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GAME APPLICATION WITH MACHINE LEARNING ELEMENTS

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Abstract: Nowadays, artificial intelligence is used in many areas of activity. In this article we will present the advantage of using AI in the gaming industry.Game development is a complex and time-consuming effort. The game environment, storylines, and character behaviors are carefully thought out, so graphic artists, storytellers, and software developers need to work in unison. Often games end with a delicate combination of hardware behavior in the form of traditional code and a slightly more responsive behavior in the form of a large set of rules. Everywhere around us, our perception of learning and intelligence is challenged daily with the advent of new and emerging technologies. From self-driving cars, go games and Chess to computers capable of defeating people in classic Atari games, the emergence of a group of technologies we colloquially call "Machine learning" has come to dominate a new era of technological growth - a new era of growth that has been matched with the same meaning as the discovery of electricity, and has already been categorized as the next technological age of man. Machine learning is the realization of artificial intelligence. It is a way for a computer to assimilate data or state and provide a learned solution or response. Now we often think of AI as a broader term that reflects a "smart" system.

Keywords: Artificial intelligence (AI), Reinforcement Learning (RL), Machine Learning (ML)

МАШИНАЛЫҚ ОҚЫТУ ЭЛЕМЕНТТЕРІН ҚОЛДАНАТЫН ОЙЫН ҚОСЫМШАСЫ

Аңдатпа: Жасанды интеллект қазіргі кезде көптеген қызметтер сферасында пайдаланылады. Бұл мақалада біз ЖИ (Жасанды интеллект) ойын индустриясында қолданудың артықшылығын көрсетеміз. Ойындарды құрастыру – күрделі де ауқымды жұмыс. Ойын аясы, сюжеттік линиялар және кейіпкерлердің іс-қимылдары жан-жақты ойластырылады, сондықтан, бағдарламалық қамсыздандырудың суретшілер-графиктері, әңгімешілері мен құрастырушылары унисон жағдайында жұмыс істеуге тиіс. Ойындар, көбінесе, дәстүрлік код нысанындағы аппаратық қамсыздандыру қызметіндегі деликаттық комбинациямен және ережелердің көптеген құрамы түріндегі мейлінше жауапты іс-қимылмен аяқталады. Айналамызда жаңа және пайда болатын технологиялардың өмірге келуімен біліміміз бен ақыл-ойымыз күн сайын сынға түседі. Автоматты басқарудағы автомобильден бастап, шахмат ойындары және Atari классикалық ойындарында адамдарды жеңуге қабілетті компьютерлермен аяқталатын, күнделікті қарым-қатынаста біз «Машиналық оқыту» деп атайтын технологиялар топтары пайда болды. Олар технологиялық дамудың жаңа дәуірінде басымдыққа ие болды. Бұл дәуірдің даму тарихындағы маңыздылығы өз кезінде электр қуатын ашумен бара-бар адамзаттың технологиялық ғасырында жаңа кезең деп атауға болады. Машиналық оқыту – бұл жасанды интеллекті жүзеге асыру. Маңыздылығы сол – компьютер үшін деректерді немесе қалпын ассимиляциялау және зерттелген шешім, әйтпесе жауап беру тәсілі. Енді біз ЖИ "ақылды" жүйені көрсететін кең термин түрінде түсініп қабылдаймыз.

Түйінді сөздер: Жасанды интеллект, қосымша оқыту, машиналық оқыту, ойын қосымшасы

ИГРОВОЕ ПРИЛОЖЕНИЕ С ЭЛЕМЕНТАМИ МАШИННОГО ОБУЧЕНИЯ

Аннотация: *В настоящее время искусственный интеллект используется во многих сферах деятельности. В этой статье представлено преимущество использования ИИ в игровой индустрии. Разработка игр – сложное и трудоемкое усилие. Игровая среда, сюжетные линии и поведение персонажей тщательно продуманы, поэтому художники-графики, рассказчики и разработчики программного обеспечения должны работать в унисон. Часто игры заканчиваются деликатной комбинацией поведения аппаратного обеспечения в форме традиционного кода и немного более отзывчивым поведением в виде большого набора правил. Повсюду вокруг нас наше восприятие обучения и интеллекта ежедневно оспаривается с появлением новых и инновационных технологий. Начиная с автомобилей с автоматическим управлением, заканчивая играми в шахматы и компьютерами, способными побеждать людей в классических играх Atari. Появление группы технологий, которую мы в разговорной речи называем «Машинное обучение», стало доминирующей новой эрой технологического роста – новой эрой, рост которой соответствовал тому же значению, что и открытие электричества, и уже был отнесен к категории следующего технологического века человека. Машинное обучение – это реализация искусственного интеллекта. Это способ для компьютера ассимилировать данные или состояние и предоставить изученное решение или ответ. Теперь приходится часто думать об ИИ как о более широком термине, который отражает «умную» систему.*

Ключевые слова: *искусственный интеллект, обучение с подкреплением, машинное обучение, игровое приложение*

INTRODUCTION

Machine learning is a set of technologies and methods of artificial intelligence, the function of which includes learning the machine when searching for solutions for more accurate and efficient execution of tasks. If several years ago the programmer had to constantly create for each problem a clear and strict algorithm for the computer, then with the advent and development of machine learning, this is no longer necessary; the system itself seeks a solution. Machine learning is created for tasks that do not have a unique solution algorithm, but only an array of input data. For example, on one computer they say that on one millionth of a cat, and not on the other, a million is not. In addition, the task of the machine is to create an algorithm by itself, after which the next image needs to understand whether there is a cat.

Artificial intelligence is an attempt to copy the process of human thinking through a computer. The task of researchers of artificial intelligence is to create such a mechanism that is as close as possible (or even surpasses) to the human natural intelligence in all tasks that need to be solved. Natural (human) intelligence is largely determined by emotions. In the human brain, there are many different neurons and hormones that cause different sensations, such as fear, joy, or hunger. Artificial intelligence is not endowed with emotions and requires other mechanisms to solve problems.

In this context, we proposed an approach to using machine learning to create a game where artificial intelligence would be the opponent. The proposed approach includes the main stage, where reinforcement learning (Reinforcement Learning) is used - one of the ways to interact, in which the system learns, interacting with the environment. The work is based on the principle of "give-take, beat-run" and after each interaction with the environment, receive either harm or reward. The algorithm is trying to find as many attempts to explore the various elements of the world. To debug this type of algorithm, we need environments with complex, but formal and limited rules. One of these environments is games.

• States: A state is a complete description of the world in which not a single piece of information characterizing this world has been omitted. This can be a position, fixed or dynamic. Typically, such states are written as arrays, matrices, or higher order tensors.

- Action: The action usually depends on environmental conditions, and the agent will take different actions in different environments. The set of valid agent actions is recorded in a space called an "action space". As a rule, the number of actions in space, of course.
- Wednesday: This is the place where the agent exists and interacts with. Different media use different types of rewards, strategies, etc.
- Reward and win: It is necessary to constantly monitor the reward function R when training with reinforcements. It is crucial when setting up an algorithm, optimizing it, and also when you stop learning. It depends on the current state of the world, the action just taken and the next state of the world.
- Strategies: A strategy is the rule whereby an agent chooses the next action. A set of strategies is also referred to as an agent "brain".

One episode of reinforcement training is
$$s0, a0, r0, s1, a1, r1, ..., sn, an, rn \quad (1)$$

Where si- the state of the medium at time ti,
ai - selected action
ri- the observed reward after applying the action to the environment.
Then the full reward for the entire training episode is
$$R = r0 + r1 + \cdots + rn \quad (2)$$

Where ri - the observed reward after applying the action to the medium at time ti.
The total future reward is presented as

$$Rt = rt + rt + 1 + \cdots + rn \quad (3)$$

Where ri is the observed reward after applying the action to the medium at time ti.

The purpose of training in this task is to build a strategy, the following, which always chooses an action that maximizes the value of the discounted future benefits.

Q-learning is a method used in artificial intelligence with an agent approach. On the basis of the remuneration received from the environment, the agent forms the utility function Q, which later gives him the opportunity not to accidentally choose the strategy of behavior, but to take into account the experience of the previous interaction with the environment. The agent has some set of actions. The agent's actions influence the environment, and the agent is able to determine what state he is in at the moment and receives this or that reward from the environment for his actions. The task of the agent is to find the best strategy. Formally, the simplest model of learning with reinforcement consists of
- sets of states of the environment S
- action sets A
- sets of real scalar "wins"
In Q-learning, we define the function Q (s,
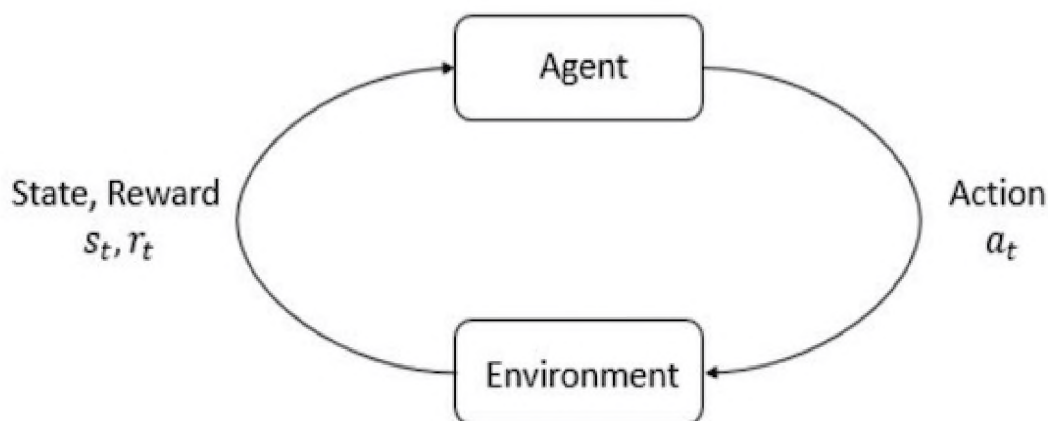
Agent-environment interaction loop.

Figure 1 – Agent-environment interaction loop

a), denoting a future reward, when we perform action a (action) in the state S [6]:

$$Q(s_t, a_t) = \max R_{t+1} \quad (4)$$

One example is the case of DeepMind, the previous division of Google, whose developers taught AI to play in the Quake III arena, as a person does. For training, the system was used with reinforcements.

The main contribution of the proposed approach is to apply this method of machine learning in order to show the potential of artificial intelligence and the speed of learning in comparison with a person. To explain the proposed approach in detail, the rest of the article was organized as follows.
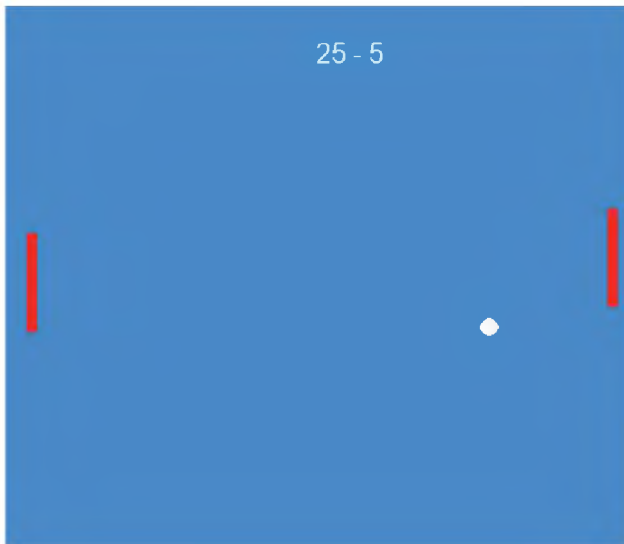

Figure 2 – score of the first steps while learning

RELATED WORKS

Although machine learning was first talked about in the late 50s, this approach has remained in the shadow of expert algorithms for almost three decades. The fact is that machine learning is based on statistics and a probabilistic approach. In the framework of machine learning, artificial intelligence does not get an accurate result, but only calculates the probability of a correct answer. Only when the probability is high enough, makes a decision. This technology has long been considered not reliable enough, but in

the 90s, the demand for this approach grew. Machine learning allows you to better predict results and optimize losses than traditional algorithms. The basis of technology is the use of statistical methods for finding patterns and correlations in databases, with the subsequent creation of forecasts. Currently, the use of machine learning technologies in game development is divided into two volume categories: machine learning in the game process and machine learning [3] in the game business.

MACHINE LEARNING IN THE GAME PROCESS

Machine learning in the game process optimizes the game based on its perception by a particular player and helps to solve various tasks.

This category also includes optimization of rendering and physical models to improve the dialog system. The dialogues of the main character with game characters become deeper, creating an emotional connection between the player and the game. To enhance this, you can provide a player image system that is similar to the owners [1].

• **Map / Level Creation:** There are already many examples where developers used ML to automatically generate everything from dungeons to realistic terrain. Getting it right can provide a game with endless replay, but this can be one of the most difficult MLs to develop.Генерациятекстуришейдеров. Another area that attracts the attention of ML is the generation of textures and shaders. These technologies are supported by advanced generative adversarial networks, or GANs.

• **Generation of models.** There are several projects that can be implemented in this area, which can greatly simplify the construction of three-dimensional objects through improved scanning and / or automatic generation. Imagine that you have the opportunity to describe a simple model in text format and have ML create it for you, for example, in real time, in a game or another AR / VR / MR application.

• **Create audio accompaniment.** The ability to create sound effects or music on the fly is already in use for other areas, not just for games. However, just imagine that you have the

opportunity to create your own soundtrack for your game, designed by ML. For example, this is not a problem. This may be a way to automatically test levels.

• **Artificial players.** This includes many applications from the players themselves using ML to play the game on their own, for developers using artificial players as improved test agents or to attract players during low activity. If your game is simple enough, this can also be a way to automatically test levels[1].

• **NPC or game artificial intelligence.** Currently, there are better models for modeling basic behavioral intelligence in the form of Behavior Trees. Although it is unlikely that BT or other similar patterns will disappear anytime soon, imagine that you can simulate an NPC that can actually behave unpredictably, but pretty cool. This opens up all sorts of opportunities that concern not only developers, but also players.

Machine Learning in Game Development

Algorithms Playing as NPCs
NPCs will respond to your actions in unique, unexpected ways.

Modelling Complex Systems
The game could predict and alter downstream effects.

Making Games more Beautiful
Textures and objects will render dynamically as you get closer

More Realistic Interactions
NLP will create more realistic conversations and responses.

Universe Creation on the Fly
Open world games have the potential to be unlimited in size.

More Engaging Mobile Games
AI chips in phones will bring the power of ML to phones.

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Figure 3 – gaming experience in many ways

No matter how attractive the introduction of machine learning in theory is, in practice it is a very complicated and expensive process. Most often, enterprises face the following difficulties:

The threshold to start working with machine learning is high, because it requires a solid mathematical base, specific experience and knowledge.

Missing data for training. The lack of information necessary for learning [5] AI (in particular, structured) often becomes a wall against which everything rests. No data - there is nothing to train the car.

The need to create infrastructure. The entire client-server package with all the costs associated with it is very resource-intensive.

Possible lack of profit. A game is a business project, not a scientific study. Therefore, it must be profitable for its developers. The machine can also optimize everything so that the game is no longer optimal from a business point of view. Thus, human control must be maintained.

MACHINE LEARNING IN THE GAMING BUSINESS

Machine learning in the gambling business shows users the appropriate individual advertising, creates prices for content in the game, and so on. Example: the system studies the influence of various game factors on the main indicators from a business point of view (retention, commitment) and independently adapts them for an optimal approach. In other words, the system itself is set up to remain profitable and not to lose the audience.

The business comes to understanding that machine learning in games can be earned. Moreover, to earn not only by introducing him into the game, but by teaching people how to play. Artificial intelligence and machine learning help optimize the games themselves. AI can be configured to play games, as a regular user does, which will help to find places vulnerable to dishonest players, dishonest players themselves, as well as weak points in the game level design. In the process of passing various levels and "communication" with other players, the AI will be able to identify players who behave strangely. In addition, AI is able to test games, tracking and then simulating user behavior in different situations. For example, a player with a small amount of free time plays differently than someone who is not limited in time. With this data, the game independently adjusts to different types of users. As a result, everyone gets a unique version of the game[4].

PROPOSED APPROACH

In this article, we proposed machine learning in the game. The proposed approach consists of the main stage, where reinforcement learning will be used for artificial intelligence, which will be an opponent in our gaming application.

Reinforcement training is a type of machine learning in which an agent learns to act in the environment, performing actions and thereby gaining insight, and then observes the results of his actionsAgent and Environment play key roles in the reinforcement-learning algorithm. The environment is the world in which the Agent has to survive. In addition, the Agent receives supporting signals from the Environment (reward): this is a number that characterizes how good or bad the current state of the world can be considered. The goal of the Agent is to maximize the total remuneration, the so-called "winnings".

Figure 4 – score after 800 steps of learning

CONCLUSION

Summing up, it can be noted that today the gaming industry is rapidly gaining momentum and occupies an important place in the global market. Artificial intelligence in games is not an ordinary program that consists of simple loops and arrays. AI in games should think about and make the right decisions. Introducing AI into games makes it much more interesting and makes it harder. In this article was presented machine learning model with reinforcement (Reinforcement Learning), perfectly suited to the development of games. The proposed approach teaches artificial intelligence to compete with a real player as they learn. The main advantage of an AI over a person is that, unlike a person who can succumb to emotions and make the wrong decision, AI will learn every time and bring its every step to perfection.
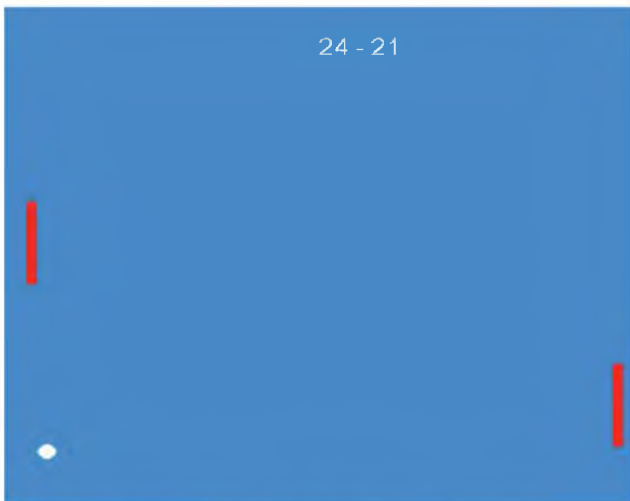
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