Research on Artificial Intelligence Chip Design Mode based on Market Demand

Changrui Li

Northeastern University at Qinhuangdao, Qinhuangdao, China

Abstract

In recent years, with the widespread application of artificial intelligence technology, the demand for large-scale and super large-scale artificial intelligence (AI) chips with complex logic is increasing. In order to meet the needs of market applications, how to improve the design efficiency has become an important topic of AI chip design. However, the entire semiconductor ecosystem is changing now. These changes indicate that the way chip manufacturers enter the market and the factors important to them are fundamentally changing. The theory of "demand leads to innovation" holds that patent activities or invention activities, like other economic activities, are basically economic activities that seek profits and are guided and restricted by market demand. Therefore, the market demand affects the innovation of chip design technology.

Keywords

Market Demand; Artificial Intelligence; Chip Design.

1. Introduction

Artificial intelligence chip refers to a chip specially designed to run artificial intelligence algorithms. In order to meet the application needs of artificial intelligence in different scenarios, artificial intelligence chips gradually show the characteristics of specificity and diversity [1]. Artificial intelligence chip technology is the core technology in the era of artificial intelligence. It is widely used in automatic driving, intelligent wearing, automatic navigation, language translation and other industries. AI related technologies have gradually become the basic core fields related to national security and development. In order to further break through the shortcomings and shortcomings of AI core technologies, we will focus on the research and development of open-source algorithm platforms (such as dedicated chips, building deep learning frameworks, etc.) and learning reasoning decisions to accelerate innovation and iterative application [2]. Taking artificial intelligence chips as the hardware carrier of the artificial intelligence era has become the hard technology and strategic commanding heights to realize the future intelligent society [3]. The starting point of chip design is changing. The past approach was fairly straightforward: choose a processor based on power consumption or performance, and then determine how much memory on-chip versus off-chip is needed [4]. Now, the situation is much more complicated. This happened in part because the market began to emphasize the use of application-specific hardware and software solutions [5].

2. Combining Artificial Intelligence and Chip Technology

Artificial intelligence technology plays a great role in promoting today's science and technology. From the national level, governments of all countries regard AI as the leading role of future strategies, issue development strategic plans, and carry out overall promotion from the national strategic level. The wide range of perception of artificial intelligence thinking mode is its first advantage. The second advantage is that the speed and accuracy of artificial intelligence processing data are higher than that of human beings. Artificial intelligence can learn from the data and classify and cluster the data

through deep learning algorithms. The operation speed is incomparable to human beings [6]. The third advantage is that the data transfer speed is very fast, and the perception range, the speed and accuracy of processing the data all exceed humans. And all of this is based on the algorithm and data processing functions provided by a powerful chip. It can be said that the chip is the core factor supporting the development of the artificial intelligence industry [7]. With the rapid development of the emerging artificial intelligence industry, the development of science and technology has been promoted again. Chip technology is the core factor in the development of the artificial intelligence industry, and traditional chips cannot meet the requirements of today's rapid development of artificial intelligence technology. Therefore, how to build a general artificial intelligence chip and combine the two technologies to improve efficiency has become a hot topic and focus [8]. From the perspective of AI technology development, AI chips carry the computing required for AI and are the basis for AI technology development. From the perspective of the AI industry chain, AI chips define the basic computing architecture of the AI industry chain and ecosystem, and are the core of the AI industry [9]. Therefore, AI chips are the strategic commanding heights of competition in the AI era. Whoever masters the AI chip technology and the ecology behind it will control the dominance of the AI era [10].

3. Application and Development of Artificial Intelligence Chips based on Market Demand

3.1 Wide Application of Ai Chips

The AI chip under the current technical conditions is mainly a "accelerator" developed for the training and reasoning of neural networks. Its underlying architecture is a computing unit with "multiply add" function. According to the report released by global market watch, the global market of global artificial intelligence chipsets is expected to grow from US $9 billion in 2019 to US $80 billion in 2026. It can be seen that the application of AI chips is more and more pervasive in all aspects (see Figure 1). With the support of AI technology, the performance of mobile phones has been greatly improved, and they are excellent in image imaging, face recognition, application optimization, etc. The protection function has also been improved, and more accurate face recognition and privacy protection have also brought better experience to users. The AI chip has performed well in performance optimization and user experience, and the intelligent machine industry has reached a new level. At present, unmanned driving is also a hot field involved in artificial intelligence, which needs to process massive real-time data collected by sensors such as lidar and millimeter-wave radar cameras. AI chips can also analyze, learn and memorize human voices through voiceprint collection, thus providing security protection in the field of voice interaction. Through voice interaction, life can be made more intelligent, simplified and convenient.

Although artificial intelligence technology has made great progress, all countries are still exploring and looking for its development direction. In the field of AI chips, there is no universal chip that is applicable to many aspects. The implementation of AI applications and large-scale commercialization is a long process. From the perspective of the general trend of AI chip development, the development of customized AI acceleration chips that determine algorithms and application scenarios to general-purpose smart chips with higher flexibility and adaptability is an inevitable direction for the development of AI chip technology.

Big data, underlying algorithms and core processor chips are key elements supporting the continuous development of artificial intelligence technology. The abundance of data is one of the decisive factors to improve the effectiveness of the algorithm. With the penetration of mobile devices, the global data volume is accelerating. Not only the data flow is growing, but also the types of data are increasing.
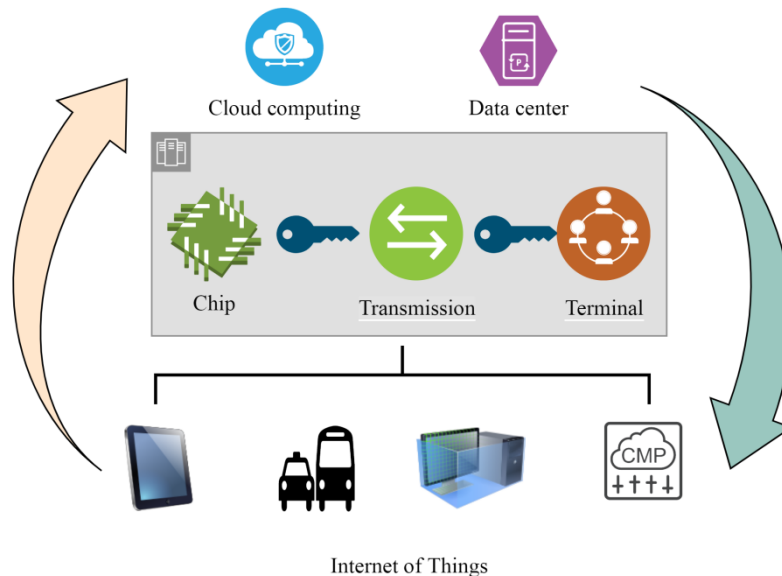
Figure 1. Artificial intelligence chips are widely used

3.2 Market Demand-oriented AI Chip Design and Development

Market demand has a great impact on chip design technology innovation. If there is a large-scale market demand, it can not only reduce the uncertainty risk in the process of technological innovation, but also lower the expected unit R & D cost, market cost and risk of products than those in countries with small market scale. Therefore, domestic demand, especially large-scale market demand, can reduce the cost of chip technology innovation and provide a stable market foundation. Sustained demand also provides market conditions for sustained technological innovation. When the function of technological innovation products exceeds the threshold value, the product function level brought by technological innovation is rapidly improved. Affected by the market induction of innovative enterprises and the demonstration effect of consumption pioneers, consumers' willingness to pay for new or improved functional products is also rapidly increased.

At present, the chip design mainly follows two development paths: one is to continue the traditional von Neumann computing architecture, with the main purpose of accelerating the hardware computing capacity, from central processing unit (CPU), general processing unit (GPU), to digital signal processor (DSP), to field programmable gate array (FPGA) and application specific integrated circuit (ASIC). The versatility of these five types of chips decreases in turn, which is the upgrading direction. The other way is to follow the non von Neumann computing architecture, represented by brain like chips, and adopt the structure of human brain neurons to improve the computing capacity. However, from the perspective of implementation, if real industrialization is realized, it needs to build an ecosystem, including a complete set of programming environment, compilers and other tools. According to the architecture, AI chips can be divided into CPU , GPU, DSP, FPGA, ASIC and brain like chips. It can be divided into cloud side and end side chips according to the use scenario, and each side can be divided into training and reasoning according to the task, as shown in Figure 2.

In order to meet different application scenarios in the field of artificial intelligence, artificial intelligence chips need to integrate a variety of computing components with different accuracy. However, the current artificial intelligence chips all adopt the technical route of integrating a variety of independent computing components, which bring a large chip area and power consumption. The innovation of AI chip industry is active, and a large number of AI chip enterprises have emerged. The innovation of technology and products is active. It actively breaks through the cloud AI chip field, focuses on the chip layout of the terminal market segment, and focuses on the smart phone, security monitoring, automatic driving and other terminal key segments. It accelerates the research and development of AI chips and tries to seize the market opportunity. However, it also faces a long-term application ecological cultivation.
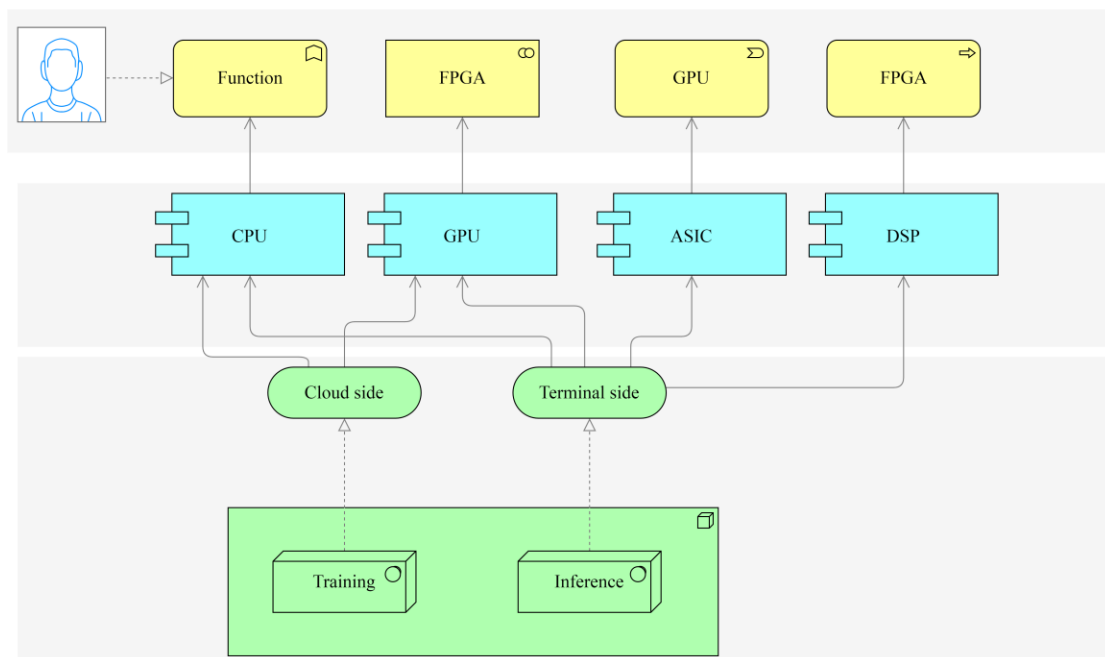
Figure 2. AI chip design architecture

3.3 Changes in Chip Design Technology Models

In the chip circuit, the data type is directly related to the bus and memory cell in the chip. Therefore, when setting the data type, the address length of the attractor, the number of columns and columns of the protruding matrix, the element value size of the protruding matrix and the data type of input and output are mainly considered. In the face of huge amount of computation, AI chips need to use more logic operation units in the back-end physical implementation, which requires more winding resources and physical area. At the same time, the power consumption is also an important indicator to determine whether the chip can work with high performance. Here, the whole process solution is used to complete the design and physical implementation of AI chip. The traditional layout planning requires the back-end engineers to be familiar with the data flow of the design, and determine the position and order of the macro cells according to the specific requirements of the product and the engineers' own experience. In order to obtain an optimal solution, it often needs repeated iterations, which is the starting point and the difficulty of the whole IC physical design. The chip design mode changes into the following three aspects:

(1) The best way to win a market is not necessarily to use the fastest or most power-efficient general-purpose processor. This has driven the industry to move toward more heterogeneous processing, advanced packaging, and a focus on how and where to process ever-increasing amounts of data.

(2) The artificial intelligence chip industry, as the most upstream industry, is the foundation and pioneer of the development of the artificial intelligence industry. Artificial intelligence chips pay more attention to super-speed computing capabilities, showing a differentiated development trend from general-purpose processor chips. Suppliers are becoming more cautious in choosing process nodes, they want to ensure that there is enough profit to recoup the resources they put in, because every product is very different now and cannot simply switch from one foundry process to another.

(3) There is also a lot of uncertainty in the end market, and architects are rethinking how to minimize the impact on the design if it needs to be adjusted for protocol or standard changes or market demands.

4. Conclusion

At present, the development of artificial intelligence chips can move from self reconfiguration, self-learning and self-adaptive artificial intelligence chips to general artificial intelligence chips. Cultivate an industrial atmosphere led by market application, and realize the coordinated development of "chip

algorithm platform application ecology". Give full play to the advantages of rich big data resources and broad application scenarios, drive the development of artificial intelligence chips with innovative applications, promote the establishment of organic interaction and cooperative R & D strategic alliance between enterprises in the fields of artificial intelligence chips, algorithms, platforms, applications and complete machines, and develop deep cooperation and collaborative innovation. In short, if we want artificial intelligence to truly change the society and people's lives, we must be down-to-earth and solve the current problems. The development of AI chip design is a long way off.

References

[1] Li Gang, Li Fengxing, Cheng Jian. Application scenario requirements: driving the development of artificial intelligence chip design [J]. Frontier Science, Vol.12(2018) No.4, p. 4.

[2] Ed Sperling. Changes in chip design ideas in the era of artificial intelligence [J]. Integrated Circuit Applications, Vol.14(2017) No.12, p. 4.

[3] Bai Songlin. Artificial Intelligence Technology in Chips [J]. Electronic World, Vol.8(2018) No.1, p. 14.

[4] Ty, Garibay. Prospects for the development process of artificial intelligence chips [J]. Integrated Circuit Applications, Vol.35(2018) No.10, p. 3.

[5] Gu Donghua, Lu Wei, Chen Tianyu, et al. AI chip design for cloud training based on INNOVUS platform [J]. China Integrated Circuits, Vol.28(2019) No.9, p. 6.

[6] Zhang Xurui. Intelligent miniature brain--Exploration of AI chip [J]. Communication World, Vol.26 (2019) No.01, p. 230-231.

[7] [7] Chen Zhengbo, Wu Tiebin, Zheng Fang, et al. Design of Floating Point Multiplier-Adder for Artificial Intelligence [J]. Computer Technology and Development, Vol.29(2019) No.8, p. 6.

[8] Gu Donghua, Lu Wei, Chen Tianyu, et al. AI chip design for cloud training based on INNOVUS platform [J]. China Integrated Circuits, 2019, No.9, p. 51-56.

[9] Chen Kuangyu. Technology development and application of artificial intelligence chips [J]. Digital Design, Vol.8(2019) No.12, p. 1.

[10] Ren Yuan, Pan Jun, Liu Jingjing, et al. Research progress of artificial intelligence chips [J]. Micro-nano Electronics and Intelligent Manufacturing, 2019, No.2, p. 15.