



Research on Self-inspired Intelligent Question Answering Method Based on Socratic Questioning

Zhichao Yao*^a, Haoran Ji^b

^a93357 Troops, People's Liberation Army of China, Anshan, 114020, China

^bIntelligent Game and Decision Lab, Academy of Military Science, Beijing, 100071, China

*yaozhichao18@nudt.edu.cn

Abstract. Large language model has become one of the hot research contents in the field of artificial intelligence due to its excellent ability in natural language processing tasks. However, large language models usually have the disadvantages of over-reliance on surface statistical information and lack of deep understanding of the problem, which affects the accuracy and credibility of their answers. This paper first introduces the connotation of Socratic questioning, then proposes a self-inspired intelligent question answering method based on Socratic Questioning, and verifies the reliability of this method through example comparison. The results show that this method can guide the self-inspired deep thinking of large language models, stimulate the intelligent emergence of large language models, and make the answer results more accurate and comprehensive.

Keywords: Socratic questioning, large language model, Prompt Engineering, self-inspired

1 INTRODUCTION

The large language model is an artificial intelligence technology based on deep learning, and its parameter scale can reach hundreds of billions to trillions^[1]. Through the training of a large number of training data, the large language model can emerge strong cognitive ability, reasoning ability, and rich general knowledge. Therefore, it can understand, explain and generate human language, and has the powerful ability to process and generate natural language texts. Internationally, top computer companies and a large number of emerging enterprises have invested in the development and training of large language models, and have proposed a variety of high-performance large language models, including ChatGPT-4, BERT, and LLaMA, which have attracted worldwide attention^{[2][3]}. These big language models are deeply changing the way of human production and life. The scientific research institutions of major domestic enterprises and universities also keep up with the pace, and are committed to the development and application of large language models. A variety of large language models have emerged, such as Pangu, Baichuan, Qwen-VL, ERNIE Bot, etc., which have the same performance as the international top models^[4].

© The Author(s) 2024

A. Haldorai et al. (eds.), *Proceedings of the 2024 3rd International Conference on Artificial Intelligence, Internet and Digital Economy (ICAID 2024)*, Atlantis Highlights in Intelligent Systems 11,

https://doi.org/10.2991/978-94-6463-490-7_14

However, although the large language model performs well in natural language processing tasks, its answers rely too much on surface statistical information and lack deep understanding of the problem. Therefore, there will be specious answers, and potential social prejudice and unfairness may be learned from the training data, and even factual errors and model illusions appear in the answers^[5].

Prompt Engineering is a relatively new discipline that focuses on the development and optimization of prompt words to help users use large language models in various scenarios and research fields. Prompt is an important medium for people to interact with large language models. It can contain detailed information such as instructions, questions, examples, and inputs that are passed to the model. Developers can achieve efficient integration with large language models or other ecological tools by Prompt Engineering Design and developing powerful engineering technologies^[6].

Therefore, it is of great significance to inspire the big language model to think deeply about the problem through thinking tips, give the big language model self-inspiration and self-correction ability, deeply mine the ability of the big language model, overcome the illusion of the model, and improve the safety, accuracy, comprehensiveness and logical rigor of the output answers of the big language model.

2 SOCRATIC QUESTIONING

The famous ancient Greek philosopher Socrates is the founder of Western philosophy. His disciple Plato wrote a 'dialogue' that detailed the contents of Socrates' life conversations, including a large number of examples of Socratic questioning. Later generations summarized Socratic questioning method and obtained the methodology of Socratic questioning.

Socratic questioning is a structured questioning method, which guides the respondent to think deeply about the essence of the problem through continuous dialectical questioning. Socratic questioning is based on the structured logic of thinking, which can make potential ideas questioned. The key difference between Socratic questioning and rhetorical questioning itself is that Socratic questioning is systematic, disciplined and in-depth, usually focusing on basic concepts, principles, theories or problems^[7].

The Socratic questioning includes six angles of questioning, namely: the questioning of clarifying definitions and concepts, the questioning of exploring hypotheses and premises, the questioning of exploring reasons and evidence, the questioning of viewpoints and perspectives, the questioning of exploring consequences and influences, and the questioning of exploring the problem itself^[8].

Considering that the answer of the large language model usually has the disadvantage of lacking deep understanding of the question, and the Socratic questioning has the characteristics of guiding the respondent to think deeply and constantly analyze its own internal characteristics, this question method meets the self-inspiration needs of the large language model. Therefore, it is possible to combine the methodology of Socratic questioning with the large language model by means of prompting engineering. This can stimulate the deep understanding of the input problem by the large language model and enhance the comprehensiveness of the answer.

3 SELF-INSPIRED INTELLIGENT QUESTION ANSWERING METHOD BASED ON SOCRATIC QUESTIONING

The methodology of Socratic questioning is divided into six categories, each of which has a clear purpose, and the large language model can master the methodology of Socratic questioning through small sample learning by virtue of its own understanding ability. Therefore, this paper proposes a self-inspired intelligent question answering method based on Socratic questioning. Using the prompt engineering method, by structurally describing the Socratic questioning methodology in the prompt word, the large language model can master the Socratic questioning method and carry out self-questioning and self-answering, self-inspired mining problem connotation, and greatly improve the performance of the large language model. The basic flow diagram of the above intelligent question answering method is shown in Figure 1.

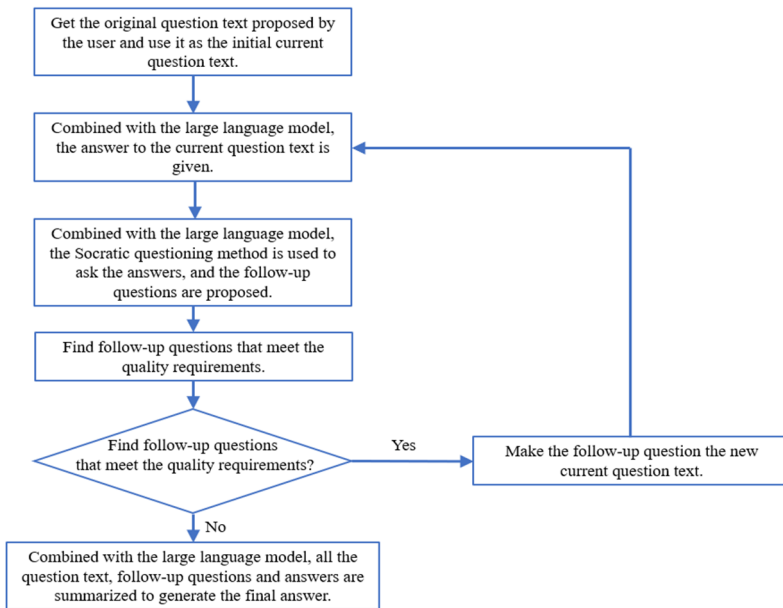


Fig. 1. Schematic diagram of the basic process of the intelligent question answering method.

The workflow of the self-inspired intelligent question answering method is as follows: firstly, the original question text raised by the user is obtained, which will be used as the initial current question text, and combined with the large language model, the answer to the current question text is given. Secondly, the Socratic questioning method was used to follow up the answers, and the follow-up questions were raised. Thirdly, evaluate the quality of the questions raised. If the questions that meet the quality requirements are found, the questions will be answered again as a new current question text. Through continuous questioning, evaluation and re-answering, until the questions

that meet the quality requirements cannot be screened out or the current questions cannot be asked. Finally, the large language model summarizes all the question texts, follow-up questions and answers to generate the final answer.

4 SELF-INSPIRED INTELLIGENT QUESTION ANSWERING system BASED ON SOCRATIC QUESTIONING

According to the self-inspired intelligent question answering method based on Socratic questioning, a self-inspired intelligent question answering system based on Socratic questioning is established, and the schematic diagram of the system structure is shown in Figure 2. The self-inspired intelligent question answering system includes system input 10, question and answer module 20, follow-up module 30, evaluation module 40, summary module 50, large language model 60 and system output 70. The large language model in the system does not depend on the specific large language model, for example, ChatGPT 3.5 can be used.

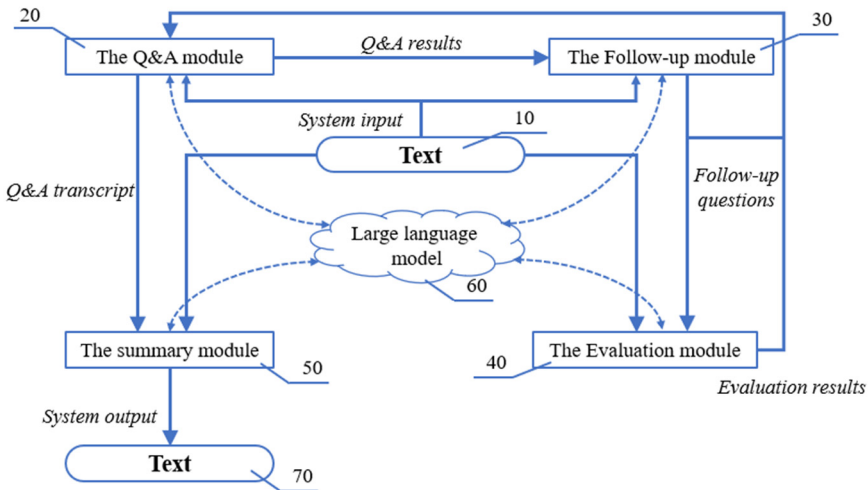


Fig. 2. Schematic diagram of the composition of the system modules.

4.1 The question and answer module

The question and answer module is used to give an answer to the current question text in combination with a large language model. The schematic diagram of the question and answer module is shown in Figure 3. The question and answer module consists of the question group to be answered 201, the question to be answered 202, the question and answer prompt 203, the answer 204 and the large language model 60. After receiving the question to be answered 202 to be answered, the question and answer module

20 calls the prompt word 203, and then splices it into a text input to the large language model 60. The text output after the completion of the large language model 60 processing is the answer 204 output by the question and answer module. Among them, the question group to be answered 201 only contains the system input 10 in the initial state. In the process of system operation, the questions output by follow-up module 30 will be expanded to the question group to be answered 201 which is evaluated as ' high quality ' by the evaluation module 40. The question to be answered 202 is the first question in the question group to be answered 201. In this module, the prompt word 203 is ' Substitute into the role of erudition artificial intelligence assistant, briefly answer the question '.

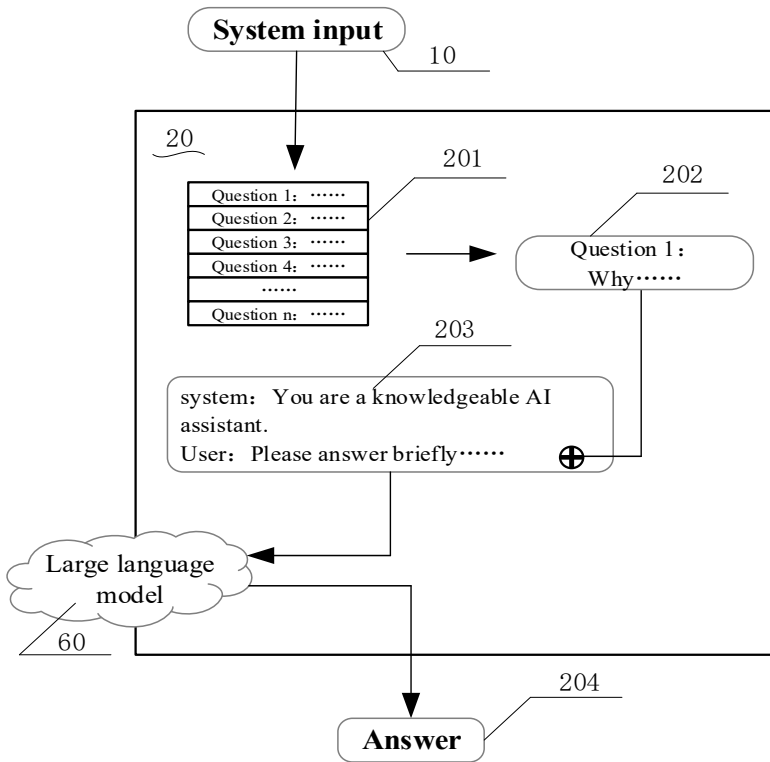


Fig. 3. Schematic diagram of the question and answer module

4.2 The follow-up module

The follow-up module is used to combine the large language model to use the Socratic questioning method to ask the answer and put forward the follow-up question. The schematic diagram of the follow-up module is shown in Figure 4. The follow-up module is connected with the system input and question and answer module, which is composed of the Socratic questioning prompt 301, the follow-up question group 302, the system input 10, the question to be answered 202, the answer 204 and the large language

model 60. The follow-up module 30 receives the system input 10, the question to be answered 202 and the answer 204. After calling the Socratic questioning prompt 301, it is spliced into a text input to the large language model 60. In the context of system input 10, the large language model 60 carries out Socrates' follow-up questions according to the question to be answered 202 and the answer 204, and generates several follow-up questions from different angles. After the large language model 60 is processed, it outputs a structured text containing several Socratic questions. After splitting the text, the output of the follow-up module 30 is obtained, that is, the follow-up question group 302.

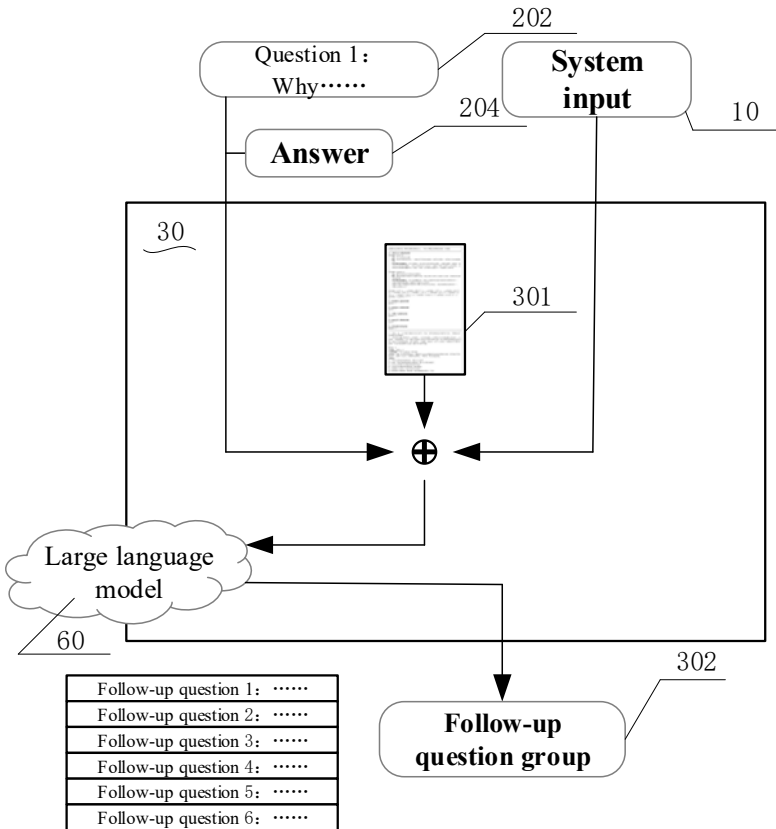


Fig. 4. Schematic diagram of the follow-up module

A schematic diagram of the Socratic questioning prompt is shown in Figure 5. In Socratic questioning prompt 301, the connotation of Socratic questioning is first explained to the large language model 60, and then the "question, answer and follow-up" cases are written from six questioning perspectives, each of which is based on 14 common official disciplines. In this article, a case study is given from each angle and for each discipline category.

Socratic questioning is a structured way of questioning. There are six angles of questioning, namely :

<1. the questioning of clarifying definitions and concepts>

#Example 01 (Philosophy)#

Question: What is the essence of existence?

Answer: The essence of existence is a complex and profound problem in philosophy, which involves the understanding and interpretation of reality, consciousness and existence.

Follow-up questions: What is philosophy ? Why do you say that the essence of existence is a philosophical problem ? What is the relationship between the understanding and interpretation of reality, consciousness and existence and the nature of existence ? Can you give an example of what is the understanding and interpretation of reality, consciousness and existence ? What is the essence of reality, consciousness and existence ? / Can you put it another way ?

#Example 02 (EConomics)#...# Example 03 (Jurisprudence) #... # Example 04 (Pedagogy) #... # Example 05 (Literature) #..... # Example 06 (History) #... # Example 07 (Science) #..... # Example 08 (Engineering) #... # Example 09 (Agronomy) #... # Example 10 (Medicine) #... # Example 11 (Military Science) #... # Example 12 (Management) #... # example 13 (Art) #..... # Example 14 (Interdisciplinary) #...

<2.the questioning of exploring hypotheses and premises>

#Example...

<3. the questioning of exploring reasons and evidence>

#Example...

<4. the questioning of viewpoints and perspectives>

#Example...

<5. the questioning of exploring consequences and influences>

#Example...

<6. the questioning of exploring the problem itself>

#Example...

Now, there is one <Topic>that needs to be studied in depth, and for this, the Socratic method of questioning is adopted, constantly asking new questions and giving explanations.

In the course of the research<topic>, one <specific question> was discussed, and the <specific question> was already have one <answer>.Unfortunately, this <answer> is obviously not logically rigorous and complete, so it is necessary to use Socratic questioning to ask questions from six angles, one question from each angle. It should be noted that although these six <question> are questioned for <answer>, they cannot deviate from the <topic> and <specific question>.

#Example:#

<topic>: What is a dog?

<specific question>: Why is a dog an animal ?

<answer>: animals generally eat organic matter and are sensory creatures capable of autonomous movement or activity. Dogs also feed on organic matter, can exercise autonomously, and can feel happiness, pain, etc., so dogs are animals.

<follow-up question>:

1. Why is it said that dogs feed on organic matter, and what do dogs feed on ?
2. If a dog can't feel happiness and pain, is it still an animal ?
3. How do you prove that dogs can feel pleasure and pain ?
4. Can dog be proved to be an animal from other angles ?
5. Dogs can move autonomously, what will this lead to ?
6. We now discuss the dog is an animal, this is enough to understand what the dog is ?

Fig. 5. Schematic diagram of Socratic questioning prompt

4.3 The evaluation module

The evaluation module is used to evaluate the quality of the follow-up questions raised in combination with the large language model. The schematic diagram of the evaluation module is shown in Figure 6. The evaluation module 40 introduces the system input 10 and the follow-up module 30, which is composed of the evaluation prompt 401, the follow-up question group 302, the system input 10, the evaluation result 402 and the large language model 60. The evaluation module 40 receives the system input 10 and the follow-up question group 302, and after calling the evaluation prompt 401, it is spliced into a piece of structured text and input to the large language model 60. The large language model 60 judges the quality of each item in the follow-up question group

302 according to the correlation between the follow-up question group 302 and the system input 10 and the logical value of each item itself. After the evaluation of the large language model 60 is completed, a structured text is output, which contains the evaluation of all items in the follow-up question group 302, and the evaluation is divided into three levels: ‘high quality’, ‘general’ and ‘invalid’. The structured text is split and processed as the output of the evaluation module 40, that is, the evaluation result 402. Finally, the evaluation results of all follow-up questions are retrieved. If the evaluation result is ‘high quality’, the follow-up question is taken as a new current question text and output to the question answering module, otherwise the summary module is skipped.

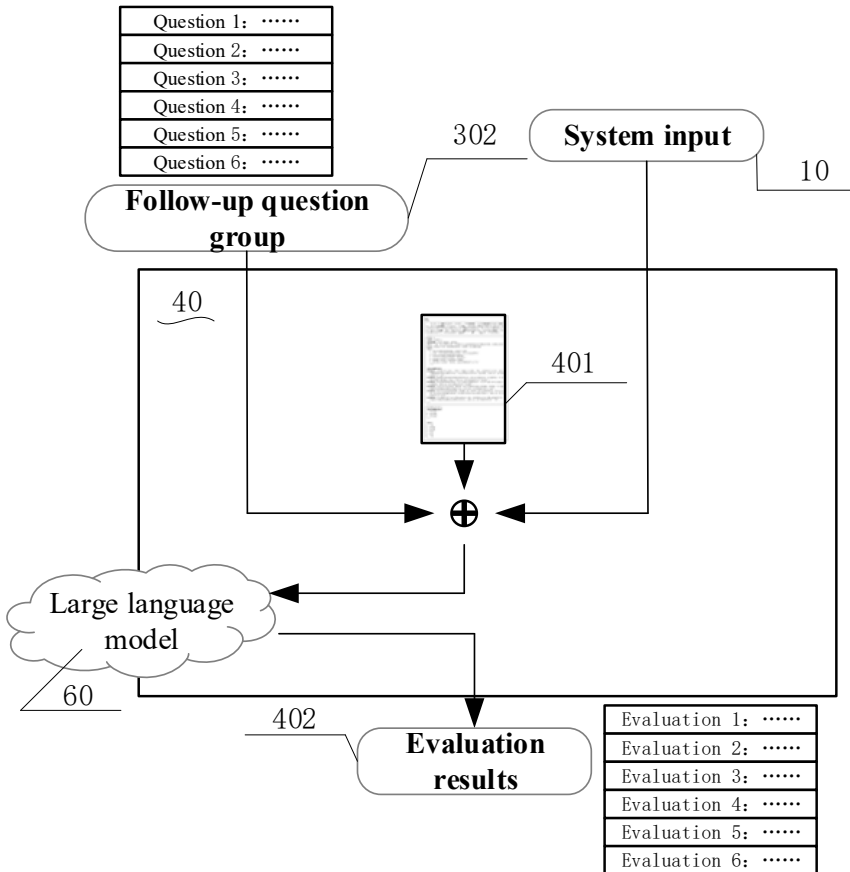


Fig. 6. Schematic diagram of the evaluation module

Figure 7 shows the schematic diagram of the evaluation prompt. Firstly, the purpose and significance of the quality evaluation were explained to the large language model 60, and the grading of the evaluation results was given. Then, several cases are given to illustrate how to combine the system input 10 and the question to be answered 202,

and evaluate the thought process and evaluation results of the follow-up question of answer 204. In order to facilitate the automatic text recognition and processing of the program, the format of the structured output is also explained.

401

In the process of discussing a certain <topic>, a certain <specific question> is involved, and this <Specific question> is subordinate to the <topic>. Someone gave an <answer> to this <specific question>, but because the <answer> was not logically rigorous enough, or the discussion in the current position had not yet allowed everyone to have an accurate conclusion on the <topic>, someone raised a new round of six <question> about the <answer>. Now, there is a need to evaluate the quality of these six <question>, and people can continue to discuss the <question> that are highly rated. The ratings are ranked according to three levels: 'high quality', 'general', and 'invalid'.

#Example:#

<topic>: What is a dog?

<specific question>: Why is a dog an animal ?

<answer>: animals generally eat organic matter and are sensory creatures capable of autonomous movement or activity. Dogs also feed on organic matter, can exercise autonomously, and can feel happiness, pain, etc., so dogs are animals.

<follow-up question>:

1. Why is it said that dogs feed on organic matter, and what do dogs feed on ?
2. If a dog can't feel happiness and pain, is it still an animal ?
3. How do you prove that dogs can feel pleasure and pain ?
4. Can dog be proved to be an animal from other angles ?
5. Dogs can move autonomously, what will this lead to ?
6. We now discuss the dog is an animal, this is enough to understand what the dog is ?

<The thought process of evaluation>:

Evaluation Question 1: Asking what the dog eats, there have been some deviations from the topic. However, asking what the dog eats, it may be possible to get the difference between the dog and other creatures, which may have some value in defining what a dog is. Generally speaking, the evaluation of this question is 'general'.

Evaluation Question 2: Dogs do not feel pleasure and pain is a probability, so this question has a certain critical, and the answer to the initial question of the logic of rigor raised objections. Generally speaking, the evaluation of this question is 'high quality'.

Evaluation Question 3: Whether the dog can feel happy is strongly related to the topic, and the credibility of the answer to the initial question is effectively questioned. Generally speaking, the evaluation of this question is 'high quality'.

Evaluation Question 4: Because the dog has been discussed as an animal, it is difficult to contribute new knowledge and research directions to the study of the topic from other perspectives to prove that the dog is an animal. In general, the evaluation of this question is 'invalid'.

Evaluation Question 5: The phenomenon of autonomous movement of dogs, such as running, jumping, playing, etc., is common knowledge and has little value, and this is not a unique characteristic of dogs. So it is not meaningful to study these topics for discussion. In general, the evaluation of this question is 'invalid'.

Evaluation Question 6: This question has inspired people to define dogs from other perspectives, which may help people understand the topic more abundantly, but this question has not been able to give a specific discussion direction. Generally speaking, the evaluation of this question is 'general'.

The format returned is:

<The thought process of evaluation>:

1. Evaluation process
2. Evaluation process
- ...

<conclusion>:

1. general
2. high quality
3. high quality
4. invalid
5. invalid
6. general

Fig. 7. Schematic diagram of the evaluation prompt

4.4 The summary module

The summary module is used to summarize all the question texts, follow-up questions and answers in combination with the large language model to generate the final answer. The schematic diagram of the summary module is shown in Figure 8. The summary module 50 leads to the question and answer module 20, the system input 10 and the system output 70. Firstly, all the question to be answered 202 and the answer 204 in the question and answer module 20 are summarized into the multi-round question and answer record prompt 501. Then, according to the system input 10, a concise topic prompt 502 is generated. Finally, the multi-round question and answer record prompt 501 and the topic prompts 502 were spliced into a piece of text and input to the large language model 60. The large language model is required to take the system input 10 as the topic, and generate the summary content based on the historical records of multiple rounds of question and answer. After the summary of the large language model 60 is completed, a text is output, which is the system output 70 of the self-inspired intelligent question answering system.

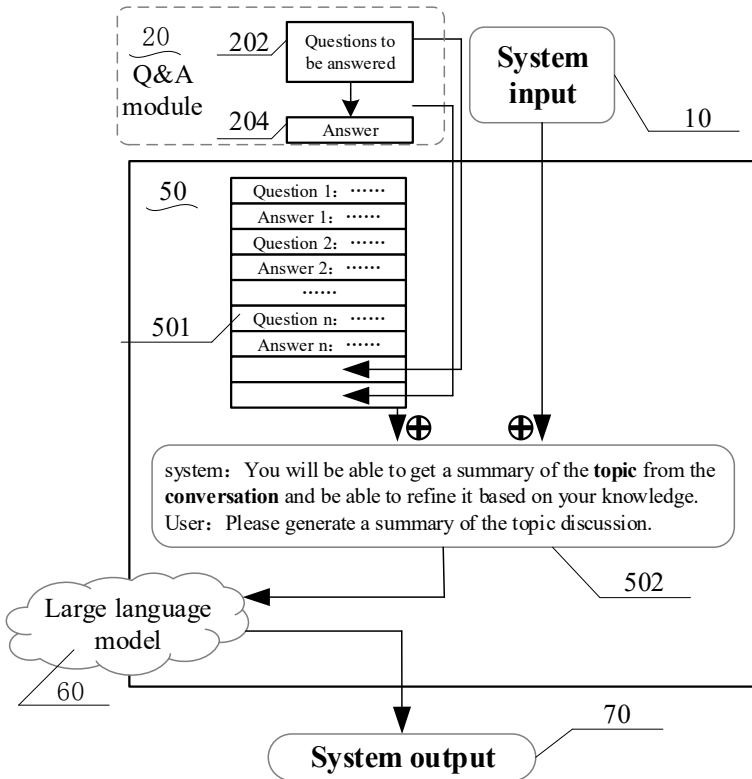


Fig. 8. Schematic diagram of the summary module

5 VERIFY INSTANCE COMPARISON

According to the self-inspired intelligent question answering method and system construction scheme in this paper, an intelligent question answering system is constructed by introducing an internet open source large language model. The following uses ‘why should we salute first and then soldier?’ as the system input, and compare the answers obtained by the large language model and the self-inspired intelligent question answering system. Figure 9 shows the verification results of the example comparison. After adopting the self-inspired intelligent question answering method based on Socratic questioning, the cognition of ‘why should we salute first and then soldier?’ of the large language model has changed from repeating the advantages of ‘saluting first and then soldiering’ to in-depth judgment and thinking, and put forward its own views and questions. The advantages and disadvantages of ‘salute before soldier’ are dialectically evaluated, self-judgment and correction are realized, and other effective methods of conflict reduction are supplemented, and the accuracy, comprehensiveness and logical rigor of answering questions are greatly improved.

System input:

why should we salute first and then soldier?

The result of the direct output of the large language model:

The phrase ‘salute first and then soldier’ comes from *Sun Tzu on the Art of War*, which means that when dealing with affairs, try to settle the matter by peaceful means, and then take force if a reasonable agreement cannot be reached. This practice helps to avoid unnecessary conflicts and losses, maintain good interpersonal relationships, and also minimize the impact and cost of conflict.

The results of a self-enlightening intelligent question answering system based on Socratic questioning:

When dealing with conflicts and problems, the core idea of ‘salute first and then soldier’ is to try to solve problems through politeness and conciliation, minimizing the impact and cost of conflict. However, this strategy will not be successful in all cases, and overuse of this strategy can lead to negative consequences. Historical cases and studies have shown that excessive tactfulness and humility can be misunderstood or seen as weakness, to the detriment of an individual or organization. Therefore, the strategy of ‘salute first and then soldier’ needs to be applied flexibly on a case-by-case basis, rather than generalizing. When dealing with problems, active communication and negotiation, third-party mediation and other methods can also effectively reduce the impact and cost of conflict, and these methods also deserve attention.

Fig. 9. Comparison of instance verification results

6 CONCLUSION

Based on the Socratic questioning methodology, this paper proposes a self-inspired intelligent question answering method and constructs a self-inspired intelligent question answering system, and verifies the reliability of this method and the system through example comparison. The conclusions are as follows:

1. Through the comparison and verification of examples, the method described in this paper can guide the large language model to self-inspire deep thinking, fully explore the various knowledge mastered by the large language model, overcome the model illusion, and improve the safety and accuracy of the large language model to answer questions.
2. Compared with the performance enhancement methods of large language models, such as increasing the amount of data and distributed training, the methods described in this paper can save time and economic costs, and greatly improve the comprehensiveness and logical rigor of large language models in answering questions.
3. Compared with the prompting method of manually fixing the prompt content, all the links of questioning, answering, follow-up, evaluation, and summary output in the method described in this paper are automatically handled by the system, and do not rely on any human judgment and intervention. It embodies excellent self-enlightenment characteristics, avoids the interference and restriction of human thinking and experience on artificial intelligence, and can also guide large language models to self-ask and self-prompt, and stimulate the emergence of large language model intelligence.
4. Compared with training the large language model through a large number of manually annotated samples in the incremental pre-training or fine-tuning stage, so that it can master the Socratic questioning methodology, this method uses prompt engineering and question answering process dismantling to empower the large language model through step-by-step few-shot prompts, which greatly reduces the training time and development workload of the large language model. It does not interfere with the learning and training process of large language models, does not depend on the neural network structure and parameter volume of the model, and has a wide range of universality.

REFERENCES

1. Thilo Hagendorff. Deception Abilities Emerged in Large Language Models[J].2023.
2. Cao Keliang. ChatGPT : The Robotic Turn of the Ideologist and Its Consequences [J]. United Front Studies, 2023, vol. 7 (4) : 134-144.(in Chinese)
3. Zhang Ye, Nie Yiming. Review of big language model research and its application prospect in the field of security [J]. Intelligent Security, 2023, Vol. 2 (4) : 100-112.(in Chinese)
4. Yizhong Wang, Yeganeh Kordi, Swaroop Mishra, Alisa Liu, Noah A. Smith, Daniel Khashabi, Hannaneh Hajishirzi. Self-Instruct: Aligning Language Models with Self-Generated Instructions[J].2023.
5. Zhao Yue, He Jinwen, Zhu Shenchen, Li Congyi, Zhang Yingjie, Chen Kai. Status and Challenges of Large Language Model Security [J].Computer Science, 2024, Vol.51 (1) : 68-71.(in Chinese)
6. Qinyuan Ye, Maxamed Axmed, Reid Pryzant, Fereshte Khani. Prompt Engineering a Prompt Engineer[J].2023.
7. Zhao Dunhua. Brief History of Western Philosophy [M]. Peking University Press, 2001.(in Chinese)
8. Phillips, Christopher. Six questions of Socrates[J]. 2004.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

