisan pula melibatkan pengetahuan leksikal, sintaksis, semantik, maklumat dunia sebenar, fonologi (pengetahuan bunyi) dan pengenalan serta sintesis ucapan. Contoh aplikasi NLP dalam pemprosesan bahasa lisan termasuk aplikasi IVR (interaktif voice response), analisis sentimen dan asisten peribadi suara.

Bab ini juga merangkumi peringkat-peringkat kecerdasan buatan (Artificial Intelligence atau AI) seperti pembelajaran mesin (machine learning), kecerdasan mesin (machine intelligence) dan kesedaran mesin (machine consciousness). Bab ini juga memperkenalkan perbezaan antara pemahaman bahasa semula jadi (Natural Language Understanding atau NLU) dan penghasilan bahasa semula jadi (Natural Language Generation atau NLG).

Fig. 6. Prompting queries and obtaining answers in different languages.



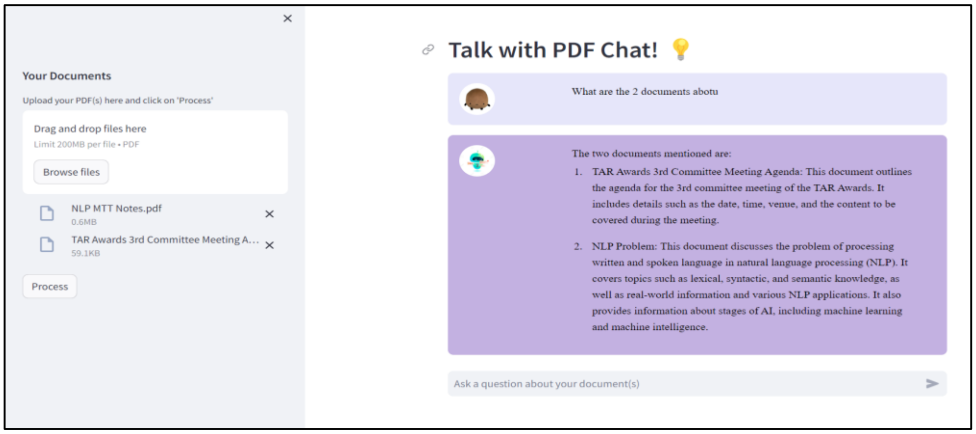
Summarize the content of Chap 1 in Chinese

第一章主要介绍了自然语言处理（NLP）的问题、应用和AI的不同阶段。在NLP中，我们需要处理书面文本和口语语言，并使用词汇、句法和语义知识以及现实世界的信息来理解和处理文本。NLP的应用包括检测假新闻、分类电子邮件、错误检测、互动语音应答系统和情感分析等。AI的不同阶段包括机器学习、机器智能和机器意识。此外，还介绍了NLU（自然语言理解）和NLG（自然语言生成）的区别，以及文本预处理和语法分析等相关概念。

Summarize the content of Chap 1 in Korean

Chapter 1에서는 자연어 처리(Natural Language Processing)에 대해 다루고 있습니다. 자연어 처리는 쓰여진 텍스트와 말로된 언어를 처리하는 기술입니다. 이를 위해 어휘, 구문, 의미적 지식과 실세계 정보를 사용합니다. 또한, 자연어 처리는 음운론적 지식, 음성 인식, 음성 합성과 같은 말하기 언어를 처리하는 기술도 포함합니다. 이 장에서는 자연어 처리의 응용 분야에 대해서도 소개하고 있습니다.

Fig. 7. Text extraction and multilingual response.



×
Your Documents
Upload your PDF(s) here and click on 'Process'
Drag and drop files here
Limit 200MB per file • PDF
Browse files
NLP MTT Notes.pdf
0.6MB
×
TAR Awards 3rd Committee Meeting A...
59.1KB
×
Process
Talk with PDF Chat! 💡
Ask a question about your document(s)

What are the 2 documents abotu

The two documents mentioned are:

1. TAR Awards 3rd Committee Meeting Agenda: This document outlines the agenda for the 3rd committee meeting of the TAR Awards. It includes details such as the date, time, venue, and the content to be covered during the meeting.
2. NLP Problem: This document discusses the problem of processing written and spoken language in natural language processing (NLP). It covers topics such as lexical, syntactic, and semantic knowledge, as well as real-world information and various NLP applications. It also provides information about stages of AI, including machine learning and machine intelligence.

Fig. 8. Conversation with PDF chatbot regarding 2 documents.

V. Discussion

According to the results mentioned above, we have successfully developed an interactive PDF Chatbot application specifically designed for document exploration and engagement. It is a technology stack that uses Python, Streamlit, and OpenAI API, enabling the easy integration of several conversational interactions and document-related features, guaranteeing a positive user experience. It can perform text extraction and summarization, allowing the user to obtain a summarised paragraph of the document. Additionally, the application offers a preview feature that displays the uploaded document, allowing users to refer to the context. Not only that, the chatbot is equipped with translation and multi-language support. It can enhance understanding and usability for a worldwide user base through translation and enabling users to communicate with the program in their choice language by handling inquiries and providing responses in languages different from the original document content. Lastly, a user-friendly interface is created for the application so that users can seamlessly navigate through the various functionalities offered.

VI. Conclusion

The limitation of the application is that some PDF files that contain images cannot be displayed in the preview section. To address this, we aim to explore alternative programming approaches to better handle and render image-rich PDFs within the preview section. To better enhance the application function, we intend to incorporate a conversation history function into the interactive PDF Chatbot so that users may review their prior questions. Additionally, we plan to provide a download feature, which would enable customers to store a copy of their queries on their devices. Besides that, future works could also involve a group of users from different specialization to test run the system and evaluate the accuracy and performance of the Chatbot system.

References

[1] F. Farhi, R. Jeljeli, I. Aburezeq, F. F. Dweikat, S. A. Al-shami, and R. Slamene, “Analyzing the students’ views, concerns, and perceived ethics about chat GPT usage,” Computers and Education: Artificial Intelligence, vol. 5, p. 100180, 2023, doi: 10.1016/j.caeai.2023.100180.

[2] I. Adeshola and A. P. Adepoju, “The opportunities and challenges of ChatGPT in education,” Interactive Learning Environments, pp. 1–14, Sep. 2023, doi: 10.1080/10494820.2023.2253858.

[3] C. K. Lo, “What Is the Impact of ChatGPT on Education? A Rapid Review of the Literature,” Educ Sci (Basel), vol. 13, no. 4, p. 410, Apr. 2023, doi: 10.3390/educsci13040410.

[4] M. Al-Emran, “Unleashing the role of ChatGPT in Metaverse learning environments: opportunities, challenges, and future research agendas,” Interactive Learning Environments, pp. 1–10, Mar. 2024, doi: 10.1080/10494820.2024.2324326.

[5] G. Verma, T. Campbell, W. Melville, and B.-Y. Park, “Navigating Opportunities and Challenges of Artificial Intelligence: ChatGPT and Generative Models in Science Teacher Education,” J Sci Teacher Educ, vol. 34, no. 8, pp. 793–798, Nov. 2023, doi: 10.1080/1046560X.2023.2263251.

[6] Z. Xie, X. Evangelopoulos, Ö. H. Omar, A. Troisi, A. I. Cooper, and L. Chen, “Fine-tuning GPT-3 for machine learning electronic and functional properties of organic molecules,” Chem Sci, vol. 15, no. 2, pp. 500–510, 2024, doi: 10.1039/D3SC04610A.

[7] J. M. Prieto Andreu and A. Labisa Palmeira, “Quick review of pedagogical experiences using GPT-3 in education,” J Technol Sci Educ, vol. 14, no. 2, p. 633, Mar. 2024, doi: 10.3926/jotse.2111.

[8] M. Enis and M. Hopkins, “From LLM to NMT: Advancing Low-Resource Machine Translation with Claude,” Apr. 2024.

[9] L. Caruccio, S. Cirillo, G. Polese, G. Solimando, S. Sundaramurthy, and G. Tortora, “Claude 2.0 large language model: Tackling a real-world classification problem with a new iterative prompt engineering approach,” Intelligent Systems with Applications, vol. 21, p. 200336, Mar. 2024, doi: 10.1016/j.iswa.2024.200336.

[10] Google, “PaLM 2,” Google AI. Accessed: Jul. 15, 2024. [Online]. Available: https://ai.google/discover/palm2/

[11] Anthrop\c, “Introducing Claude.” Accessed: Jul. 15, 2024. [Online]. Available: https://www.anthropic.com/news/introducing-claude

[12] J. Ao et al., “SpeechT5: Unified-Modal Encoder-Decoder Pre-Training for Spoken Language Processing,” in ACL 2022, May 2022. [Online]. Available: https://www.microsoft.com/en-us/research/publication/speecht5-unified-modal-encoder-decoder-pre-training-for-spoken-language-processing/

[13] W. Lopes, “Streamlit Pro vs Cons,” Streamlit . Accessed: Jul. 15, 2024. [Online]. Available: https://www.linkedin.com/pulse/streamlit-pro-vs-cons-wendel-lopes/

[14] datacamp, “Python Tutorial: Streamlit.” Accessed: Jul. 15, 2024. [Online]. Available: https://www.datacamp.com/tutorial/streamlit

[15] AWS, “What is LangChain?,” AWS. Accessed: Jul. 15, 2024. [Online]. Available: https://aws.amazon.com/what-is/langchain/#:~:text=LangChain%20simplifies%20artificial%20intelligence%20