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## Cognitive Function of Artificial Intelligence Literature

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# Cognitive Function of Artificial Intelligence Literature

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**Abstract.** Artificial Intelligence literature is a literary work that is generated by AI in semi-automatic or automatic method. AI literature needs the integration of symbolism and connectionism AI to finally realize general AI in literature. AI literature can also promote research in AI technology, such as emotion and creativity. The metaphor in literature provides the possibility for AI to learn and master the analogy-associative thinking of human beings.

## 1. History and Concept: Artificial Intelligence Literature

People have imagined the concept of automatic writing in long history. In ancient Greece, God used the mouth of the psalmist to sing poetry. People seemed to be the machines that God manipulated. In the modern art such as Dadaism and Surrealism, God gives way to the subconscious, automatic writing is to liberate the subconscious mind controlled by consciousness. After the birth of the computer, the era of programming computer programs to write literature began. In 1962, R.M. Worthy and others invented the poetry creation process, "Auto-beatnik", its poems published in magazine *Horizon*. [1] In 2018, IBM researchers created AI programs to create Sonnet poems. They input 2,600 sonnets in AI, and AI was able to generate new sonnets and pass blind tests. However, researchers acknowledge that the poems created by these machines still lack emotion. [2] In China, AI writing poetry technology has achieved significant breakthroughs. The Microsoft Xiaobing program developed by MSRA, after learning the works of 519 poets, published the poem collection in 2017. In terms of novel, in 1998, S. Bringsjord, D. Ferrucci developed the computer software "Brutus", which can write a short story in only 15 seconds. In 2013, D. Kazemi founded the NaNoGenMo (National Novel Generation Month), a conference of Writing Robot: "where people are challenged to write code that writes a novel." [3] NaNoGenMo has gradually become a composite art movement using algorithm experimental literary forms. In 2016, M. O'Neill and others created a computer program that could write a Harry Potter style novel. Script is more regular than novel and therefore automatic writing of script is smoother. In 1976, Mechan's TALESPIN can write simple characters and straightforward narrative scripts. In 1983, M. Lebowitz developed the program "Universe" that automatically writes scripts. It focuses on the coherence and consistency factors in writing, such as role, relationship and historical background, can write a series of soap operas [4]. In 2016, the first short film "Sunspring" written by AI was shot and shortlisted in the top ten of a film competition. In the writing of biographical literature, one of the authors, Feng Tao, working with researchers at Peking University to plan a project called "Dabai Write Biography".

In addition to the writing of fictional literature, the performance of AI in non-fiction writing is more eye-catching. In 2015, Tencent released a financial report written by the automatic writing program "Dreamwriter". Baidu writing programs can also produce three kinds of news: quick reports, knowledge,



and information collection. The Associated Press has used the robot editor “Wordsmith” to write, but its job is mainly to produce corporate financial report. The program Saatchi can write 50 ad scripts based on location, behavioral characteristics and career data. Crystal Knows understands their personality by analyzing the email language of the user's colleagues or customers, and then it helps to optimize the user's email accordingly.

Therefore, the authors define “AI literature” as “literary work that is generated by AI in semi-automatic or automatic method”. The biggest difference between AI literature and previous program writing and digital literature is that AI program has become the subjectivity of writing to some extent, and it is possible to create literary works independently. At the same time, we should also see that under weak AI technology, AI could not be completely separated from human work, pre-programming and data inputting, as well as supervised learning and output evaluation, all of these requires human assistance.

## **2. Art and Technology: The Technical Orientation of AI Literature**

At present, the technology of AI literature mainly has two major directions, one is symbolism whose method is from top to bottom. Experts in this school believe that it is possible to analyze a certain type of knowledge of human beings, set up a framework for AI, and form an expert system and database in advance. For example, in the writing script, story can be divided into many dimensions: plot, character, setting, literary theme, writing style, imagination, and so on. The designer of Brutus said: “our approach has been to bestow the Brutus architecture with a counterpart to every substantive aspect of human literary genius.”[5]. The advantage of this method is that the structure is clear and the accuracy is high. The disadvantage is that the application range is narrow and the text's style is limited. The other approach is bottom-up connectionism, which is based on the latest machine learning, combined with big data technology. This school advocates to input a large amount of text data for AI, letting itself find the rules of the text and generate works. For example, Tsinghua's “Jiu Ge” program, after learning 300,000 poems, can write Chinese classical verses. AI in this way has a certain degree of independence and can generate more diverse works. However, it requires a large amount of data, and it requires a lot of manpower in the early data labeling and classification.

The authors believe that the more ideal way is the combination of symbolism and connectionism. Now some writing procedure like Baidu writing program is based on this combination. It needs to divide the core process “automatic writing” into three stages: document planning and micro-planning and surface realization, each of which requires data entry and human supervised learning. However, this low level of combination is that people need to be more involved in the creation process of AI. This is just a semi-automatic writing process. The real fusion in the future is that after people set up the initial program, AI can judge the text, collect and input data, and finally generate the work independently. AI realizes the general intelligence in writing.

At present, the main purpose of AI writing technology is not to create real literary works, but to aim to the research of AI natural language processing, affective computing and cognitive function. For example, in order to improve the interactivity of its APP, Google's AI has read 2865 romance novels for better understanding of human language. Software engineer Andrew Dai said the purpose of the work was to improve search application technology and provide feedback to users, as well as improve the “smart response” capabilities of mailboxes to make them more natural and diverse. He believes that romance novels are an excellent tool for training AI because their plots have a commonality that allows AI to focus on understanding the subtleties of human language.

AI writing uses affective computing technology, which allows AI to grasp the partial relationship between words and human emotions. In this way, it is possible to set emotional programs for AI and to understand human emotions. For example, Microsoft Xiao Bing is “based on the affection computing framework proposed by Microsoft, with EQ as the main direction, creating Conversational AI with complete sense and knowledge map”[6]. Psychologist A. Damasio found that emotions, feelings and affections are the basis of human understanding of activities and minds. Therefore, if AI wants to achieve true intelligence, truly understand human beings, and realize human-computer communication, it must

understand human emotions, and even it needs emotional programs. And this kind of emotional learning can be realized through AI literature.

In addition, one purpose of AI literature is to achieve the creativity of AI. The creators of the writing program "Brutus" claim that Brutus has achieved raw origination.[5] And if AI can create literary works, then it can realize human creativity. Shen Xiangyang, the developer of Microsoft Xiaobing, put forward the "three principles of AI creation": he said, "The process of AI creation must correspond to some kind of creative behavior of human beings, not a simple substitute for human labor." [6] This kind of creative behavior is embodied in literature and art obviously. That is why the report issued by Oxford University also regards creative work such as writers as the most difficult substitute for AI. Only if AI could have real intelligence, is it truly created.

### **3. Metaphor and Analogy-Associative Thinking: The Cognitive Function of AI Literature Language**

In addition, the authors believe that AI can also enhance its cognitive and behavioral ability through the learning and understanding of human language. The current AI requires big data and only can accomplish a single task. But humans do not need too much data, and can learn a variety of skills to complete a variety of tasks. The authors believe that the root causing of AI's big data - small tasks is that AI lacks human analogy - associative thinking. And if we want to train AI to get this ability, let it learn from the language of AI literature.

The first thing that AI literature must solve is natural language understanding. However, at the level of natural language processing, AI is far from human beings in some aspects, such as semantic problems, common sense processing, and analogical reasoning. This is because AI is very different from human beings in the way of language processing. The language of the computer is pre-defined, only in the deep learning stage, the computer realizes the induction to a certain extent, and realizes the feedback and correction of the language through the big data of network. Human language is not only innately defined, but also acquired posteriori experience, which means that human language is inseparable from human's experience. Human language contains rich semantics which are rooted in the diversity of this experience. This human's experience is the basis of human analogy-associative thinking, and this kind of thinking makes people's language have the essence of metaphor. On the one hand, humans learn the language and understand the deep meaning (metaphor) behind the language through analogy-associative thinking, on the other hand, through metaphor, to further exercise the analogy-associative thinking ability.

Both AI experts J. Hawkins and R. Kurzweil mentioned a key cognitive model of auto-association in the human cerebral cortex, which means arousal of the overall memory through a partial memory or fragment.[6] The authors believe that human analogy-associative ability is an important foundation for language with rich semantics. Language is not only the symbolic representation of objects, but also contains people's understanding, imagination and experience of the object. The speaker and the listener share through the dialogue not only the reference of a fixed object, but the understanding, experience and even value of the two parties. Therefore, the language has rich other meanings besides the object. That is what we often say "the meaning beyond words."

Metaphor has a very complex connotation. In traditional idea of metaphor, it is generally regarded as a means of rhetoric. However, the modern idea extends it to the basic characteristics of human cognition and thinking. Linguists G.Lakoff and M.Johnson believe that metaphor is a basic way of thinking throughout people's daily lives.[8] They divide metaphor into three major types: orientational metaphor, ontological metaphor, and structural metaphor. Spatial orientation is one of the foundations of human cognition. Kant believes that time and space are intuitive forms of human cognition. The establishment of the spatial sense often comes from the body's experience of the external world. In addition, entity perception transforms the abstract, opaque emotions and mental states of thinking into tangible entities, which also requires human experience. Therefore, the body has become a sign of measuring the external world and inner feelings. Structural metaphors show that human physical experience can be systematically transformed into a structure that corresponds to the conceptual system. We can also see from the character-creation of Oracle bones that the oracle bones have a lot of words

related to body parts and organs. Therefore, when human experience, thinking and emotion are expressed through language, metaphor is applied everywhere. Metaphor connects the human body and the world, which is the basis of human cognition. Metaphor is the embodiment of human analogy, association, imagination and other thinking in language. At the same time, people continue to learn and strengthen these abilities in metaphor. In other words, language is not only a manifestation of human thinking ability, but it will in turn strengthen and consolidate some of human cognitive ability. This two-way feedback process is lacking in current AI.

In order to truly understand natural language, AI must understand rich semantics. Human beings can understand the implication because of human analogy, association, imagination and etc. Men can connect superficially different words through the metaphorical relationship between languages. There are two ways to bestow AI associative ability. One is the combination of human and machine as envisioned by Hawkins and Kurzweil, adding counterpart of human new cerebral cortex to the machine, because human language, memory and auto-association skills come from this part. But they also point out that human emotions, affections and feelings are not produced in the new cortex of the brain, and such mechanisms are difficult to imitate. We also know that metaphor has a lot of contents about human subjective feelings, emotions and affections. Without these experiences and participation, metaphors may be difficult to produce. Another method, which is now commonly used, is to collect all the relevant semantics of human sentences through network big data and keyword search methods, to build a corpus, and let AI grasp the meaning of these sentences through deep learning. However, this method is still only a passive imitation, unable to truly understand the language and create new words or metaphors. Keyword searching can only search from the similarity of words in a single way, and cannot consider the connection between rich images behind semantics.

The authors believe that AI natural language understanding should pay attention to the metaphorical features of human thinking and language. AI experts should study and learn the metaphorical structure of human beings in depth, set up procedures for AI agent, and put metaphorical structures in human language into it. In addition to this top-down setup, you can also let the machine learn from the bottom up. For example, we can create a human metaphorical corpus, let AI learn and master the methods of generating metaphor through deep learning methods, and then generate new metaphors. The combination of these two methods allows AI to use and generate metaphorical language like humans. AI learning and using metaphors in language can also reinforce and enhance its own analogy-association capabilities, and it is even possible to extend this capability from language to image, action and the entire representation system. And if AI really masters the analogy-associative ability, then its intelligence will move forward a big step.

In the literary text, there is a rich metaphorical corpus. Moreover, literary text is a unified organism, not a collection of word fragments. After AI learning metaphors, we also need to let AI learn in the entire literary text. In this case, AI learns not simple words-words pairing, but a more complicated connection of sentence and thinking.

#### **4. Conclusion**

With the development of AI technology, AI literature has slowly grown from simple program writing, and it is possible to create literary works relatively independently. The combination of symbolism and connectionism is the future development direction of AI literature. AI literature can promote the development of technology. Through the study of human literary works and the imitation of human writing methods, AI can enhance emotional learning, improve emotional communication skills with humans, and enhance creativity. And a large number of metaphors in literary works can provide a rich metaphorical corpus for AI. By learning human metaphor, AI can understand and learn human analogy-associative thinking to some extent. This kind of thinking enables AI to acquire more knowledge and creativity on the basis of a few experiences, thus achieving generality. AI literature reflects the combination and promotion of art and technology, and also provides a way for AI to master human cognition.

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