The Evolution of Artificial Intelligence and its Collaboration with Brain Science

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Abstract. The emergence of artificial intelligence is the product of the development of science and technology. At the same time, the development of science and technology has greatly improved the ability of the human brain and artificial intelligence. For example, scientists choose to train artificial intelligence with video games and improve the flexibility of the human brain. One example of artificial intelligence's success and its rapid development is AlphaGo. Go has long been recognized as one of the most difficult games in the world, and it seems surprising that artificial intelligence could easily win a match against a human master. But, it wasn't easy, and the reason for AlphaGo's victory has a lot to do with machine learning. By mimicking humans and their own evolution to give themselves an edge in the game and win. At the same time, many people think that artificial intelligence is very dangerous, and they think that artificial intelligence will replace or eliminate human beings, but the fact is the same as people's imagination? The benevolent see benevolence and the wise see wisdom. After decades of development, artificial intelligence can reach the level of cooperation with humans. Basic cooperation can no longer meet people's needs, and more advanced cooperation projects need to be developed. Human beings and artificial intelligence help each other, especially in brain science and the application of CNN in image processing. In these studies, human beings provide inspiration for the research and development of artificial intelligence, and artificial intelligence provides convenience for human life. Therefore, we can know that artificial intelligence plays a very important role in the evolution of human beings.

Keywords: Neural Networks and Deep Learning, Monte Carlo tree search (MCTS), Convolutional neural network (CNN), Pooling operation.

1. Introduction

For this paper, it was inspired by an article called "The Evolving Brain,"[1] which talked about the role of artificial intelligence in the development of brain science. Although I saw this article several months ago, it still impressed me deeply. This article is the beginning of my interest in the research of artificial intelligence in biological science. Therefore, when I conceive the topic and content of this paper, the first thing I think of is: Is there any cooperation between human beings and artificial intelligence? According to this question, I learned some information from different angles, such as strong artificial intelligence, application of artificial intelligence in medicine, composition and function introduction of human eye, development of artificial intelligence, achievements of artificial intelligence in different fields and so on. Because in my opinion, there are already a lot of scientists working on the combination of artificial intelligence and human beings, I mean, more and more cooperative projects are being proposed and realized.

2. Artificial intelligence training -- Electronic games

The emergence of artificial intelligence is a product of scientific and technological development

Our brains are constantly adapting to the environment, adapting to the environment, and then adapting to the new environment, and in the process, constantly competing and cooperating with others, so that our brains are constantly upgraded. In the process, humans have developed many ways to train their brains. The most enjoyable part is the game.

The amount of time people spends playing electronic games is skyrocketing due to the COVID-19 pandemic. Now NDP, an industry data tracker, has put the situation into perspective. As a result,

people of all ages (children, adults, and even many older adults) are playing electronic games more frequently. According to an NDP report, four out of every five people in the United States have played a game in the past six months. What's more, people are spending 26 percent more time playing electronic games than they did a year ago. [2]



Source: The NDP group / 2020 entertainment survey

Fig. 1 People's time changing on electronic games during the outbreak

In Fig1 [2]. As some unexpected things happen, the electronic games play a bigger role.

Artificial intelligence can be improved through some video games.

For example, the data problems. Artificial intelligence algorithms have improved a lot, and it can learn and execute human commands by constantly analyzing large amounts of data. Tiktok, for its part, creates an extraordinary amount of data every day, and it has the ability to solve those problems. There are even tens of millions of videos and pictures tagged on TikTok, and artificial intelligence uses big data to analyze users' preferences. But except that not all companies can accomplish such tasks, they don't have enough time to train artificial intelligence, so the role of video games comes into play here. This brings us to a project on artificial intelligence called MALmo. Artificial intelligence project Malmo is an open source and artificial intelligence experiment and a research platform based on the game <Minecraft>. The player can enter the virtual world through sensors and sense the signals sent back by the game. [3] This is a necessary way to train artificial intelligence before it can be used in the real world. At the same time, it could make it easier for researchers to understand how AI interacts with humans.

Another example is grand Theft Auto, which works for self-driving cars. Professor Artur Filipowicz and his team used game modeling in Grand Theft Auto to train artificial intelligence to correctly identify different signs. But their main job is that under different conditions (rain, snow, smog, damaged signs), artificial intelligence can still recognize the meaning of the traffic signs. The logos are all from scenes in Grand Theft Auto. Because the game has extremely large maps, it fits into different scenarios for research projects, and it fits into a very effective way to train artificial intelligence. Another example is grand Theft Auto, which works for self-driving cars. Professor Artur Filipowicz and his team used game modeling in Grand Theft Auto to train artificial intelligence to correctly identify different signs. [4] But their main job is that under different conditions (rain, snow, smog, damaged signs), artificial intelligence can still recognize the meaning of the traffic signs. The logos are all from scenes in Grand Theft Auto. Because the game has extremely large maps, it fits into different scenarios for research projects, and it fits into a very effective way to train artificial intelligence.

On the other hand, if we play some video games can improve our brain in observational and cognitive abilities. [5] There was a team of researchers who studied the effects of video games on the human brain, and during that time, they published several papers. They found that video games have a positive and formative effect on the brain. In a paper published in Nature, they found that video games can enhance and improve cognitive control in some older adults with cognitive decline.

Playing video games can make our brain more flexible and enhance our attention to life and video game [6] So what does play video games have to do with artificial intelligence?

In my opinion, we can think of this way of improving ourselves by playing video games as a collaboration between human brain and artificial intelligence (or a developing trend). When we play a game, we usually follow the rules of the game to ensure that we have the best chance of winning or winning, so in such an environment, our brain gives enough instructions, so our brain becomes more flexible and improves. So, when our brains are competing against a smarter artificial intelligence, our brains have the best chance to improve themselves, which has never been the case before. There are a lot of examples as proofs: AlphaGo is a good example. Demis Hassabis, the founder of AlphaGo, once gave a talk on the battle between artificial intelligence and the human brain, entitled "Beyond the Limits of Human Cognition". [7] The sentence that impressed me most was "Artificial intelligence is not only imitating human beings, but making its own judgment".

Human beings are pitiful, go has a long history, but even though human beings have been studying for thousands of years, they can't beat artificial intelligence that has only existed for less than 50 years. The cooperation between human and artificial intelligence is bound to create a new legend, not only in Go, but more importantly, artificial intelligence will be used in countless fields in the future.

2.1 A comparison of three chess games

To understand why AlphaGo can win against the best humans, one needs to understand how artificial intelligence learned how to play. Here according to three kinds of chess from simple to difficult to gradually discuss part of the principle.

6.1.1 Tic-tac-toe chess.

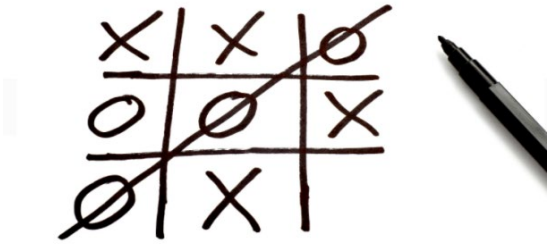


Fig. 2 An explanation of Tic-tac-toe chess

The rule is very simple, the two sides in turn draw a circle or cross, when three of the same symbols join to form a straight line, the victory. So, what are the key steps for artificial intelligence victory? For tic-tac-toe, there are three different moves as you can see in the first step, in the corner, in the middle of the board, and in the mid-top of the board. And opponent needs to make a decision based on the position of the first step. The computer needs to go step by step and guess at each situation.

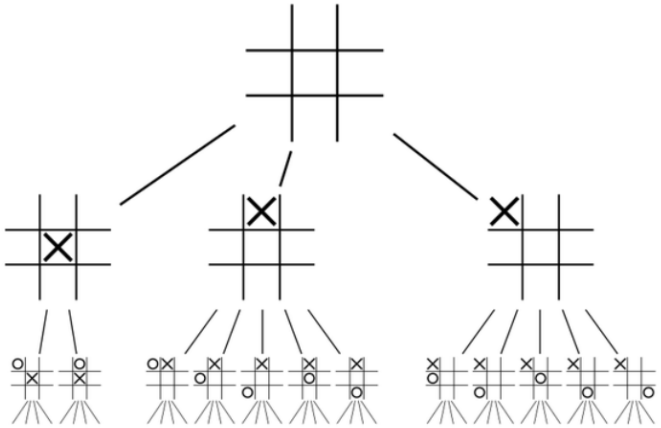


Fig. 3 The way of moving on the first two steps

In Fig3, it shows only the first two way of moving in a game, but there are 26,830 in tic-Tac-toe. Although the number is high, the computer can easily analyze every situation and record every win and loss. When the artificial intelligence plays chess, it can choose the branch that gives it the chance to win.

6.1.2 Chess.

Ian 8-by-8 board of 64 squares, with an average of about 30 different choices for each move halfway through the game, meaning the computer has to calculate more than a thousand possible scenarios for each deduction. One statistic: by the eighth round, there are 100 trillion possibilities. [8]. But for artificial intelligence, it doesn't have to deduce all the possibilities, it just has to deduce a few steps more than humans do. For example, when the computer found out that there was a game in round 10 that could get an advantage. If the opponent can be gradually induced into this situation, the probability of victory can be greatly increased. after a few pieces have been taken, the game changes a lot less, so deduction becomes easier.

This is the scoring algorithm: each game is evaluated with an advantage and a quantified score.

Artificial intelligence doesn't need to know which steps it can take to win a game, it just needs to know that the next step will give it a better chance of winning. This idea is called game theory: minimization Max algorithms. If you make your computer's graphics card more advanced, you can play more chess games, and your computer will win more often.

6.1.3 Go (Weiqi)

It has been calculated that there are 3^361 possible choices in Go, if people all over the world played go every day since 13.7 billion years ago, and each one is different, so far, only a tiny fraction of all possible choices have been made. Japanese go master Hideyuki Fujimawa once said, "I understand only 5 percent of go." People couldn't imagine what would happen if someone came along who understood 100 per cent of go, until AlphaGo seemed to satisfy that desire.

Alphago's achievements (Man Vs. Artificial intelligence)

Before going into the details of the story between AlphaGo and Go, I want to briefly introduce some of the basics of Go.

There are two major levels and 18 minor levels, namely professional level (1-9) and amateur level (1-9). The famous go master Lee Se-dol is a professional level 9 player. So far, China has only 42 pro 9 players. In other words, Lee Se-dol is one of the best men alive today.

On January 27, 2016, Google invited Lee to play a game of Go with alphaGo artificial intelligence robot. If Lee won, he would receive a prize of 1 million yuan, so Lee accepted the invitation gladly. But before the game began, many of the biggest names in the field were bearish on AlphaGo, and even its designers weren't confident. Jonathan Schafer, a renowned computer scientist (and draughts artificial intelligence designer), said: "I'm betting on Lee Se-dol, not to look down on AlphaGo. I think alphaGo is like a child genius who has learned go at a stroke, at a very high level, but it's not experienced enough. And its project manager, David Silva, put it this way: "I'm not betting on AlphaGo. Humans have a lot of tricks, some of which we can't train our computers to handle." Contrary to popular belief, However, Lee Se-dol failed miserably. [9]

In fact, in my opinion, the reason of Lee Sedol's failure is what we are facing is not the bulky computer program we imagined, but an artificial intelligence that has gone through big data analysis and deep learning.

2.2 Reasons for AlphaGo's victory

That's because it's playing chess the way humans do: learning. For a normal program, a programmer might need to plan every step of the way, but AlphaGo is different. AlphaGo’s core algorithm uses three of the most powerful approaches to machine learning today: Monte Carlo tree search, reinforcement learning and deep neural networks. Monte Carlo search is the big framework, reinforcement learning is the learning method, deep neural network is the tool, the mother is used to fit the situation evaluation function and strategy function. The former two constructs an algorithm

with autonomous learning ability, while the deep neural network can carry out a quantitative score on the advantage of the changes in the chess game. In addition, The AlphaGo also has the support of Google, which provides very powerful cloud computing hardware resources.

AlphaGo goes through three steps to learn and outperform humans. Initially, AlphaGo watched human players play games on an online go game platform, so it could learn what human choices were in certain situations. The team of AlphaGo used a smarter approach. Instead of simulating what AlphaGo should do when faced with a difficult decision, they simulated the human brain! Using 30 million human games as a sample, they trained a deep neural network that could mimic the way humans play. [10] Rather than having AlphaGo memorize all the human responses to each game, the neural network learns human thinking patterns and uses different approaches depending on the game.

As an example, neural network deep learning has been applied in many fields, such as face recognition and weather forecasting. An example that is very close to our life is China's Alipay. Due to the epidemic, Alipay upgraded its face scanning payment service. Even if people are wearing masks, Alipay can recognize you and make the payment. With 30 million samples of human matches, AlphaGo could easily cope with new games. This experiential approach is already better than many human players, and AlphaGo has a better memory and more experience.

But what really made AlphaGo evolve? -- Monte Carlo tree search algorithm (MCTS). The Monte Carlo search algorithm looks very advanced, but it essentially means "random". In other words, monte Carlo trees let the artificial intelligence play chess with itself -- in a random way. AlphaGo has the great advantage of being able to calculate a wide variety of different chess situations in a fraction of a second. While humans may only be able to play 1,000 games a year, AlphaGo can play millions of games against itself in a day. And how to simulate a larger number of times? Or how to calculate so many cases ---- random

The more random you are, the less chance you will encounter. Even without enumerating all the possibilities, for example, if we have two points: point A and point B, and AlphaGo does A random run of 10 million times and finds that point A has A higher chance of winning than point B, then point A might be the right choice, though we don't know why.

By simulating chess games using Monte Carlo tree search algorithms. In my personal understanding, this algorithm can be interpreted as randomly selecting apples, if there are 100 apples in the basket, let me close my eyes and choose the biggest one in the basket. So I pick a random one, and then I compare it to another random one, and then I keep the larger one, and then I pick a random one after that... Every time I pick it up, I leave an apple at least as small as the last one. The more I take, the bigger the apple, but I can't be sure I take the biggest apple until I take it 100 times. The algorithm for picking apples is the Monte Carlo algorithm -- try to find the best, but it's not guaranteed to be the best. AlphaGo was able to summarize and conclude which positions it placed its pieces in were more likely to win, allowing it to use those methods more frequently. After each simulation, AlphaGo will be smarter than before. In the constant simulation and selection, the method with low probability of winning will be eliminated quickly, and the probability of AlphaGo winning will increase when it plays a match. A better word to describe AlphaGo would be evolution.

In fact, for reasons of efficiency, AlphaGo's team chose to let AlphaGo evolve from learning 30 million games.

After an artificial intelligence called "Master" defeated humans, the AlphaGo team suddenly found that they had been thinking in the wrong way from the beginning, because they found that imitating human thinking all the time was becoming an obstacle to the artificial intelligence's ability to improve. Because the formulas and methods that humans have discovered so far are probably only a small fraction of the total possibilities of the game. So to ensure that they can see the real power of artificial intelligence, or that artificial intelligence is not constrained by human thinking, the AlphaGo team tried to make AlphaGo learn by itself without watching human matches. In October 2017, a new generation of AlphaGo was named AlphaGo Zero, which uses a self-iterative approach. In the initial program of AlphaGo Zero, the only thing set were the basic rules of Go. There is no human

intervention, no human experience, no data from previous versions of training, just it playing with itself.

In fact, AlphaGo in 2016 has refreshed people's understanding of artificial intelligence, so AlphaGo Zero in 2017 has completely changed people's understanding of artificial intelligence. And one cannot imagine how quickly AlphaGo has evolved. Before 2016, people thought that go was a very complex game with more changes than the universe and that it was impossible for artificial intelligence to win the game against human beings. But since 2016, people have come to believe that Go is a very complex game with more changes than the universe and planets, so it is impossible for human beings to win the game against artificial intelligence.

3. Will artificial intelligence replaces human brain?

Is it possible that artificial intelligence will replace human beings and become the master of the earth someday in the future?

Artificial intelligence is human creation of intelligent machines, artificial intelligence is a motion to simulate human thinking to serve human wisdom machine, scientists through the computer program in a language, the machine build neural network, and then by countless experiments in-depth study, in order to achieve the machine can do humans can accomplish this goal. In the 1940s, the world's first computer was developed. But now the computer field develops rapidly, more and more intelligent products are gradually born, decades of time, artificial intelligence has penetrated into every field of our life, and become one of the main development trends in the future.

In fact, our human brain has a limit, and when brain evolution reaches its end, so does human intelligence, but computers are different. Scientists predict that by the year 2030, computers will be able to process information faster than our brains today, replacing many of our brain's functions as computers store more and more knowledge [11]. Even in the future, computers can evolve and self-study, have self-consciousness, although they are created by human beings, but they have wisdom and thinking beyond human beings.

AlphaGo represents that robots have officially surpassed us in intelligence. In recent years, as more and more new technology is put forward and the application (for example, big data, cloud computing, etc.), make the development of artificial intelligence is very fast, so that now the robot is more and more new, they can speak, can imitate human can do most of the things, and even the intelligent robot can do humans can't do. The code programmers write for them seems to become their brains, allowing them to decide for themselves what they want to do.

Renowned astrophysicist Stephen Hawking believes that artificial intelligence can imitate human intelligence and will surpass human intelligence in the near future. It is possible that human beings will be helped by artificial intelligence, or be despised, marginalized or even destroyed in the future. Bill Gates believes that artificial intelligence will dominate the world. They believe that intelligence itself is the product of freedom, not the wild nature of intelligence. Artificial intelligence will eventually cross the threshold of intelligence, and then they will become independent in thinking and no longer subject to human constraints, attempting to dominate the world. Of course, some artificial intelligence is developed by human beings, so artificial intelligence will not produce self-consciousness in a vacuum, it just imitates, they are designed for the service of human beings, it is impossible to dominate the earth beyond human beings.

But anyway, a conflict between humans and artificial intelligence is possible, but that's in the future, and now humans control artificial intelligence. At present, artificial intelligence has indeed brought us a lot of beneficial effects. Based on big data and its own computing ability, artificial intelligence can be competent for many tasks that are difficult for human beings to complete, and human beings need not face boring work.

3.1 Artificial intelligence + Human brain = New Direction for Brain Evolution?

Artificial intelligence in the current life and study, is considered by most people is a very useful engineering discipline, and has played an extremely important role in many fields. But what is the better AI? It depends on the definition of "intelligence." Some people believe that when a person recognizes an object or picture, due to fatigue and carelessness, the error rate of the result will be greater than that of artificial intelligence. But when you talk to an artificial intelligence about an object it understands, you might get a lot of results at once. For example, if you go to Siri and ask: Can you give me some information about Apple? Its answer will include not only the components of the apple (fruit), or the benefits of eating it, but also apple Inc., or the apple was ate by Snow White. As a result, the results presented by humans will be closer to the desired results than the relevant concepts presented by artificial intelligence, because the information selected by artificial intelligence (machine learning classifiers) comes from the entire Internet and is not subject to selection. In other words, "intelligence" is a kind of ability to solve complex problems, but its understanding ability is not necessarily good, it will quickly reach the upper limit of solving complex problems. Like the picture below, humans can quickly tell the difference between a cookie and a dog. But artificial intelligence cannot. The very similar images interfere with the accuracy of artificial intelligence's judgment. So in my opinion, the cooperation between artificial intelligence and human brain is crucial.



Fig. 4 The similar details on difference objects.

3.2 Simple collaboration

Whenever the relationship between artificial intelligence and human beings is mentioned, the new direction of human brain evolution is closely related to artificial intelligence, which is a new direction of human evolution, and in fact, many scientists have started their research in this area.

In the United States, scientists led by Massachusetts General Hospital implanted a neural signal acquisition array with 96 microelectrodes into the brain of a quadriplegic patient. The chip was placed in the brain's primary motor cortex, and the signals from the patient's brain were analyzed by a computer, allowing him to use the brain signals to control the computer to help him perform simple movements. This method of implanting electrodes in the brain and allowing people to control objects using brain signals through artificial intelligence and machine learning can be seen as a process of human brain and artificial intelligence training each other.

Ai performs certain tasks by constantly learning and analyzing signals from the human brain, while the human brain adjusts itself according to the feedback from ai. While this is only the most basic form of collaboration, some teams are developing more advanced ways of combining human and artificial intelligence. For example, convolutional neural network (CNN) has been inspired by the human visual system

3.3 Receptive field and cisterification

When it comes to higher level cooperation between human brain and artificial intelligence, convolutional neural network (CNN) has a great connection with human visual system. In

neuroscience, a neuron can receive signals from many other upper neurons in different locations and a certain spatial range, integrate and make its own output. The spatial range of upstream neurons is called the local receptive field of the neuron.

In my opinion, the local receptive field can be regarded as CNN's pooling operation.

3.4 Pooling takes place in the retina

What I consider to be typical pooling occurs only in the retina, but this does not mean that the retina only completes pooling. What is the retina? The retina is a neural network structure located at the back of the eyeball that converts light signals into bioelectrical signals and transmits the processed bioelectrical signals to the lateral geniculate body through the optic nerve after preliminary analysis. The other two layers of the retina occupied by neurons are the lateral and medial nucleoli. The former is mainly composed of bipolar cells and horizontal cells. The latter is mainly composed of ganglion cells and cell bodies without long process cells. Pooling occurs between photosensitive layer and bipolar cell layer and between bipolar cell layer and ganglion cell layer. From the perspective of deep learning, the purpose of pooling operation is to use one value to replace the information represented by multiple values in a local area, so as to reduce the scale of the network but retain the characteristics of the original data. Pooling is a typical application of the concept of receptive field (STRF) in CNN [12]. In the retina, a ganglion cell receives a signal from one or more bipolar cells, which receive a signal from one or more photoreceptors.

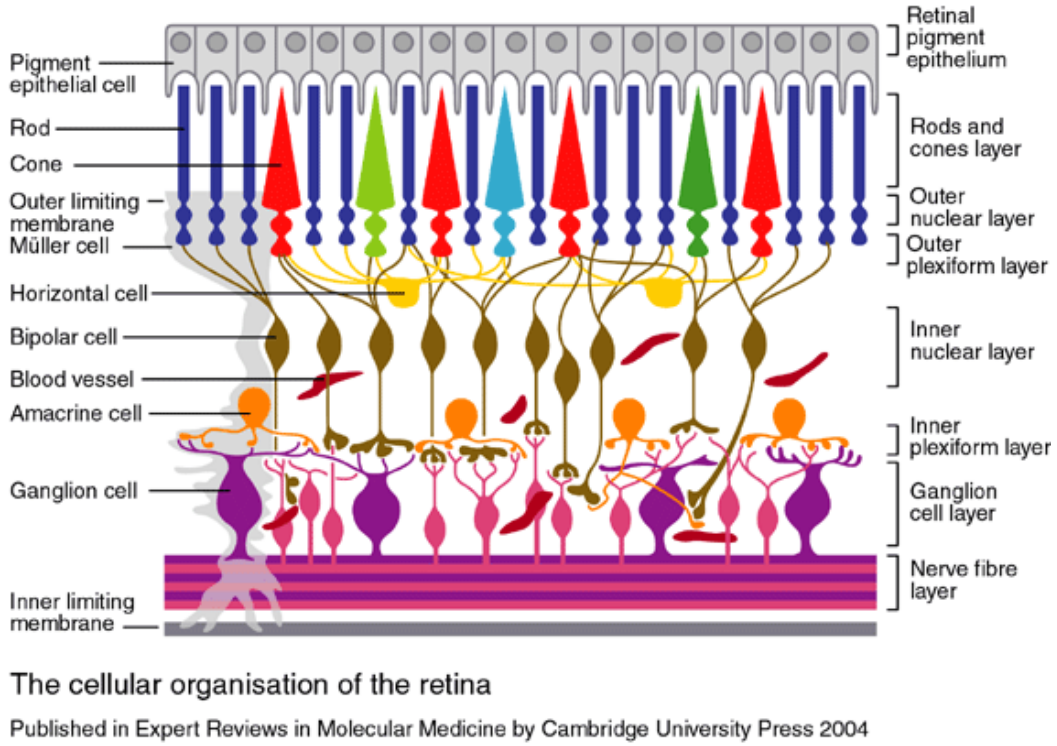


Fig. 5 The cellular organization of the retina

In Fig5 [13], there are cells called horizontal cells, which link and coordinate signals in the photoreceptor layer. You'll also find a class of cells called elongate cells that perform tasks within the ganglion cell layer (the same as horizontal cells). These two types of cell function is not entirely clear, my personal point of view, this may be caused by offset and pooling is not natural transition, may also be related to human eye image processing ways, because the human eye treatment video is dynamic, and CNN processing is static images, on the other hand and eye attention mechanism may have relation. For example, the human eye is more attracted to areas that change dramatically over a short period of time. For example, if someone is in a dark environment and suddenly a bright spot passes in front of their eyes, this will cause a dramatic change in the output of cells in the retina over a short period of time. However,

The similar structure does not be found in CNN. We need such a structure to deal with more complex problems, such as Video processing. Especially in the future, when human beings will always grow old, we may use these artificial intelligences with deep learning to help us live a more convenient life. On the other hand, the evolution of human brain is limited, so human beings need the help of artificial intelligence to continuously explore the unknown things.

4. Conclusion

There are always many factors that make the development of Both AlphaGo and artificial intelligence working with human brains uncertain, but more and more people are paying attention to the field, and more and more money is being invested in the research and development of artificial intelligence. This shows that artificial intelligence is becoming more and more important for human development, and artificial intelligence will play its role in more fields,

To improve the speed of human evolution, and in the future, there are more opportunities for cooperation between human brain and artificial intelligence to make greater contributions to human beings.

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