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The Evolution of Artificial Intelligence and the Possibility of its Application in Cyber Games

Эволюция искусственного интеллекта и возможность его применения в кибериграх

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Abstract

Artificial intelligence, as a separate field of research, is currently experiencing a boom - new methods of machine learning and hardware are emerging and improving, and the results achieved change the life of society. Machine translation, handwriting recognition, speech recognition are changing our reality. The work of creating unmanned vehicles, voice assistants and other devices using these technologies is in an active process. The article examines the historical context of the artificial intelligence development, it evaluates the possibilities of its introduction into cyber games, as a safe and effective platform for testing new methods of machine learning. The promotion of such projects can increase the reputation of development companies, ensure increased user confidence in other products and, with a competent marketing strategy, cause a significant public resonance among video game fans, providing the developer with economic profit.

Key Words: artificial intelligence, cyber games, machine learning, neural network, pattern recognition.

Аннотация

Искусственный интеллект, как отдельная область исследования, в настоящее время переживает подъём – появляются новые и совершенствуются существующие методы машинного обучения, аппаратные средства, а достигнутые результаты меняют жизнь общества. Машинный перевод, распознавание рукописного текста, распознавание речи уже повсеместная реальность. Активно ведутся работы по созданию беспилотных автомобилей, голосовых помощников и прочих устройств, использующих данные технологии. В статье рассматривается исторический контекст становления искусственного интеллекта, оцениваются возможности его внедрения в киберигры, как безопасную и эффективную площадку для испытаний новых методов машинного обучения. Продвижение подобных проектов способно повысить репутацию компаний-разработчиков обеспечить повышение уровня доверия пользователей к остальной продукции и, при грамотной маркетинговой стратегии, вызвать весомый общественный резонанс среди поклонников видеоигр, обеспечив экономическую прибыль разработчику.

Ключевые слова: искусственный интеллект, киберигры, машинное обучение, нейросеть, распознавание образов.

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Introduction

One of the interesting properties of society is the growth rate of its individual measurable indicators at rates close to exponential progression. Such an effect can be seen in the population, in economic indicators, in science.

F. Engels noted: «... science is growing at least as fast as the population; science moves forward in proportion to the mass of knowledge inherited from the previous generation» (F. Engels, 1968). In the modern world, the ways of interaction between scientists are being improved, the work organization of large groups of researchers becomes possible, the natural consequence of this is the emergence of new areas of research, new sciences - either specifying individual classical sections, or arising at the junction of several research areas. As a result, within the framework of one generation, we can see the formation of a new field of knowledge, which is becoming one of the leading and determining in society. A striking example was the Dartmouth seminar, which brought together in 1956 ten scientists from different fields of science working on similar issues, who received the name proposed by John McCarthy - artificial intelligence.

As far back as in the past centuries, philosophers argued on the topic of thinking, searched for answers to questions - if there is any difference between mind and matter, and various fields of science have created a theoretical machine, the foundation which artificial intelligence stands on now. For artificial intelligence, formalization of three fundamental areas became important: logic (George Boolean - Boolean logic), computation (Church-Turing theorem) and probability theory (Bayes theorem, which underlies many machine learning methods). Economists, trying to understand how people make decisions to achieve preferable results, have come to the creation and study of decision theory and game theory. A logical continuation of the study was the study of operations, and a certain class of sequential problems of decision-making (Markov processes) was formalized in the work of Richard Bellman. Interesting results were obtained by the work of neurologists - the collaboration of simple neuron cells can lead to the appearance of thinking, action and consciousness. The brain is consisted of billions of neurons, therefore, to simulate its behavior, it requires the creation of many simple modules and the organization of their interaction - computer technology has begun to solve this problem. All these achievements are only a background in which many other scientists played an important role.

Theoretical framework

The authors of the first work on artificial intelligence are Warenn McCallock and Walter Pitts - described a model consisting of artificial neurons (a kind of symbiosis of the knowledge of physiology, logic and computational theory of Alan Turing), which could calculate all possible logical connections (McCulloch W.S., Pitts W., 1943). It has been suggested that such a model can be trained - such a method was demonstrated by Donald Hebb, his proposal is now called Hebb training.

Another important work is an article by Computing Machinery and Intelligence by Alan Turing, which described: Turing test, principles of machine learning, genetic algorithms, reinforcement learning (Turing, 1950).

For many years, scientists worked on creating artificial intelligence systems, high expectations were placed on programs, but all of them solved some small problem in their simulated “microcosm”, and when attempts were made to create larger-scale projects, this approach did not work. The programs did not possess "intelligence", but sorted through all sorts of options and found the right ones - for complex problems a combinatorial explosion occurred, that is, the number of searches exceeded the calculated powers. The problem was not only in the insufficient power of computers, but also in the poor elaboration of the theory - the accumulated experience and planning were inefficiently used. A very striking example: the development of machine translation of text. A lot of money was invested in this project by the US National Research Council, but it all ended in collapse. The program translated "word for word", not considering the context, which was very important. As a result, funding programs were shut down, and artificial intelligence waited for several years of calm.

The next surge of interest in artificial intelligence systems occurred in the period 1980-1986 and is associated with the development of expert systems. In these projects, the programs had a knowledge base (rules), separated from components that could carry out logical reasoning. The first such example is the Dendral program, which has been successfully used for scientific purposes. After a while, the first

commercial expert system appeared - all these successes increased the flow of funding from the states and private capital, and artificial intelligence, in fact, became an industry. But the story repeated itself. The subsequent calm was called the "winter of artificial intelligence", although some groups of scientists did not stop working. For example, in 1987, neural networks with back spread of error were developed, evolutionary methods — genetic algorithms and genetic programming — were better studied. Around the same time, artificial intelligence became tougher based on exact calculations, the mathematical machine.

The next stage of the revival occurred in the middle of the two thousandth, when several factors converged:

1) computing power, and especially the ability to calculate on GPUs, accelerated learning by orders of magnitude,
2) there were quite voluminous data sets for training,
3) advancement in the theoretical machine, including the work of scientists led by Jeffrey Hinton and Yoshua Benji on teaching deep neural networks.

The term "deep learning" appeared after the work of Rina Dichter (Dechter, 1986), although, in fact, the origins of this method can be found in the works of Soviet scientists Alexei Grigoryevich Ivakhnenko and Valentin Grigoryevich Lapa «Cybernetic predictive devices» (Ivakhnenko A.G., Lapa V.G., 1965). It was deep learning that marked the current revolution, and the potential of this approach has not yet been exhausted.

Thomas Mitchell in the classic work «Machine Learning» gave the concept of «learnability»: «A computer program learns as experience is gained regarding a certain class of tasks T and objective function P, if the quality of solving these problems (relative to P) improves with new experience.» (Mitchell, 1997).

It should be noted that the most important part of learning is the choice of a function - that is exactly what interprets the quality of the result, which can be considered successful learning.

Machine learning is classified as follows:

- training with a teacher - when there is marked up data (with the correct answer);
- training without a teacher, when there is data, but it is not marked up, or when it is difficult in principle to do this - the computer independently looks for patterns;
- training with the partial involvement of a teacher - something in between the first two points;
- reinforcement training - when there is no data, but the computer can interact with a certain system and receive rewards.

The mechanism of human intelligence has not been fully studied, there is no exact list of properties, the fulfillment of which can be attributed to the program of artificial intelligence - on an intuitive level it is understood "to be like a human being." And therefore, when loud statements are made that the program implements "artificial intelligence", this, in essence, means that only some single problem is solved, even if at the human level.

The first attempt to compile a test to confirm the presence of intelligence is a Turing test in a 1950 Computing Machinery and Intelligence article. The general outline of the test is very popular - a computer must pass itself off as a person in written communication with a judge. The original wording is interesting, because, in fact, in this test the computer impersonates an abstract person, and it's enough for a person to remain himself (a person cannot pass the "Turing reverse test" - pretend to be a computer). Therefore, Turing suggested that only men participate in communication with the judge, and they try to impersonate a woman, as well as a computer. Now, in our time, this is not a legitimate test, because the so-called "chatbots" are quite capable of passing it, but in fact they do not understand the context and are not intelligence.

Since deep machine learning has been successfully applied, it has become possible to achieve results that were previously impossible and now you can name the results of this peculiar revolution:

- virtual personal assistants: Siri, Kortana, Alice are able to work with natural speech, making it easier to find and perform some tasks of their users;
- offer of goods, advertising: by collecting user data, targeted advertising becomes possible, which allows various platforms (for example, Yandex) to effectively offer goods to the user;

- online customer support: the introduction of chatbots on sites simplifies interaction with customers, while work is ongoing on the introduction of voice "answering machines";
- video surveillance: machine learning technologies make it possible to monitor video data, which, among other things, increases the safety of people;
- smart home: many companies offer their solutions, although you can't call them the full realization of the ideas of science fiction films, but the progress is impressive.

Machine learning has reached great heights, but computers are still not able, for example, to understand the context of text at the human level. At the same time, they need a large amount of data for training (where a person can understand and develop a certain skill in a couple of minutes) - this is called transfer learning transfer learning, studies are now being conducted for training with one example of one-shot learning. Also, from childhood, a person develops "basic knowledge" - intuitive physics - the principles by which the surrounding physical world works, and intuitive psychology - the pursuit of goals, what is the moral that people use in future in various life situations. Success in recognizing objects in a photograph does not mean that such artificial intelligence understands what is actually happening in the image - this is a problem of causality.

Therefore, in fact, the successes of artificial intelligence belong to the "weak artificial intelligence", such technologies make it possible to solve problems well in a certain subject area.

Strong artificial intelligence, Artificial General Intelligence (AGI) will be able to work with all individual tasks, but also make conclusions, learn, operate on concepts of different areas, i.e. will be at least "like a man". A person has biological limitations, strong artificial intelligence will be deprived of this and, having reached the level of people, such intelligence will begin to develop incredibly quickly - this effect is called singularity. At present, this question is rather a philosophical one - in what the role of people will become, how the intellect will treat humanity, etc .(Tim, 2015).

Also known is the experiment of Eliezer Yudkowski - the AI box experiment (AI in a black box), and as a result it was shown that communicating with a person only through a text channel, artificial intelligence is able to get out of the black box. Discussions on this subject can be found among various modern futurologists, for example, Nick Bostrom (Bostrom, 2016; Barrat, 2015).

Methodology

We use the method of analysis of literature and Internet sources on philosophical, social and technical issues, such as artificial intelligence and cyber games, as well as the study and generalization of experience in the development and implementation of cyber games.

Results and discussion

One of the interesting and promising areas of studying strong artificial intelligence is reinforcement learning. The program is placed in a situation where it can collect the initial information, and then practice in applying of the processed data - to develop different strategies to achieve the goal. Games can be such an environment - since, in fact, this is a ready-made virtual space with its own set of rules and an ultimate goal, and it's relatively easy to measure. There are several advantages to this approach. For example, it is safe for the outside world - for testing an autopilot in a city full control by the developers is required, which means, as a result, also cheaper. The developers also strive to create such artificial intelligence for one game that training for another will be quick, like a person's. In the game, it is easy to make changes to the rules of the world, which means that artificial intelligence must be able to adapt. At the same time, game worlds have a large number of variables, requiring quick decision-making, which can have consequences only after a long period of time - a wide field for creativity and research.

Note the disadvantages. Such systems are still being trained on a multitude of examples - unlike a person who can understand the basic principles and the basic strategy of the video from YouTube. Another problem is rewards. In games, it's easy to reveal this, for example, an increase in the score, but in reality everything will be much more complicated. Moreover, in successful demonstrations of the work of neural networks, fraud moments, such as unsportsmanlike and honest reactions, are later revealed.

The first games the computer tried to be taught were classic board games. Since 1952, Arthur Samuel, a future participant in the Dartmouth seminar, has written a number of drafts programs

that could ultimately play at the amateur level. Herbert Simon, another participant in the Dartmouth seminar in 1957, made a very brave prediction that within ten years a computer could defeat a person in chess. Although this happened later, the fact has come true. On May 11, 1997, the Deep Blue2 chess supercomputer defeated world champion Garry Kasparov in 6 games. The first series of games was held a year before, where Kasparov was able to win, but the developers made significant changes to the design of the chess processor, successfully implemented them, adapting the software. As a result, this supercomputer was consisted of two racks, with thirty nodes located in them. Each node had its own processor with two boards, which had eight chess processors on each. Logically, the software used one of the alpha-beta cut-offs a forced version, iterative deepening, permutation tables, and also debut books. As a result, the main processor examined the first few moves of the game tree, and distributed the positions among the nodes. The nodes also moved forward several steps and distributed the search to a greater depth among the chess processors. To evaluate positions, a special evaluation function was developed. Thus, the first victory of the computer was won due to the incredible amount of enumeration of positions, but since a simple enumeration of all possible positions is not feasible even with a multiple increase in computer power, various optimizations have been used and are now being used. Nevertheless, even with such assumptions, the computer could not cope with the Chinese version of chess, where the number of possible moves is way higher than the classical version.

The story with a chess supercomputer is interesting because in early 2018, a team of developers from DeepMind solved this problem with the help of machine learning. The AlphaZero algorithm they created defeated quite a bit the strongest classic version of Stockfish9 computer chess with a score of “+155 -6 = 839” in 1000 games. Approximately the same ratio remained with Stockfish - AlphaZero when it comes to the time handicap, and it takes less to sort out the moves, as it is able to “intuitively” evaluate the situation. Stockfish estimated 70 million positions per second, and AlphaZero - 80,000 per second. As Jonathan Rawson said after a crushing match defeat from Michael Adams in 1998: "I was shocked at how little he saw."

Here is the point of implementation. AlphaZero neural network initially does not know about strategies in chess - the algorithm begins to play the game with itself. When losing, the scales are re-evaluated - to avoid made mistakes. Moreover, the neural network itself is consisted of two parts:

1) "evaluating" - evaluates the current position of the figures,
2) "strategic" - suggesting moves.

The choice of moves, or rather the selection of potential moves, is carried out using the Monte Carlo method (i.e., with some degree of randomness). As a result, the strategic part offers a certain set of moves (much smaller than Stockfish considers), which are considered several moves ahead, but the evaluating part, due to its "intuition", quickly rejects weak moves, which also reduces the computational load. Learning from scratch to a competitive level in the algorithm takes 4 hours, but significant computing power is used so that approximately 70 million games are played. It is worth noting that after all, a small part of good moves may not be considered due to chance - therefore, Stockfish won some games.

An important fact is worth noting here - there was no chess terminology. The algorithm starts from scratch, just knowing the possible moves (rules), then it plays by itself and learns.

This approach was successfully applied two years before chess, in the game go. Go is also played on a board with cells, there are pieces that move according to certain rules, but there is more field, more pieces, more complex rules, and it’s very difficult to evaluate positions. For this game, the tree of potential moves cannot be sorted out - it is too huge, therefore there was not even a program playing at the human level. DeepMind with its AlphaGo algorithm defeated the go world champion in 2016 - the first such case for a computer program (Silver, D., Schrittwieser, J., Simonyan, K. et al., 2017).

The first mention of DeepMind (Hodsonm, 2019) occurred in August 2010 at the Singularity Summit. The logo of this company appeared on the slide of the speech of Demis Hassibis, its founder - he told “A systemic neurobiological approach to the construction of AGI”.

Demis argues that the attempt to copy the biological structure of the brain is not particularly effective for building strong artificial intelligence - it is more interesting to study the processes occurring inside, the "software of the brain." After that, DeepMind received a solid investment, including from the organizer of that

conference, Peter Thiel - both of them were united by a goal in creating AGI.

Currently, DeepMind remains one of the leading companies and continues to work on reinforcement training, in December 2018 there were demo games with professional Starcraft2 players, where the neural network won. Unlike chess and go, where in theory you can calculate all the possible moves, Starcraft2 is a real-time game - you need to evaluate the current situation literally every fraction of a second, time for making decisions is limited. Also, some data is hidden from the player - intelligence is required. Moreover, Starcraft2 is considered one of the most difficult strategies, the player controls many separate game units, and the decisions made at the beginning will have an effect after a long time. The AlphaStar deep learning neural network architecture works according to the "transformer torso to the units, combined with a deep LSTM core, an auto-regressive policy head with a pointer network, and a centralized value baseline" method (AlphaStar team, 2019).

Initially, the neural network was trained on the basis of anonymous replays - game records, which made it possible to identify the main strategies. Further training took place in a multi-agent environment - following the example of tournament games. New agents were added by copying the current ones, then they played among themselves, thereby learning. This is similar to the idea of evolutionary algorithms, thus the agents met with the strongest tactics, but did not forget the old ones. Some agents finalized the original strategy, others completely changed, trying to implement a counter-strategy. At the same time, to promote training, some agents had different goals, for example, to defeat a specific group of agents, or to use certain units.

The peculiarity is that in real-time games, reaction, click speed is often important, and Starcraft2 is just like that - a large number of game units, a rapidly changing situation, and a person has a limit. Due to the quick simulation of clicks, the computer gains an advantage that is not compensated even by a perfectly thought-out human strategy. Therefore, they always set limits, thereby equalizing the chances (Pietikäinen Aleksi, 2019).

Another major project to develop artificial intelligence for video games is the brainchild of the collaboration of Valve and OpenAI. OpenAI is a nonprofit organization for researching AGI, which received support from Elon Musk, Gabe Newell, Peter Thiel, Amazon. OpenAI works with the game Dota2, which is also a complex strategy with many parameters. The development was announced at International 7 - one of the largest cyber tournaments, the Dota 2 World Cup, where they demonstrated a one-on-one game. A year later, at International 8, there were games between the professional team and the bots, but with rather big restrictions - people won. In the spring of 2019, they launched an open test, which meant everyone could register and play against the computer. OpenAI also provided an open platform - OpenGYM, a kind of sandbox for testing and comparing different learning algorithms

Conclusions

A computer has great capabilities and is capable of performing calculations much better than humans, it remains only to program the necessary actions, but there are subject areas for which the creation of clear algorithms is so difficult that, in fact, is impossible. A person is able to cope with it due to his accumulated experience, the presence of imagination, the possibility of strong abstraction and the ability to learn. An attempt to reproduce these features by a machine has been going on for a long time, such technologies have received the general name of machine learning - developers create a model with many parameters, and the computer selects them.

The history of artificial intelligence developed in waves - after a breakthrough there followed years of calm. About 15 years ago, the so-called deep learning was successfully applied, as a result deep neural networks were able to solve previously uncalculated tasks.

Initially, it was popular to use the so-called teaching with a teacher and teaching without a teacher. In the first case, there are large databases of tagged data, and in the second, just data. Therefore, in recent years, researchers have been trying to reinforce learning - the model can interact with the provided environment, and thereby learn (Fedosov A., Eliseeva D., Karnaukhova A., 2019).

A good example of a ready-made environment, with its own set of rules and the result that can be evaluated are games. Board games, such as chess and go – which means, games with theoretically calculated all positions, explore real-time games. In such games, the possibility of miscalculation is much less possible, and decisions must be made as quickly as possible. But on the other hand it is safe and less expensive, therefore,

companies such as DeepMind and OpenAI work with popular games.

Despite the not fully understood potential of learning with reinforcement in games, he has disadvantages that should not be forgotten: a lot of tests are carried out, a convenient evaluation function. In addition, in general, artificial intelligence causes controversy - from the theoretical destruction of mankind until vice versa, the only salvation of the last, nevertheless, at this stage of development, this technology significantly improves human life.

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